V3D inverter - VLD inverter - VHD inverter

frequency converters programmer's manual

from software version V8.94.11 onwards

procon HAJTÁSTECHNIKA

Since 1984

Table of contents

Thank you for having decided in favour of PROCON Ltd's frequency converter.

This Instruction Manual contains all information necessary for starting up, programming and operating the frequency converter.

Instructing graphic symbols

Following graphic symbols will be used in this manual:

⚠ This symbol is used for those instructions whose negligence could cause personal injury, damage in the equipment and property damage.

i Important information

Important information

⚠ CAUTION
Prior to setting up, operating, maintaining or servicing the frequency converter please carefully read this Programmer's manual!
Please entirely comply with all safety measures, warnings and instructions described in the manual!
Absolutely follow the safety notes described in the manual! The operating company is responsible for any personal injury and property damage caused by the negligence of the warnings described in the manual.

Programming the frequency converters

The tools, which can be used for programming:

- Programming terminal
- Operating terminal
- Controlling terminal
- Computer

i	When connecting more than one tool, the programming can be made from any of them, and the process will be shown on the other tools, too.
	With remote control, when transmitting "Write" messages on the MOD bus (e.g. reference signal setting), parameter setting with the terminal is not possible. In this case, the parameters can be modified with remote control, or for the duration of the parameter setting the "Write" messages on the bus have to be suspended.

Serial line communication

The RS485 serial line communication is implemented with a 6-pole telephone connector and a 6-wire telephone cable of custom length.

If the cable becomes faulty or a new cable is needed for any other reason, followings have to be considered for the replacement:

⚠ CAUTION
Since the serial line connectors also carry supply voltage (+9 V), the assignment of the connector socket pins is identical in any case!
The connecting cables always must connect pin 1 of a connector socket to pin 1 of the other connector socket (and all other pins in this way, respectively)
Simple commercial telephone extender cables reverse the pin assignment therefore they are not suitable here, because they cause short circuit!
The demands pertaining to the serial cable (length, design etc) must be co-ordinated with the frequency converter's manufacturer!

A correct connection can only be established with this arrangement of the 6-wire telephone cable:

Length of the serial line

In case of a remote located terminal or display, the length of the terminal connecting cable is limited by the ohmic resistance because - due to the display's background lighting - the current consumption is not negligible.

In case of standard 6-wire telephone cable a maximum length of 10 m can be used. This assures that the 9 V supply voltage will still be sufficient for the externally connected terminal or the internal power supply of the display. If the terminal is connected through a thicker cable and adapter, the ohmic resistance of one cable wire should be calculated for not to exceed the value of 2 ohms.

e.g. at using a wire with a cross section of 0.5 mm^2 the maximum length can be 50 m.

at using a wire with a cross section of 1.0 mm^2 the maximum length can be 100 m.

When connecting more than one equipment to the serial line, this applies for the total length of the connecting cables, since the supply voltage for the externally connected terminal or display may happen to be supplied by the farthest equipment, if it is the only one being switched on!

If the terminal or display is powered through a short cable (e g. from an independent external power supply, the length of the connecting cables is not limited!

i	When using long cables, shielded cable or at least twisted-pair cable should be used!
	The serial line can accept two equipment with backlight, at the same time. Two displays or one (programming or operating) terminal plus one display. Beyond these, connecting a computer is allowed. These can operate in parallel without disturbing each other.

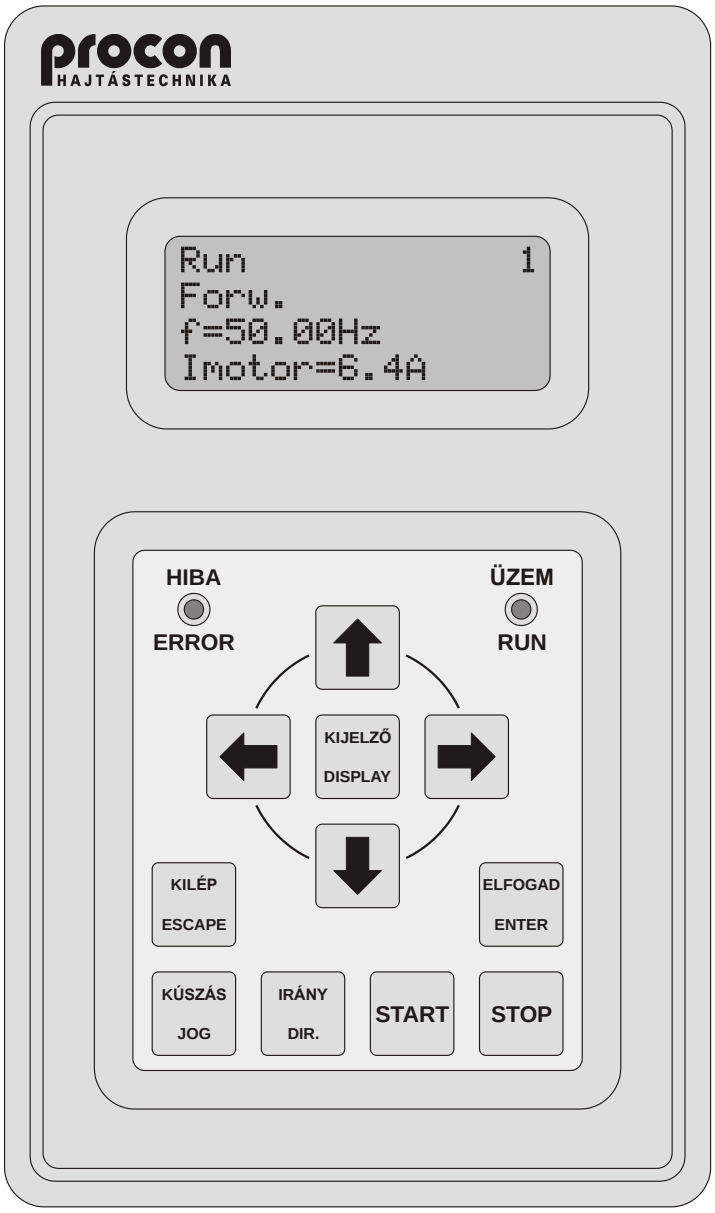
The 2x8-character controlling terminal can be connected to any equipment irrespective of the other equipment with backlite, because it loads not the supply voltage of the serial line. It cannot be of external mounting, it can only be used built in the equipment!

Programming terminal

Using the programming terminal, setting, inspection and display can be made through the serial line.

The programming terminal is equipped with a 4x16-character display, 11 push buttons as well as error and operating state signalling.

It can be used as a built-in unit or in casing as a standalone unit.



The pane of the push buttons is arranged in two groups:

- Upper group: ↑, ↓, ←, →, DISPLAY, ESCAPE, ENTER,
- Lower group: JOG, DIRECTION, START, STOP.

Operation of the push buttons of the lower (control) group

With the push buttons of the lower group, the operation of the frequency converter can be controlled, if earlier the terminal was selected for the control (**4-8-1 terminal control** menu item). The lower four push buttons operate independently of the upper push buttons. Thus – if the control is given to the terminal – even during data setting, the motor can be stopped or started etc.

i	To the digital inputs can be selected even inputs identical with the functions of the terminal control buttons, thus for operating the control from the terminal only, the functions of the digital inputs have to be set to differing meanings.

Jog: The motor starts to rotate with a preset small frequency (**8-4-1**, **8-5-1** menu item) in the preset direction with the preset rising slope (**8-4-2**, **8-5-2** menu item). On releasing the button, the motor stops, on the repeated push the motor starts again. The Jogging mode serves for the adjustments needed by the technology (e g. threading the paper in the printing industry etc.)

i	The "Jog" push button is only effective in the standing state of the motor (STOP state).

Direction: The direction of the rotation changes. When pushed several times, the motor changes the direction of rotation each time: it stops according to the preset way then starts rotation in the opposite direction and accelerates to the preset frequency.

Start: the motor starts rotation.

Stop: the motor stops rotation. (It functions as "**Emergency stop**" if the selected source of the logic control is not the terminal. (In this case also an error signal is given!

Operation of the push buttons of the upper (programming) group

With the push buttons of the upper group, it can be moved between the menu items of the data setting and display, data can be entered and the data to be displayed can be selected, after changing from display mode to programming mode by pushing the "Escape" button.

The most important parameters are included in the quick menu (menu 0), which is directly accessible by pushing the "Escape" button.

In basic state, in the quick menu following seven parameters are available:

- control rise time,
- control fall time,
- motor nominal current,
- maximum frequency,
- minimum frequency,
- motor starting voltage,
- selecting the active menu.

The parameter set of the quick menu can freely be changed up to 15 parameters. The adopted parameters are included also in their natural places in the menu system. The way of adopting and removing parameters is given in the description of the quick menu.

Setting the operation data (e.g. maximum frequency, rising time, etc.) can be made in the menu system. The menu system consists of series of submenus proceeding from the items of the main menu (tree structure). The submenus go to that depth where the requested data can be set unambiguously. This way of parameter setting was chosen to make the handling easy.

The main menu denotes a group of self-evident parameters:

- Frequencies,
- Starts,
- Outputs, etc.

The submenus proceeding from these, tighten more and more the scope of the parameters, until finally the parameter to be set is reached.

i	Note, that not all parameters of frequency dimension are included in the main menu item "Frequencies" (and this also applies to the other parameters), rather at their natural place of setting.

Within the individual menu levels, moving is made with the ↑ and ↓ buttons, while the next submenu is reached with the "Enter" button and the previous one with "Escape".

At the end of the menu the setting follows.

The setting procedure

- On pushing the "Enter" button the cursor in the lower row starts to blink, signalling the parameter to be ready for setting.
- When using the selector switch, the ▲ ▼ push buttons can be used for selecting from the offered options. E.g. in the **1-3 selection** menu, at selecting the operation mode, the "Operation" or the "Control" switch can be selected.
- At numeric setting, the setting occurs by digits. Between the digits, moving can be made with the ◄ ► push buttons. When stopping on a digit, its value can be increased or decreased with the ▲ ▼ push buttons. After „9" upward „0" follows, after „0" downward „9" follows, and the higher positional value changes according to the sense.

i	If the setting would overstep the limit value, the push buttons become ineffective.

- Setting textual parameters is made similarly to the numeric setting, but here the parameter position can be selected with the ◄ ► push buttons and from the characters can be selected with the ▲ ▼ push buttons.

  The available characters are following:

  space, numbers 0-9, letters A-Z, letters a-z, accented letters, punctuation marks, special characters

- After having selected the proper parameter and having set all digits and/or characters, by pushing the "Enter" button the data can be validated (it will be written in the non-volatile memory, too).

i	If altering of the parameter is not possible, a warning message appears for 1 second in the lower row of the terminal or display or on the regulator terminal. Possible warning messages: ▪ Go to Stop! - The parameter can only be altered in Stop state. ▪ Permit altering! - Altering of the parameter has been disabled in menu item **11-1-3 enable parameter modification**. ▪ User password! - For altering the parameter, entering of the user password is necessary. ▪ Setup password! - For altering the parameter, entering of the setup password is necessary. ▪ Manuf. password! - For altering the parameter, entering of the manufacturer password is necessary.
	When setting the reference signal in both the control and the regulation mode, at Start, with buttons ▲ and ▼ also the so called terminal motor potentiometer function can be implemented. This means that the reference signal can be set (with a speed depending on the place value of the actual digit) with running motor. If the reference signal reached the desired the value, it can be validated with the Enter button. Pushing Escape sets back the reference signal to its previous value!

Prior to setting the values of the individual parameters in the submenus, they are factory set to their default values, which appear at the very first setting. The default values of all parameters can be recalled at any time with a single command. This can be useful if the actual parameters cannot be used by the system for any reason e g. due to a mistaken setting, and there is no time to check up each parameter value.

Procedure of resetting

There is possibility of resetting any parameter to its factory value. This can be needed, if the factory setting is not known or resetting would be complicated (e.g. textual parameters)

With selecting the desired parameter, pushed and kept depressed the "Enter" button, on pushing the "Escape" button the factory setting will be offered.

After releasing the buttons, between two options can be selected:

- On pushing the "Enter" button the offered factory setting will be entered,
- On pushing the "Escape" button the earlier setting returns.

This operation permits also inspection of the factory setting of any parameter

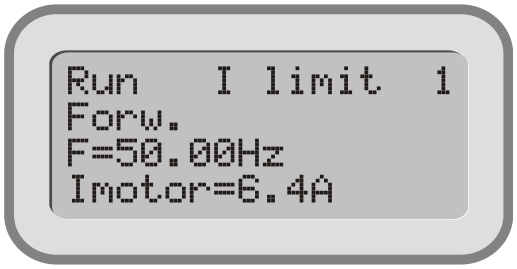
i	With the frequency converters of different power values, the factory values and the available limit values may differ!

Display mode

On pushing the "Display" button the display changes to data display mode. Return to programming mode is made with the "Escape" button.

In Display mode, a possible state of the screen is shown below:

(The display layout can freely be configured: any parameter can be displayed in any row)



Row **1** shows the **state** consisting of three parts:
- the motor's state: **Run / Stop**,
- dynamic feedback of the state (e.g. **I limit**),
- identification mark of the frequency converter (e.g. **1**).

Row **2** shows the actual running direction **Forward / Backward**

Row **3** shows the frequency (e.g. **f=50.00Hz**),

Row **4** shows the motor current (e.g. **Imotor=6.4A**)

If more than one frequency converter is used, looped on the Terminal serial line, in display mode the individual frequency converters can be selected with the ← and → buttons. The identifier always indicates the actual frequency converter!

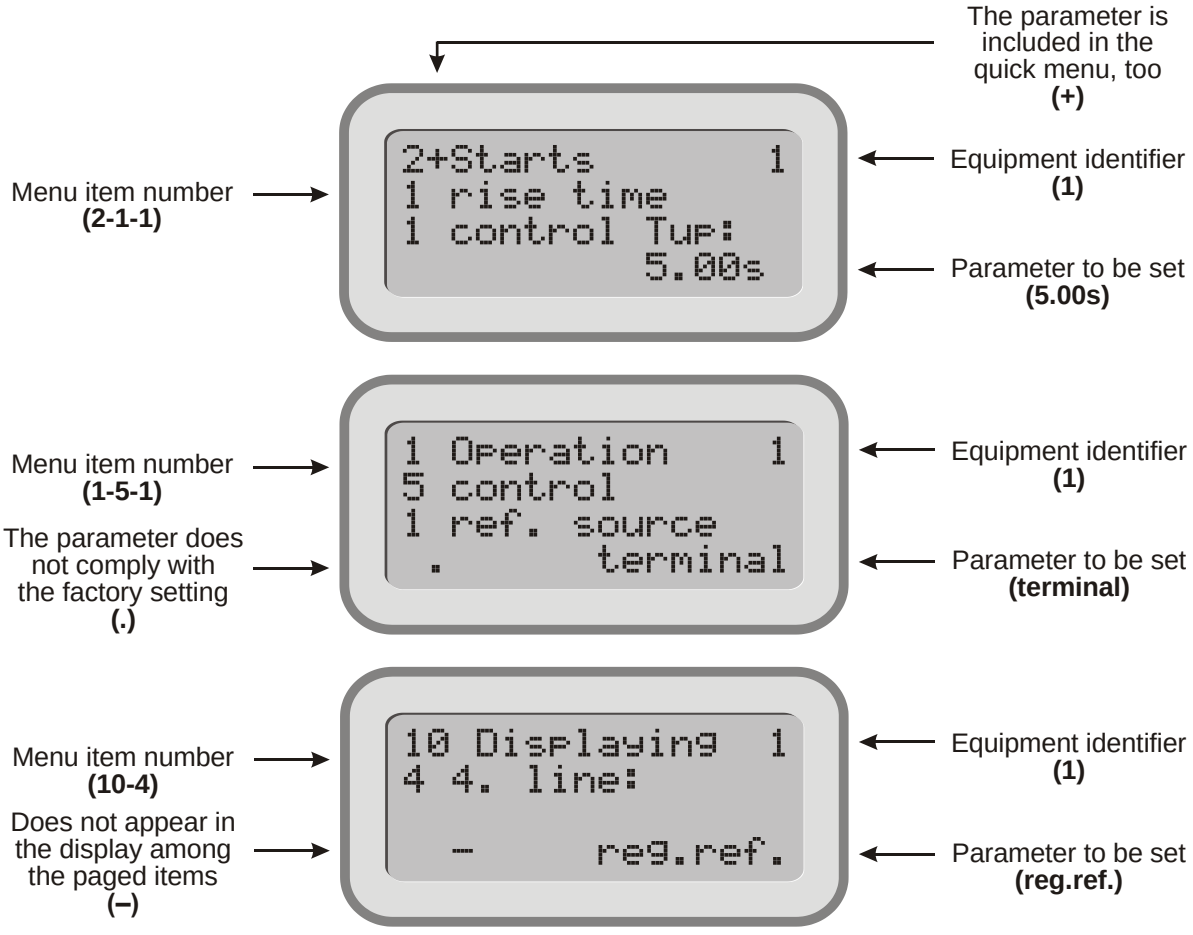
The functions of the ↑ ↓ push buttons during display can be selected (e.g. operating the motorized potentiometer, changing the parameter displayed in row 4 etc.)

In case of error, the **! Error !** state feedback appears in the state display. On pushing the „Escape" button, it will be jumped to the error menu, where the error can be inspected!

Programming mode

After switching on, the DISPLAY mode is active on the programming terminal connected to the frequency converter. Pushing the „Escape" button changes to PROGRAMMING mode. Pushing the "Display" button switches backwards.

Examples for the appearance of the display in programming mode:



Operating from the computer

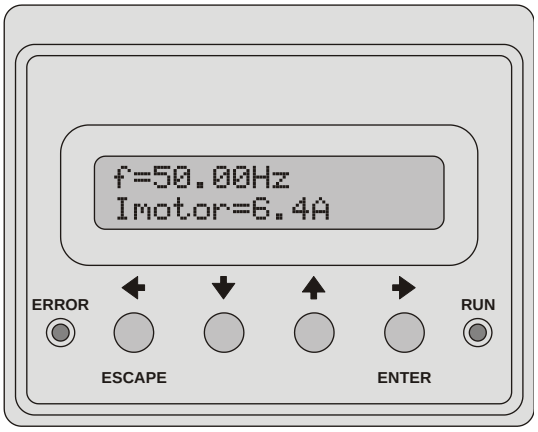
The frequency converter can be connected to the computer through RS485-T line using RS 232 / 485 or USB / RS 485 adapter (interface).

Here the TermOnly program permits setting the frequency converter from the computer and provides a user interface with the same look as that of the programming terminal.

The ProContact program beyond handling the frequency converter permits reading out, modifying and archiving the actual parameter set as well as reading out and archiving the event- and error log.

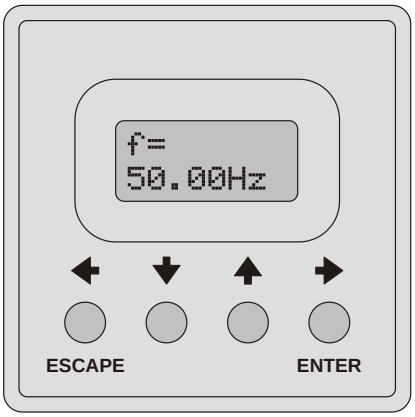
Both programs are available on CD as attachment of the adapter (interface) unit or can be downloaded from www.procon.hu

Operating terminal



- **This terminal allows programming the parameters of the quick menu, displaying 2 parameters and generating reference signal.**
- Includes a 2x16 character display, 4 push buttons and displays for error state and operation state.
- Reading in display mode: first row - the frequency, second row - another parameter (e.g. voltage, current), which can be stepped with the ▲ and ▼ arrows.
- Reading in programming mode: first row - the name of the parameter along with its main menu ordinal number (e.g. **2 Control Tup**), second row - the submenu ordinal number and the value of the actual parameter (e.g. **1-1 5.00s**), that can be modified with the push buttons.
- In case of error at the end of the first line the ordinal number of the error, in the second line the name of the error is displayed. The error list can be stepped with the ▲ and ▼ arrows.
- The terminal can be used as a built-in unit (VHD), in casing as a stand-alone unit or as an externally mounted unit (e.g. to the door off the control cabinet)

Controlling terminal



- **This terminal allows programming, displaying 1 parameter and reference signal generation.**
- Equipped with a 2x8 character display and 4 push buttons.
- Reading in display mode: first row - the name of a displayable parameter (e.g. **f**=), second row - its value (e.g. **50,00Hz**). The display can be stepped with the ▲ and ▼ arrows.
- Reading in programming mode: first row - the parameter's ordinal number in the menu (e.g. **3-1-1**), second row - (in case of a variable parameter) the value of the actual parameter (e.g. **5.00s**), that can be modified with the push buttons.
- The terminal can be used built in the front panel of the frequency converter only!

Functions of the push buttons (operating and controlling terminal)

← (Escape)	▪ Change between display mode and programming mode ▪ Parameter setting mode: shift the cursor to the left ▪ Repeated push: exit parameter setting mode without saving (until the cursor blinks) ▪ At error display: displaying the cause of the error
↓	▪ Display mode: scrolling the displayed variables downward ▪ Programming mode: moving in the menu downward ▪ Parameter setting: decreasing the value or scrolling the selector switches downward ▪ With selected terminal motor potentiometer: decreasing the reference signal ▪ With enabled motor potentiometer start / stop: Stop
↑	▪ Display mode: scrolling the displayed variables upward ▪ Programming mode: moving in the menu upward ▪ Parameter setting: increasing the value or scrolling the selector switches upward ▪ With selected terminal motor potentiometer: increasing the reference signal ▪ With enabled motor potentiometer start / stop: Start
→ (Enter)	▪ Programming mode: starting the parameter setting ▪ Parameter setting mode: shift the cursor to the right ▪ Repeated push: save parameter value (until the cursor blinks) ▪ Acknowledgement at error

Programming procedure (operating and controlling terminal)

← (Escape)	▪ Changing from display mode to programming mode
↓ ↑	▪ Moving between the menu items
→ (Enter)	▪ Starting parameter setting
← ↓ ↑ →	▪ Parameter setting
→ (Enter)	▪ Repeated push: save parameter value (until the cursor blinks)
or	
← (Escape)	▪ Repeated push: exit parameter setting mode without saving (until the cursor blinks)

Features and capabilities of the frequency converter and the program

For changing the parameters, the programmer or operator terminal (built in the frequency converter or stand-alone unit) or the regulator terminal (built in the frequency converter).

For the continuous inspection of all parameter values use of a display may be needed.

Some options for being built in the equipment (differs for the V3D, VLD and VHD types!):

- PID extension, or adding further relays for further feedbacks,
- fitting with further digital inputs,
- analogue output,
- fitting with IRE reception for rotation speed control or position adjustment,
- CAN bus connection (e.g. master / slave),
- a second RS 485 serial line for remote control (MOD bus).

Through the features and capabilities, the manufacturer aims to make the frequency converter proper for the most possible scopes of application.

The analogue and digital inputs, outputs and relays facilitate solving complex control and regulation tasks

Some programming options (differs for the V3D, VLD and VHD types!):

- programmability of procedures up to 15 steps (even different in each parameter chart),
- arbitrary acceleration and deceleration times, frequencies, regulation parameters, durations etc.,
- a maximum of 3 kinds of digital feedback on the internal state of the frequency converter (on optocouplers or relays),
- two free programmable analogue output back indications,
- two (optionally four) free programmable analogue input signals for regulation or control (potentiometer, voltage or current),
- "S"-curve type soft start and stop (for materials handling and passenger transport),
- timing functions, delayed starts and stops, preset operation periods,
- counting functions (to be activated with the digital inputs, or program group cycle counter), counting by piece, or operation depending on the counted value (counting down and stop at zero)
- multifunction display (optionally selectable parameter displays)
- modification of the main parameter values from analogue input (e.g. acceleration time, fmax, etc.),
- several motor control tasks (one controlled and a maximum of three fix switchable),
- reception of the rotation speed feedback signal from the driven shaft (not necessarily the motor shaft) (Incremental rotation speed encoder, IRE),
- rotation speed regulation tasks,
- position regulation tasks,
- torque regulation tasks,
- master/slave operation tasks,
- synchronised systems, also with acceptance of IRE reference signal,
- correct motor protection based on the preset motor parameters,
- automatic error acknowledgement (useful with unattended equipment which can restart in this way!),
- elimination of resonance frequencies by inhibiting,
- implementation of optional voltage/frequency characteristics (e.g. for special motors),
- keeping an error log with error numbers and chronology (256 errors can be stored inspected),
- Optional computer connection (query, program editing, data processing, etc.),
- etc.

Information about the program versions

Due to our continuous program developing and our efforts to meet our customers' demands

we reserve our rights to alter the program!

The program versions are indicated in both the Programmer's Manual and the **11 System** menu of the frequency converter (e g. 8.94.11)

In order to maintain compatibility, please note following about the meaning of the version number:

- The first two numbers refer to the system processor.
- With identical first figures, the frequency converters are fully compatible. (they work similarly, they can be replaced by each other, and if necessary, they can be connected to each other)
- With increasing values of the second number, the capabilities of the given program are wider.
- The third number refers to the peripheral processor.

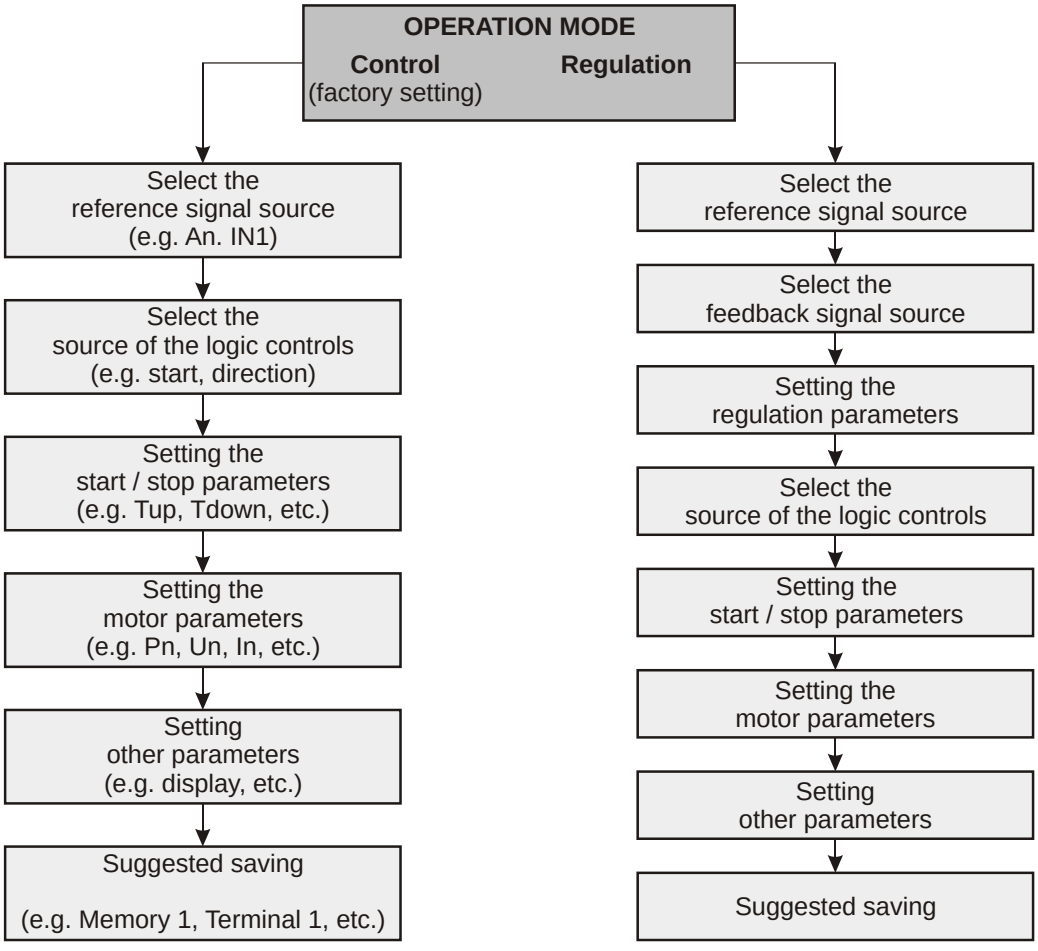
⚠ CAUTION
Always use the manual with the same version number as that of the frequency converter!
In any uncleared question contact the manufacturer!

Information on program update

- The manufacturer provides all users with the latest program version free of charge, but they have to bring the frequency converter to the manufacturer's premises! The new program is downloaded while you wait!
- The user can request program upgrading on the site of the frequency converter to avoid interruption of the production procedure (or for other reasons).
  The program upgrading is free of charge in this case, too. The user has to bear the costs of the field-work only!

Procedure of programming

After defining the objective, programming should be started as follows.



Packed menu system

0 - Quick menu
- 0-1 control Tup
- 0-2 control Tdown
- 0-3 motor In
- 0-4 f maximum
- 0-5 f minimum
- 0-6 U boost
- 0-7 active menu

1 - Operation mode
- 1-1 control ref. signal
- 1-2 regulation ref. signal
- 1-3 selection
- 1-5 control
- 1-6 regulation
- 1-7 feedback
- 1-8 modification
- 1-10 PID settings
- 1-11 PID 1 data
- ⋮
- 1-14 PID 4 data

2 - Starts
- 2-1 rise time
- 2-2 acceleration
- 2-3 multistep acceleration
- 2-4 S curve
- 2-5 start disable
- 2-6 direction change disable
- 2-7 restart
- 2-8 start type
- 2-9 brake release
- 2-10 fly snips
- 2-11 flying start

3 - Stops
- 3-1 fall time
- 3-2 deceleration
- 3-3 multistep deceleration
- 3-5 stop type
- 3-6 normal brake
- 3-7 free time
- 3-8 DC brake
- 3-9 resistor brake
- 3-10 Udc hold

3 - Stops
continued
- 3-11 brake operation
- 3-12 Udc filter
- 3-13 emergency fall time

4 - Inputs
- 4-1 analogue input 1.
- ⋮
- 4-4 analogue input 4.
- 4-8 logical control source
- 4-9 logical parameters
- 4-10 fix start
- 4-11 digital input 1.
- ⋮
- 4-18 digital input 8.
- 4-21 virtual input 1.
- ⋮
- 4-26 virtual input 6.
- 4-30 slave data
- 4-31 IRE data

5 - Outputs
- 5-1 analogue output 1.
- 5-2 analogue output 2.
- 5-11 digital output 1.
- ⋮
- 5-13 digital output 3.
- 5-16 timing 1.
- ⋮
- 5-18 timing 3.
- 5-21 comparator 1.
- ⋮
- 5-23 comparator 3.
- 5-26 period 1.
- ⋮
- 5-28 period 3.
- 5-29 PID extension

6 - Motor
- 6-1 nominal power
- 6-2 nominal voltage
- 6-3 nominal frequency
- 6-4 nominal current
- 6-5 nominal rotation speed
- 6-6 cooling type
- 6-7 limit
- 6-9 torque limit
- 6-10 test

6 - Motor
continued
- 6-11 R stator meas.
- 6-12 n maximum
- 6-13 R stator
- 6-14 L stator
- 6-15 magnetizing current
- 6-16 linearity of the magn. current
- 6-17 exponent of the magn.current
- 6-18 R rotor correction
- 6-19 nominal start time
- 6-20 I regulator
- 6-22 n regulator
- 6-23 field weakening
- 6-24 sensorless
- 6-25 blocking
- 6-26 R rotor adaptation
- 6-27 sync. offset
- 6-28 type

7 - U/f ratio
- 7-1 characteristic types
- 7-2 U/f modification
- 7-3 user characteristic

8 - Frequencies
- 8-1 f maximum
- 8-2 f minimum
- 8-3 frequency inhibit limit
- 8-4 jog normal
- 8-5 jog inverse
- 8-6 inhibited bands

9 - Programs
- 9-1 counter 1.
- ⋮
- 9-3 counter 3.
- 9-10 program activation
- 9-11 program 1.
- ⋮
- 9-25 program 15.
- 9-26 sequence 1.
- ⋮
- 9-28 sequence 3.

10 - Displays
- 10-1 row 1.
- ⋮
- 10-4 row 4.
- 10-7 productivity 1.
- ⋮
- 10-10 productivity 4.
- 10-11 user define units
- 10-12 big characters
- 10-13 consumption meter clear
- 10-14 active menu

11 - System
- 11-1 parameters
- 11-4 macro
- 11-5 remote control
- 11-6 modulation
- 11-7 slip-compensation
- 11-8 output
- 11-9 language
- 11-10 CAN bus
- 11-12 terminal function
- 11-13 automatic error ackn.
- 11-14 save event

READ ONLY
- 11-18 manufacturing number
- 11-19 software version
- 11-20 date

PASSWORD PROTECTED
- 11-21 currents
- 11-22 voltages
- 11-23 special data
- 11-24 clear log
- 11-25 password
- 11-27 menus with password

12 - Events

The event log can store 256 events along with the belonging point of times.

13 - Errors

The error log can store 256 errors along with the belonging point of times.

0. Quick menu

This menu permits the parameters frequently modified by the user to be set at the same place. The parameters here can be set in their own menus, too!

Following parameters can be set here (in basic state):

- regulation rising time
- regulation fall time
- nominal motor current
- maximum frequency
- minimum frequency
- staring voltage
- selecting the active menu

The number of parameters can be maximum 15! This has two reasons:

- Limitation of the number of parameters in the quick menu to avoid retaining the really quick setting.
- The operating terminal (2x16 character display + 4 direction buttons) cannot replace the programming terminal (4x16 character display + 11 buttons), but permits this number of parameters to be programmed still comfortably.

The display permits the parameters of the quick menu to be identified through displaying them along with their menu item numbers:

2-1-1	**control Tup:**	**2**	Starts
		1	rise time
		1	**control Tup:** **5.0 s**

Adopting parameters in the quick menu

In programming mode, each parameter can be adopted in the quick menu with button →. This is indicated by a "**+**" sign after the number of the main menu. Those parameters being already parts of the quick menu are indicated in this way.

One parameter can be included in the quick menu once only. If the sign "**+**" does not appear, the quick menu is filled.

i	Adopting and omitting parameters applies to the quick menu, if in menu **11-4-2** **change** the quick menu is set (this is the default state).

Removing parameters from the quick menu

In programming mode, each parameter which is part of the quick menu, that is, following its main menu item number a "**+**" sign appears, can be removed from the quick menu with button ←.

This operation can be made in both the menu of the actual parameter and the quick menu. For removing parameters in the quick menu, with the ← button pressed, the „Enter" button needs to be pushed.

After removing a parameter the quick menu will be renumbered automatically.

Factory setting of the quick menu

Submenu	Explanation, further submenus	Values	Default setting	Unit
Parameter - 1 - **2-1-1** **control Tup**	The time of linear acceleration, in control mode. (the time for reaching fmax or fnom starting from 0 Hz)	0,05 - 3276,7	5,00	s
Parameter - 2 - **3-1-1** **control Tdown**	The time of linear deceleration, in control mode. (the time for reaching 0 Hz starting from fmax or fnom)	0,05 - 3276,7	5,00	s
Parameter - 3 - **6-4** **motor In**	The motor current permitted durably. This current value corrected with the current limit is the maximum, which can develop.	0,5 - type-dep.	type-dependent	A
Parameter - 4 - **8-1** **f maximum**	fmax, the highest frequency. Even if the frequency reference signal is set to a higher value, the fmax value is effective! ** For V3D type equipment without controlling terminal the default setting is 100 Hz*	0,1 - 1050,0	50,0 *	Hz
Parameter - 5 - **8-2** **f minimum**	fmin, the lowest frequency. Even if the frequency reference signal is set to a lower value, the fmin value is effective!	0,1 - 1000,0	1,0	Hz
Parameter - 6 - **7-2-1** **U boost**	The starting voltage to be given on the motor in standstill after start, for providing the initial flux.	0,0 - type-dep.	type-dependent	V
Parameter - 7 - **10-14** **active menu**	This decides the menu accessible from the regulator terminal. With „quick" is the quick menu accessible only, whereas with „full" the whole menu system.	quick full	quick	

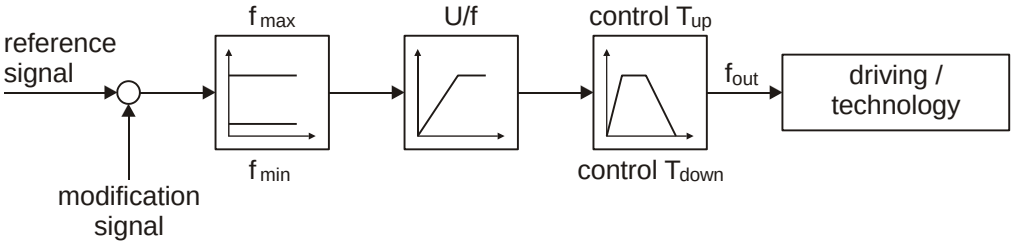
1. Operation mode menu

In this menu, the most important parameters of the operation mode of the frequency converter can be set.

Following parameters can be set here:

- terminal regulation reference signal,
- terminal control reference signal,
- operational mode selection,
- data of the regulation,
- data of the control,
- data of the control signal,
- data of the modifying signal,
- PID selection,
- PID data

Submenu	Explanation, further submenus	Values	Default setting	Unit
1-1 control ref. signal	If the source of the reference signal is the terminal, it means the prescribed value of the output frequency in control mode.	0,01 - 1000,0	1,00	Hz
1-2 regulation ref. signal	In regulation mode, the value of the regulation reference signal if the source of the reference signal is the terminal.	0,00 - 100,00	0,00	%
1-3 selection	Permits the selection of the operation mode.	control regulation	control	
1-5 control	Permits the settings of the parameters used with control tasks.			
	1-5-1 source of the control reference signal Selects the source of the control reference signal. (Setting the parameters of the control reference input is made in the **4. Inputs** menu!) ** IRE 2 for VLD and VHD types only*	analogue IN 1-4 IRE IRE 2 * terminal motor pot. MOD bus CAN bus	analogue IN 1.	
	1-5-3 control reference signal limits If the source of the reference signal is an analogue input, these limits will come to effect, in so far as they are within the limits of **8-1 f maximum** and **8-2 f minimum**.			
	1-5-3-1 maximum	0,01 - 1000,0	1000,0	Hz
	1-5-3-2 minimum	0,01 - 1000,0	0,01	Hz



Submenu	Explanation, further submenus	Values	Default setting	Unit
	1-5-6 correspondence	0,1 - 6000,0	100,0	
	1-5-7 dimension This serves establishing and displaying the reference signal corresponding to the manufacturing process. The correspondence needs to be related to 100 Hz. If the product is e.g. a bag, its number of pieces changes linearly with the reference signal, and with 30 Hz reference signal 6 bags are produced. Then the ratio is 30 / 6 = 5, that is setting the correspondence to 100 / 5 = 20 and the dimension to pieces in menu 1-1, the regulation reference signal will be displayed in pieces instead of Hz. Thus, adjusting the number of produced bags is much easier, because the operator does not need to recalculate it to frequency reference signal.	- percent % piece pc mass kg mass t length mm length m speed m/s speed m/m speed km /h volume l volume m3 revolution rpm pressure bar pressure Pa temp. °C frequency Hz user 1 user 2	frequency Hz	

1-6 regulation	Permits the settings of the parameters used with regulation tasks.			
	1-6-1 source of the regulation ref. signal Selects the source of the regulation reference signal. (Setting the parameters of the regulation reference input is made in the **4. Inputs** menu!) ** IRE 2 for VLD and VHD types only*	analogue IN 1. analogue IN 2. analogue IN 3. analogue IN 4. IRE IRE 2 * terminal motor pot. MOD bus CAN bus	analogue IN 1.	
	1-6-2 type of the regulation normal: increasing error signal effects increasing frequency. inverse: increasing error signal effects decreasing frequency. bidirect: normal regulation with changing the direction of rotation	normal inverse bidirect	normal	
	1-6-3 regulation reference signal limits			
	1-6-3-1 maximum	0,00 - 100,00	100,00	%
	1-6-3-2 minimum	-100,00 - 100,00	0,00	%
	1-6-4 regulation reference signal set-in times			
	1-6-4-1 acceleration	0,00 - 500,00	0,00	s
	1-6-4-2 deceleration	0,00 - 500,00	0,00	s

Submenu	Explanation, further submenus	Values	Default setting	Unit
	1-6-5 regulation start / stop In Control mode, if the frequency converter operates durably near to the fmin frequency within a given hysteresis, this appoints the time limit after which "waiting" state will be effectuated, and it appoints also the value of the error signal which starts the control process again. (e g. if a pump does not convey for a prolonged time, its operation is superfluous!)			
	1-6-5-1 time limitation With setting "N", the duration of operating at fmin is not limited	N 0,1 - 3000,0	N	s
	1-6-5-2 start error signal At this value of the error signal, the frequency converter exits the "waiting" state	0,00 - 100,00	1,00	%
	1-6-5-3 hysteresis If the frequency is in this range above the minimum frequency, time limitation starts, if active.	0,0 - 100,0	1,0	Hz
	1-6-6 correspondence	0,1 - 6000,0	100,0	
	1-6-7 dimension This serves establishing and displaying the reference signal in a way easier corresponded to the manufacturing process. The correspondence should refer to 100 %. For example, in a printery compressed air will be produced with a compressor for the machinery. The pressure of the compressed air will be measured with a remote transmitter and the control occurs to this pressure. If the 100 % reference signal corresponds to 20 bar pressure, then after setting the correspondence to 20 and the dimension to bar in menu 1-2 the control reference signal will be displayed in bar instead of %.	- percent % piece pc mass kg mass t length mm length m speed m/s speed m/m speed km/h volume l volume m3 revolution rpm pressure bar pressure Pa temp. °C frequency Hz user 1 user 2	percent %	
1-7 feedback	Permits the selection of the source of the feedback signal used with regulation tasks. (Setting the parameters of the input is made in the **4. Inputs** menu!)			
	1-7-1 source of the feedback signal In case of simple torque control (**6-28 Operation mode**: „U/f") the motor parameters are ruling. (**6. Motor** menu) In case of torque control with signal transmitter (**6-28 Operation mode**: „with signal transmitter") the measured rotation speed and the output frequency are ruling. It is important to set the nominal rotation speed belonging to the nominal torque of the motor! (**6. Motor** menu). The output frequency sets between „0" and fmax in the way that the motor can deliver as a maximum those percent of its torque, set with the control reference signal!	analogue IN 1. analogue IN 2. analogue IN 3. analogue IN 4. analogue IN 1-2. analogue IN 3-4. IRE rotation IRE position torque	analogue IN 2.	

Submenu	Explanation, further submenus	Values	Default setting	Unit
1-8 modification	Permits the parameter setting of the signal which is used to modify the reference signal of the control or regulation tasks.			
	1-8-1 source of the modification signal At setting "N" there is no modification.	N dig. + virt. IN PID extender an. IN 1, 2, 3, 4 motor pot.	N	
	1-8-2 type of the modification normal: increasing or active modifying signal causes increase of the reference signal. inverse: increasing or active modifying signal causes decrease of the reference signal.	normal inverse	normal	
	1-8-3 lower This is the extent of the modification of the absolute reference signal, which will be effectuated at the minimum of the modifying signal of variable value (analogue IN or motorised potentiometer). According to the way of modification the reference signal will be increased or decreased.	0,00 - 300,00	5,00	%
	1-8-4 upper This is the extent of the modification of the absolute reference signal, which will be effectuated at the maximum of the modifying signal of variable value (analogue IN or motorised potentiometer). According to the way of modification the reference signal will be increased or decreased.	0,00 - 300,00	5,00	%
	1-8-5 discrete value This menu can be used with active digital IN1 – IN8, virtual IN1 – IN6 or with PID extender. It sets the absolute change made by an active input.	0,00 - 300,00	0,00	%
	1-8-6 gradient normal: The value of the modification related to 100 Hz or 100 %. ref.sig: The value of the modification related to the reference signal.	normal ref.signal	normal	

Function of the modifying signal

In a control system, the function of the modification signal is to facilitate the correction of the reference signal by an external analogue signal or the digital input (e g. change of day run and night run of the system).

In theory, the modified control reference signal can vary between fmin and fmax. If its value goes outside them, the limits become valid! A modification of 1% means a change of 1Hz in the reference signal!

In a regulation system, the function of the modification signal is to facilitate establishing two-element regulations, or correcting the regulation reference signal from the digital inputs or at PID extension.
(e g.: humidity depending temperature regulation or temperature depending pressure regulation,
PID extension, if the number of the pumps changes and the reference signal needs to be changed etc.)

In theory, the modified regulation reference signal can vary between 0 and 100 %. If its value goes outside the preset minimum and maximum control reference signal limits, the limits become valid!

In case of digital input, the percentual value of the modification is the value set in menu item **1-8-5** for each active input.

In case of PID extension the modification can only be interpreted in control mode only, the modification % is the value set in **1-8-5,** at all switched in units.

The modifying signals of variable value (analogue IN or motorised potentiometer) can modify he reference signal according to the following relationship

$$K=\frac{\text{lower [\%]+upper [\%]}}{100\ \%}$$

Normal modification: modified reference signal [%] = reference signal [%] - lower [%] + modification [%] x K

Inverse modification: modified reference signal [%] = reference signal [%] + lower [%] - modification [%] x K

Discrete modification (digital input, virtual input or PID extender):

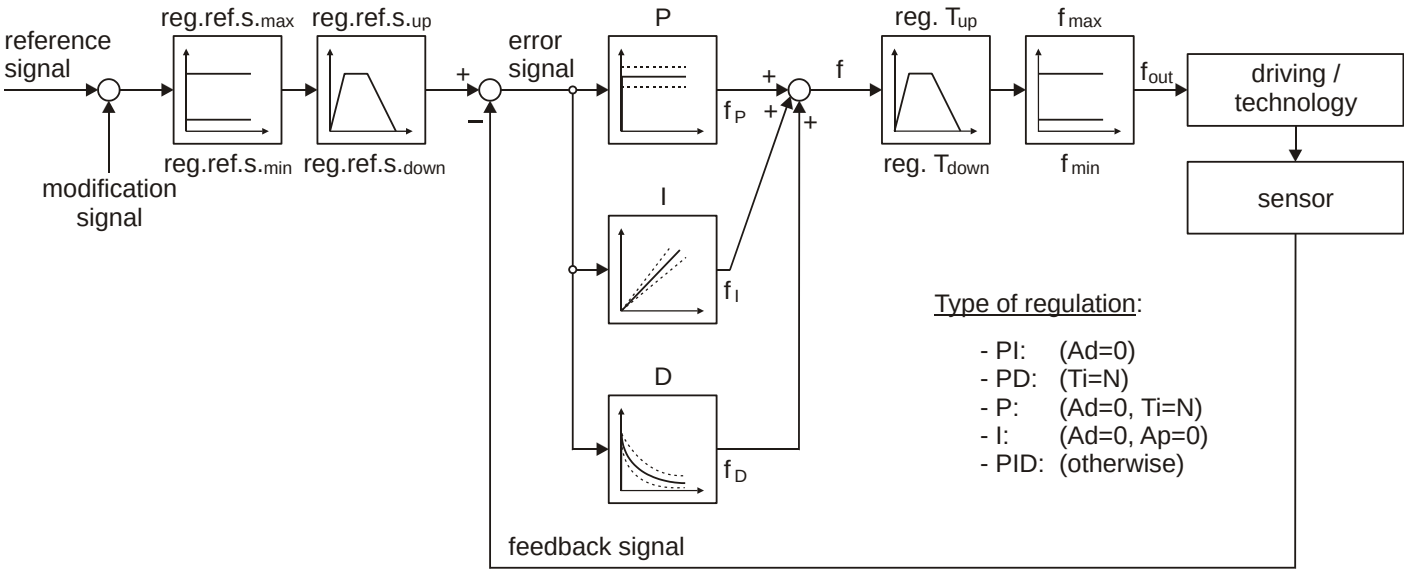
n = number of the active units

Normal modification: modified reference signal [%] = reference signal [%] + n x discrete value [%]

Inverse modification: modified reference signal [%] = reference signal [%] - n x discrete value [%]

PID regulation

Submenu	Explanation, further submenus	Values	Default setting	Unit
1-10 PID settings	Serves for selecting the PID parameter set to be used.			
	1-10-1 selection In regulation mode this PID parameter setting will be valid.	PID1 PID2 PID3 PID4 frequency-dep.	PID1	
	1-10-2 change-over points The change-over frequencies of the PID regulators, if frequency depending PID regulation has been selected. The change-over is implemented with hysteresis to avoid possible swingings.			
	1-10-2-1 switch-over to PID2	0,1 - 1000,0	20,0	Hz
	1-10-2-2 switch-over to PID3	0,1 - 1000,0	30,0	Hz
	1-10-2-3 switch-over to PID4	0,1 - 1000,0	40,0	Hz
	1-10-2-4 hysteresis	0,0 - 10,0	1,0	Hz
1-11 PID 1 data	Setting of the regulation parameters (Proportional regulation can be implemented if Ti is programmed to "N")			
	1-11-1 Ap proportional gain	0,00 - 120,00	0,50	
	1-11-2 Ti integration time	N 0,01 - 2000,0	1,00	s
	1-11-3 Td differentiation time	10 - 20000	10	ms
	1-11-4 Ad diff. element overdriving factor	0,00 - 9,99	0,00	
1-12 PID 2 data	The setting is the same as that of item **1-11 PID 1 data**			
1-13 PID 3 data				
1-14 PID 4 data				



Explanation of the parameters

P: $f_P=f_{min}+(f_{max}-f_{min})\cdot\frac{\text{Error signal [\%]}}{100}\cdot A_P$

I: Change of f during the time of T_I: $\Delta f_I=(f_{max}-f_{min})\cdot\frac{\text{Error signal [\%]}}{100}$

D: In the moment of the error occurrence: $f_D=(f_{max}-f_{min})\cdot\frac{\text{Error signal [\%]}}{100}\cdot A_D$

which at remaining error converges to zero with the time constant of T_D

Explanations to the PID regulations

The use of the PID parameters of the frequency converter permits the sophisticated yet simple implementation of controls of types lasting value and following.

In the regulation procedure, on the effect of the arisen error signal the **P**, **I** and **D** elements modify the output frequency so that the error signal decreases.

Approach from the point of view of the regulation technique: $f=\left(A_P+\frac{1}{ST_i}+A_D\cdot\frac{ST_d}{1+ST_d}\right)\cdot\frac{\text{Error signal [\%]}}{100}\cdot(f_{max}-f_{min})+f_{min}$

Error signal = Regulation reference signal - Feedback signal

The effect of the parameters depends on the sign and magnitude of the error signal. Of course, each action is to be understood algebraically, along with sign. The action (frequency increase or decrease) should always act to decrease the absolute value of the error signal! This has to be decided at selecting the type of the regulation (normal or inverse) (menu item **1-6-2**)

At regulating the rotation speed and the position, the correct adjustment of the IRE is very important! This applies to the IRE parameters and the wiring, too. If the IRE measures not the rotation of the motor shaft but some decreased (or increased) rotation, then in the IRE division the value per 1 revolution of the shaft is to be entered.

(e g. at 1:50 reducing gear and IRE division number 2000, the value of 40 is to be entered.)

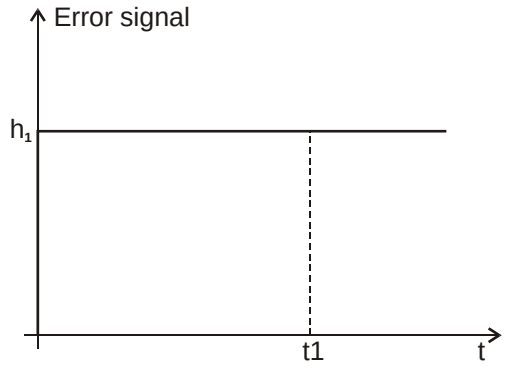
At position regulation, the integration element (I) of the PID parameters is not utilized due to the nature of the job! This means a special PD regulation!

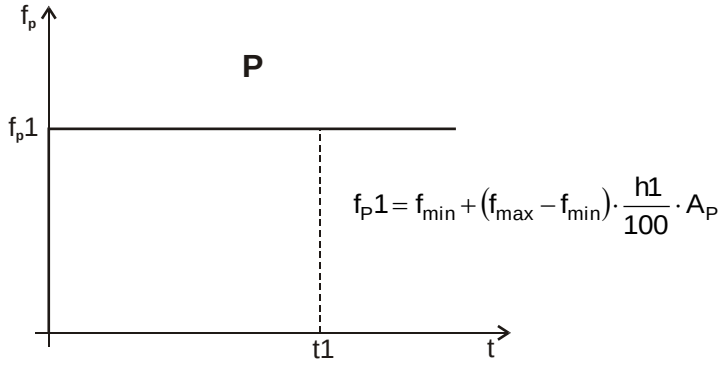
At torque regulation, selecting normal mode means driving (motor) torque regulation while selecting inverse mode means braking (generator) torque regulation!

The change of the frequency is also influenced by the frequency slope limitation through the regulation acceleration time (menu item **2-1-2**) and the regulation deceleration time (menu item **3-1-2**)! With operating system, these mean the highest permissible slopes independently of the PID parameters.

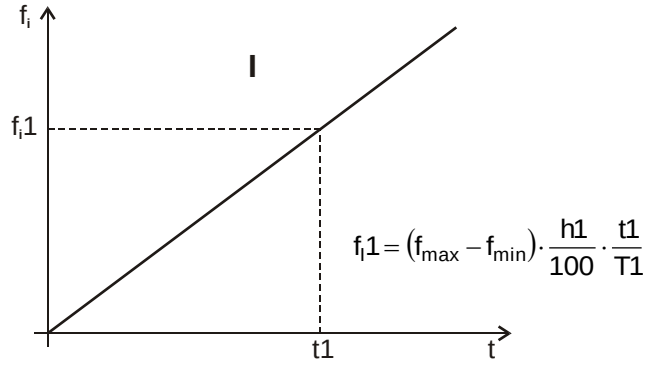
The normal acceleration and deceleration times are ineffective in the regulation process but at stop the deceleration occurs according to the control deceleration time (menu item **3-1-1**) and the stop mode!

An example for the regulation

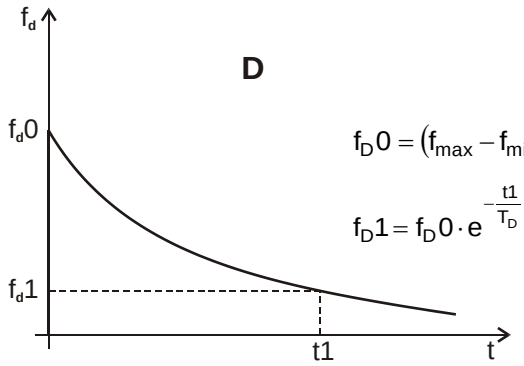




$$f_P1 = f_{min} + (f_{max} - f_{min}) \cdot \frac{h1}{100} \cdot A_P$$



$$f_I1 = (f_{max} - f_{min}) \cdot \frac{h1}{100} \cdot \frac{t1}{T1}$$



$$f_D0 = (f_{max} - f_{min}) \cdot \frac{h1}{100} \cdot A_D$$

$$f_D1 = f_D0 \cdot e^{-\frac{t1}{T_D}}$$

At setting the PID parameters be very careful, because the quality of the regulation depends on this setting!

Prior to setting the parameters, clarify if the job needs proportional regulation, PI regulation or really a PID regulation?

The absolute limitation of the output frequency (f) is built into the regulator therefore at reaching the limit the I element will not be integrated off!

The limitation of the acceleration and deceleration slopes of the output frequency (f) is independent of the regulator. Setting wrong parameters (e.g. too large deceleration time and short integration time) may cause the regulator to be integrated off thus the system to swing over.

Some hints

P (proportional): For simple regulations (e g. fluid level regulation) it is practical to use proportional regulation.

Thus, the set-in process is the fastest and there is no tendency to swinging.

The regulation works with the minimum error (due to the regulation being proportional to the error signal) but this is not essential at these kinds of applications. (Ti=N, Ad=0)

The PI regulation can be used at regulation tasks of relatively high time constant.

(e g. pressure regulation with pumps or temperature regulation with blowers etc.) (Ad=0)

PID regulation has to be used for fast regulations.

(e g. regulation of the rotation speed)

At adjusting Ad and Td special care has to be taken to avoid swingings but maintain the speed of the regulation!

2. Starts menu

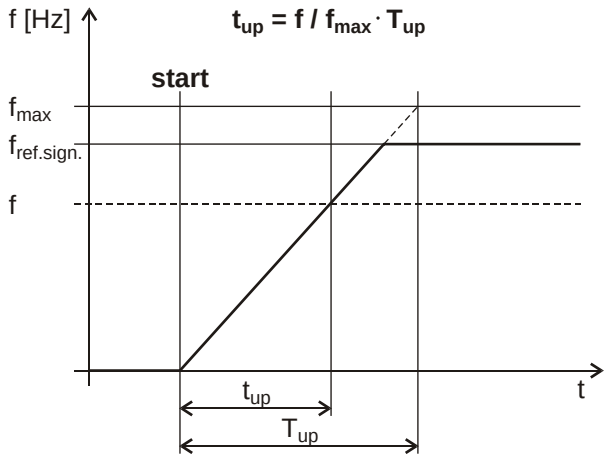
This main menu includes the parameters related to the starting of the motor operated by the frequency converter.
Following parameters can be set here:

- normal rise time,
- mode of rise,
- data of rise with breakpoint,
- S curve,
- start inhibition,
- inhibition of direction change,
- start backwards,
- mode of start,
- loosen of the brake,
- flying scissor,
- flying start

Explanation of the acceleration time

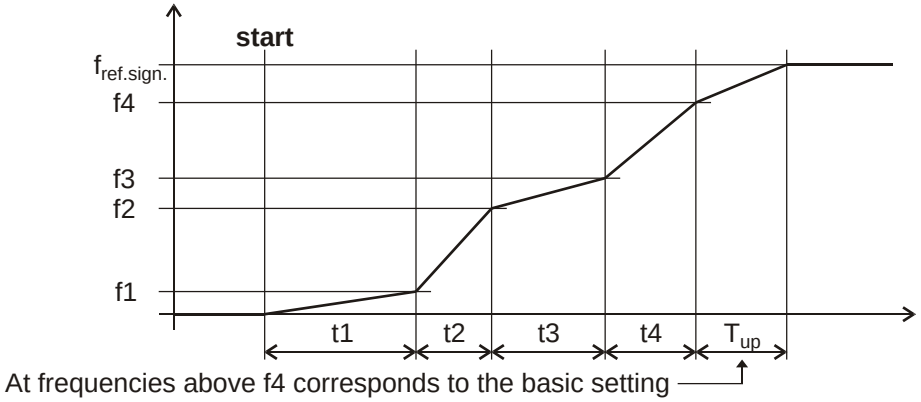
Submenu	Explanation, further submenus	Values	Default setting	Unit
2-1 rise time	It means at both control and regulation the limitation of the slope of the frequency rise.			
	2-1-1 control Tup	0,05 - 3276,7	5,00	s
	2-1-2 regulation Tup	0,05 - 3276,7	5,00	s
	2-1-3 referencing Setting the reference of the rise and fall time. (With fnom. selected, the rise and fall steepness do not change with changing fmax.)	f max. f nominal	f max.	

If the rise time is assigned to fmax (factory setting), the time set refers to between 0 Hz and fmax.
There is possibility for assigning the rise time also to the nominal frequency of the motor (in menu **2-1-3**).
The effective acceleration time (**tup**) belonging to a given frequency can be calculated.



Explanation of the acceleration with breakpoints

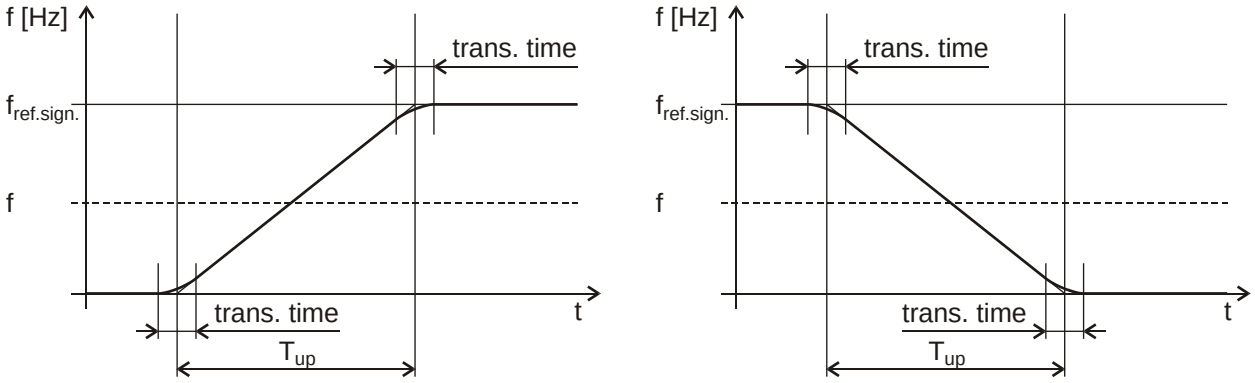
Submenu	Explanation, further submenus	Values	Default setting	Unit
2-2 acceleration type	Acceleration without breakpoints (normal) and with breakpoints (multistep acceleration) can be selected	normal multistep	normal	
2-3 multistep acceleration	The duration is the time necessary for running from the previous frequency to the prescribed one. The starting point of the characteristics is 0 Hz. If the last frequency (f4) is lower than fmax, then between f4 and fmax the acceleration occurs with the normal slope. The acceleration consists of linear sections. If the prescribed frequency is lower than the previous one, it will be disregarded by the program!			
	2-3-1 first breakpoint (0 Hz → f1)			
	2-3-1-1 duration	0,01 - 300,00	1,00	s
	2-3-1-2 frequency	0,1 - 1000,0	1,0	Hz
	2-3-2 second breakpoint (f1 → f2)	The setting is the same as that of item **2-3-1 first breakpoint**		
	2-3-3 third breakpoint (f2 → f3)			
	2-3-4 fourth breakpoint (f3 → f4)			



Effect of the "S" curve (the same at acceleration and deceleration)

Submenu	Explanation, further submenus	Values	Default setting	Unit
2-4 S curve	It means the implementation of "soft" transitions in the breakpoints of the acceleration, expressed by means of time. This is the transition time from one slope to the other. The "S" curve is effective in the start and end points at normal acceleration, and in all breakpoints at acceleration with breakpoints! Without programmed "S" curve, the form of the transitions is "angled"			
	2-4-2 transition time This is the time elapsing at changing-over from one steepness to the other. N: No change-over time, the nature of the change-over is "angled".	N 0,01 - 10,00	N	s

The acceleration and deceleration times become longer by the transition time. The transition from one slope value to another occurs without breaks, continuously. The steepness of the rise and fall does not change in the straight sections!



Submenu	Explanation, further submenus	Values	Default setting	Unit
2-5 start disable	After having put the system under voltage or after function commands inhibit, stop and roll out, the system can only be started from the start input (terminal block) if prior to that the input was in stop state!	no yes	no	
2-6 direction change disable	always: The direction change function is ineffective, independently of its source (terminal unit, terminal block etc.). Only direction "forward" prevails. If the inhibition of the direction change will be set in backward direction to "always", the equipment goes to the "forward" direction according to the actual fall and rise times. in start: Direction change is possible in stop state only. In Start mode, the direction change function is ineffective, independently of its source (terminal unit, terminal block etc.)	no always in start	no	
2-7 restart	It is of importance at short voltage blackout when using the start push button or the terminal start: If the equipment was set to pulse start and a blackout occurred, on a repeated switch-on within the restart time the equipment gives an automatic start. When „N" is set, or with **2-5 start inhibit** the start backward is inhibited **⚠ CAUTION** Its use must be thoroughly considered from the point of view of accident prevention!			
	2-7-2 time	N 1 - 60	N	s
2-8 start type	normal: Starts from 0 Hz flying: Seeks the frequency necessary for operating the rotating motor. In case of short voltage blackout, especially with large flywheel the "flying" mode is advantageous, because the load does not need to be stopped, and restarted from standing state.	normal flying	normal	
2-9 brake release	At starting the motor, standing torque will be given to the motor for the time preset here, giving time for releasing a possible mechanical brake.	0,00 - 30,00	0,00	s
2-10 fly snips	For cutting up continuously moving material. During the preset acceleration time, the shears takes the speed of the material, and then the frequency converter gives a cutting pulse (shears starts). (If the material is faster than the moving of the shears, the equipment does not give cutting pulse.)			
	2-10-1 speed up time	50 - 1000	300	ms
2-11 flying start	The rotation speed and direction of the running motor is established by the frequency converter, which operates it from this rotation speed, according to the reference signal.			
	2-11-1 voltage step This is the value, the motor voltage can increase with per 1 ms during flying start. For motors with higher power, a lower value should be set.	0,1 - 10,0	type-dependent	V
	2-11-2 change frequency This is the time needed for the frequency to reach 0 Hz starting from fmax. Setting a higher value results in a slower but more accurate determination, whereas setting a smaller value results in a faster but less accurate determination.	20 - 5000	200	ms

3. Stops menu

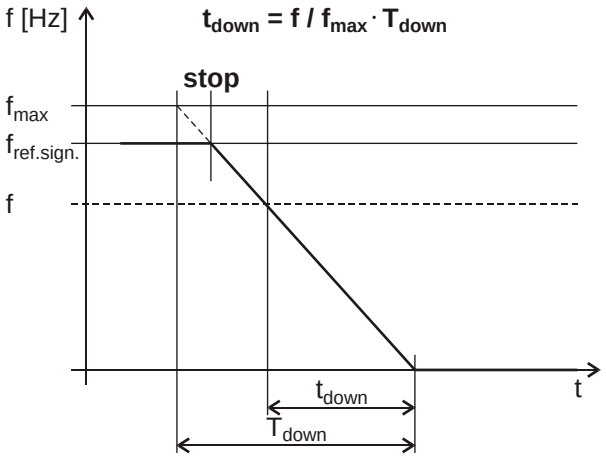
This main menu includes the parameters related to stopping the motor operated by the frequency converter.
Following parameters can be set here:

- normal fall time,
- mode of fall,
- parameters of fall with breakpoint,
- way of stop,
- data of the normal brake,
- time of spin out,
- data of the DC braking,
- data of the resistor brake,
- measure of keeping Udc,
- pulling of the brake
- Udc filtering

Submenu	Explanation, further submenus	Values	Default setting	Unit
3-1 fall time	In means at both control and regulation the limitation of the frequency decrease slope. (In case of stop, the fall time of the regulation acts even in control mode. (The time needed for reaching 0 Hz starting from fmax or fnom.)			
	3-1-1 control Tdown	0,05 - 3276,7	5,00	s
	3-1-2 regulation Tdown	0,05 - 3276,7	5,00	s

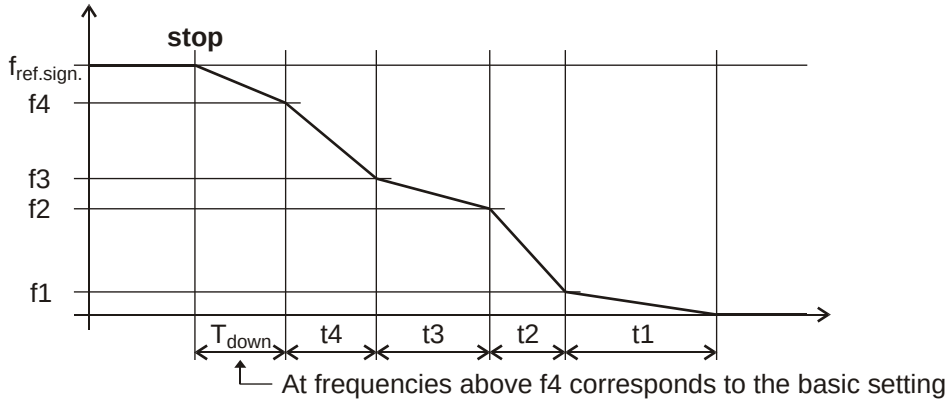
Explanation of the deceleration time

If the fall time is assigned to fmax (factory setting), the preset time is to be understood between 0 Hz and fmax.
There is possibility for assigning the fall time also to the nominal frequency of the motor (in menu **2-1-3**).
The effective deceleration time (tdown) belonging to a given frequency can be calculated.



Submenu	Explanation, further submenus	Values	Default setting	Unit
3-2 deceleration type	Deceleration without breakpoint (normal) and with breakpoint (multistep deceleration) can be selected.	normal multistep	normal	
3-3 multistep deceleration	Duration is the time necessary to decelerate from the prescribed frequency to the previous one. The starting point of the characteristics is 0 Hz. If the last frequency (f4) is lower than fmax, then between f4 and fmax the deceleration occurs with the normal slope. The deceleration consists of linear sections. If the prescribed frequency is lower than the previous one, it will be disregarded by the program!			
	3-3-1 first breakpoint (0 Hz ← f1)			
	3-3-1-1 duration	0,01 - 300,00	1,00	s
	3-3-1-2 frequency	0,1 - 1000,0	1,0	Hz
	3-3-2 second breakpoint (f1 ← f2)	The setting is the same as that of item **3-3-1 first breakpoint**		
	3-3-3 third breakpoint (f2 ← f3)			
	3-3-4 fourth breakpoint (f3 ← f4)			

Explanation of the deceleration with breakpoints

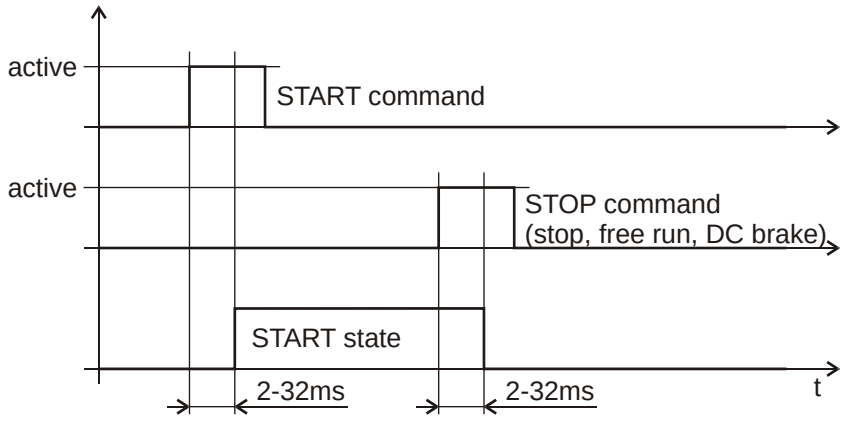


3-5 stop type	normal: It means running down the frequency. DC brake: Switching a standing field to the motor. mixed: Combination of the normal and the DC brake. free run: The equipment leaves alone the motor.	normal brake DC brake mixed free run	normal brake	
3-6 normal brake	Degree of the increase of the actual motor terminal voltage during generator operation mode. The loss of the motor increases but the braking dynamics increases. If even this is not enough for the demanded braking effect, additional resistor brake is to be used!			
	3-6-1 over excitation With increasing this value, the dynamics of the braking increases but in extreme case it may also cause overcurrent and the equipment stops with error message.	0 - 50	0	%
	3-6-2 excitation time N: The overexcitation voltage will be switched to the motor with a sudden jump. By increasing the excitation time forming of overcurrent can be decreased.	N 0,01 - 5,00	0,01	s

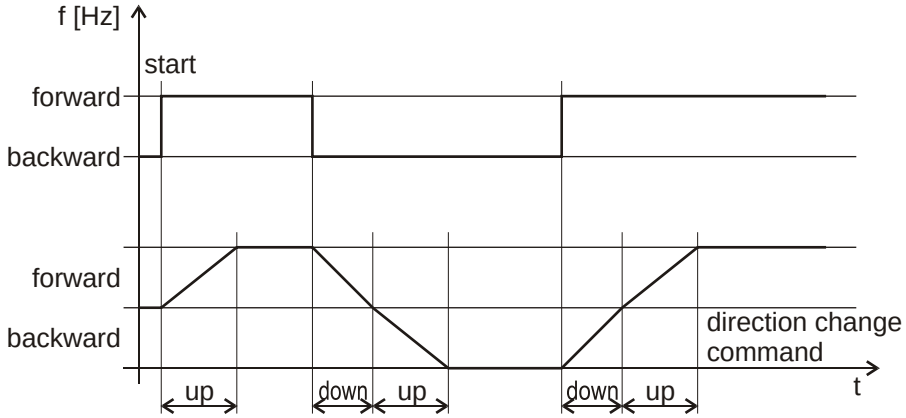
Submenu	Explanation, further submenus	Values	Default setting	Unit
3-7 free time	In case of stop with spin out, during this time an other start command remains ineffective, for disabling a restart. **2-8 start mode:** in „normal" mode the running unit cannot be restarted.	0,1 - 1000,0	4,0	s
3-8 DC brake	The **6-4 motor nominal current (In)** parameter overrules the brake current. Even with setting larger current, the frequency converter permits the nominal current of the motor as a maximum! The operation of the DC brake is shown in the status display ("DC brake"). **i** In case of activating from digital input, also current values differing from this can be set (**4-9-3 continuous DC brake current**).			
	3-8-1 maximum DC brake current	0,0 - type-dep.	type-dependent	A
	3-8-2 changing frequency With mixed stop **(3-5 stop mode),** above the switch-over frequency the normal brake, below it the DC brake will be effective. At higher frequencies the DC brake is not so effective.	0,1 - 25,0	1,0	Hz
	3-8-3 operation time	0,0 - 1000,0	2,0	s
	3-8-4 de-excitation time At pure DC brake	0,10 - 2,00	0,20	s
3-9 resistor brake	Without being equipped with resistor brake, at generator mode (e g. at fast deceleration) the frequency converter limits the gradient of slope, if it is needed for providing secure stopping! If the resistor brake is enabled, its operation is shown in the state display („R brake")!			
	3-9-1 permission yesVent: In case of start the frequency converter turns on also the ventilator. After expiry of the start state, the ventilator operates for further 2 minutes. In case of connecting a brake module with ventilator, the ventilators of the brake resistor can work together with the ventilators of the equipment.	no yes yesVent	no	
	3-9-2 R value	type-dependent	type-dependent	Ω
	3-9-3 maximum load	type-dependent	type-dependent	W
	3-9-4 U brake Brake switch-on level	600 - 720	660	V
3-10 Udc hold	At expiry of the supply voltage, the equipment strives to hold the minimum value of the DC voltage necessary for the operation! (with decreasing f)	N 1 - 100	N	%
3-11 brake operation	After the motor stopped, for the time set here, standing torque will be given to the motor, permitting time for activating a possible mechanical brake.	0,00 - 30,00	0,00	s
3-12 Udc filter	The time constant of the filter used at measuring the DC voltage can be set here. It serves avoiding the swingings caused by the of the driven mass!	1 - 200	200	ms
3-13 emergency fall time	At activating the emergency stop input, the equipment stops with the fall steepness set here.	0,05 - 3276,7	2,50	s

Start command with pulse control, from terminal blocks

(using a terminal similarly to the operation of the start and stop buttons)
The minimum pulse width will be established by the extent of debouncing, in 2ms steps (menu **4-9-5**).

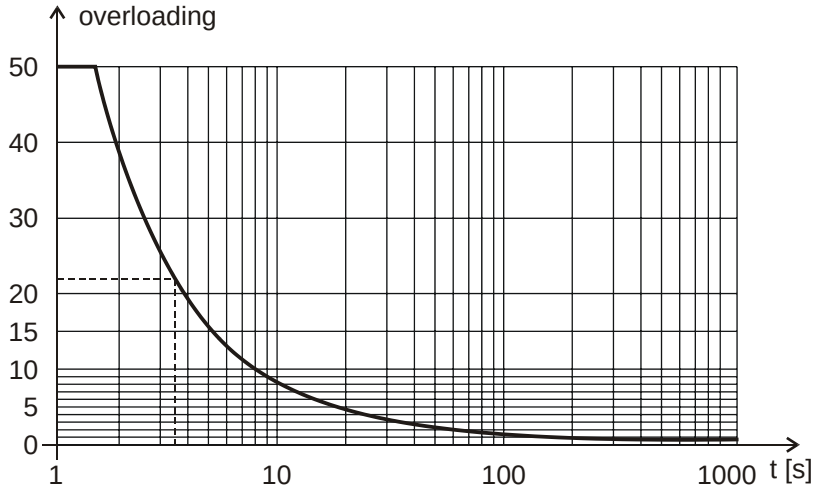


Direction change while running



Permissible load of the brake resistor (typical curve)

The brake resistor must be of wire wound type. If the user provides the brake resistor, the rating, type and placement must be consulted with the manufacturer.



Example:

Rbrake = 100 Ω
P (Rbrake) = 200 W
Ubrake = 660 V

$P = 660V^2 / 100\Omega = 4356W$

Overloading = 4356 / 200 = 21,78 (~22)

Starting from the overloading, the diagram curve reads 3.5 s for the maximum value of the braking time.
The interval between brakings should be at least 22 x braking time!

4. Inputs menu

In this menu the analogue and digital inputs at the SA and SD low voltage terminal blocks, the virtual inputs, as well as the input like parameters connected with the terminal, the CAN regulation and the incremental rotation speed signal transmitter can be set.

Following parameters can be set here:

- analogue inputs,
- source of the logical regulations,
- logical parameters,
- fix start,
- digital inputs,
- virtual inputs,
- data of the slave equipment,
- IRE parameters

Analogue inputs

In case of potentiometer setting, the equipment expects the signal of the potentiometer connected to its own reference voltage, whereas in case of voltage input, it expects the 0-10 V signal of an external signal source, and in case of current input the 0-20mA signal of the external signal source. In all three cases both the mode and the stop zone is applicable.

In case of signed setting of the mode, the mid-position relates symmetrically to the half of the analogue input range, below and above it the motor runs in opposite directions.

Optionally, (in VLD and VHD type equipment) reception of reference signals of ±10V can be implemented, too. In this case the positive voltage refers to one direction and the negative voltage the other direction. The reference signal is the absolute value of the voltage.

In normal case the stop zone is above 0V (0mA), in signed case symmetrically to the half of the analogue input range, in the percent of the whole range. In this voltage (current) zone, on start command the equipment is in waiting mode. The start will be active again in a distance of the hysteresis from the stop zone

Explanation of the lower and upper levels of the analogue inputs.

- In **control** mode, the upper corresponds to → f maximum and the lower to → f minimum, if they are not narrowed by the control reference signal limits (**1-5-3 control reference signal limits**).
- In **regulation** mode, the upper level → corresponds to the maximum % value and the lower level → to the minimum % value

Control function

It means the analogue signals necessary for the control and regulation modes. (control or regulation reference signal, feedback signal, modification signal)

Special functions (rise time, fall time, U boost, torque, f max, f min)

The special functions permit the most important parameters to be set during operation.

The value of the parameter set here belongs to the upper value of the analogue input, thus it can only be decreased.

Digital inputs

Each digital input can freely be programmed.

- Digital IN 1.: default setting: Start / Stop
- Digital IN 2.: default setting: Direction
- Digital IN 3.: default setting: Jog
- Digital IN 4.: default setting: Acknowledgement
- Digital IN 5.: Default setting at VLD and VHD types: External error (or IRE2 input option)
  at V3D types digital or IRE input option
- Digital IN 6.: Default setting at VLD and VHD types: Stop (or IRE2 input option)
  at V3D types digital or IRE input option
- Digital IN 7.: at VLD and VHD types digital or IRE input option
  at V3D types not.
- Digital IN 8.: at VLD and VHD types digital or IRE input option
  at V3D types not.

⚠ CAUTION
In case of start command given with pulse, the possibility of stopping the motor has to be assured, e.g. by programming an input to stop, spin out, DC brake, external error etc.
A requirement for the pulses, that they will only be accepted, if they exist in both logical state at least for the time of the debouncing (2-32 ms, depending on the setting)

Submenu	Explanation, further submenus	Values	Default setting	Unit
4-1 analogue input 1.	With setting the parameters, the character of the input is decided only! The purpose, the input will be used for (control reference signal, regulation reference signal, feedback signal, modification signal) is selected in menu **1. Operation mode**.			
	4-1-1 type The jumper belonging to the input has to be set according to the equipment type (s. Manual). (At V3D: A1, at VLD - VHD: A1P, A1N)	potentiometer voltage current	potentiometer	
	4-1-2 features			
	4-1-2-1 type signed value: referring to the mid-position.	normal signed value	normal	
	4-1-2-2 stop range With setting "N" there is no stop range	N 0,1 - 50,0	N	%
	4-1-2-3 hysteresis	N 0,1 - 10,0	1,0	%
	4-1-3 voltage Setting the upper and lower level.			
	4-1-3-1 upper	0,0 - 10,0	10,0	V
	4-1-3-2 lower	0,0 - 10,0	0,0	V
	4-1-4 current Setting the upper and lower level.			
	4-1-4-1 upper	0,0 - 20,0	20,0	mA
	4-1-4-2 lower	0,0 - 20,0	0,0	mA
	4-1-5 function Functions of the analogue IN1 input. control: the control, reference and modification signals can be entered. The further functions permit the most important parameters to be set during operation. At the upper level of the analogue input the preset value will be valid, at the lower level as follows here: rise time: a 50th part of the preset value fall time: a 50th part of the preset value U boost: 0 V torque limit: a 10th part of the preset value f max.: 5 Hz f min.: 0.01 Hz U motor: a 10th part of the preset value	control rise time fall time U boost torque f max. f min. U motor	control	
	4-1-6 filter For use to eliminate the influence of the ambience.	0 - 60000	20	ms
4-2 an. input 2.	The setting is the same as that of item **4-1 analogue input 1.** The jumper belonging to the input has to be set according to the equipment type (s. Manual). (At V3D: A2, at VLD - VHD: A2P, A2N))			
4-3 an. input 3.	The setting is the same as that of item **4-1 analogue input 1.** (Optional) Voltage input only. Current signal can be received with an external 500Ω termination resistor.			
4-4 an. input 4.	The setting is the same as that of item **4-1 analogue input 1.** (Optional) Voltage input only. Current signal can be received with an external 500Ω termination resistor.			

Submenu	Explanation, further submenus	Values	Default setting	Unit
4-8 logical control source	This parameter permits the source of the Start/Stop, Direction and Jog inputs to be selected. **i** The above signals in default setting are valid from the terminal blocks. For terminating them the input(s) have to be reconfigured to an other function or to „N"!			
	4-8-1 terminal control Whether a logical control signal can be given out from the lower four buttons of the terminal (jog, direction, start, stop)	no yes	no	
	4-8-2 CAN control Whether a logical control signal can arrive through CAN bus. If in start mode, the signal ceases on the bus, the equipment stops with error!	no yes	no	
4-9 logical param.	Setting further parameters of the digital inputs.			
	4-9-2 motor potentiometer			
	4-9-2-1 up time In case of control, the rise time for the reference signal from 0 to fmax (or fnom). In case of regulation, the rise time for the reference signal from 0 to 100% In case of modification, the rise time for the modification signal from 0 to 100%.	0,0 - 1000,0	10,0	s
	4-9-2-2 down time In case of control, the fall time for the reference signal from fmax (or from fnom) to 0. In case of regulation, the fall time for the reference signal from 100% to 0. In case of modification, the fall time for the modification signal from 100% to 0.	0,0 - 1000,0	10,0	s
	4-9-2-3 clear Zero setting of the value of the motorized potentiometer. ENC0cmd: At activating IREpos0 input selected to any digital input, the value of the motorized potentiometer will be set to zero.	no start up by start change direction ENC0 cmd.	no	
	4-9-2-4 stop Whether a stop in the control could be given out with the motorized potentiometer. In case of yes, if the control reference signal set with the motorized potentiometer is in minimum position and a down command occurs again, this will effect stop, and the motor stops. In this state, on an up command of the motorized potentiometer, the equipment goes in start state and the motor starts with the minimum frequency.	no yes	no	
	4-9-3 DC brake current If the DC brake is operated with the activation of the digital input.	0 - Inominal	0,0	A
	4-9-5 inp. filter The time of filtering the digital inputs. The value of the input will only be accepted, if it has not changed within the preset time.	2 - 32	32	ms
4-10 fix start	Whether the 'ready for operation' state of the equipment should mean start at the same time.	no yes	no	

Submenu	Explanation, further submenus	Values	Default setting	Unit
4-11 digital input 1.	Selecting logical function commands and activation of program or counter function can be made here!			
	4-11-1 type selection N: It means inactive input, except for IRE input. *(see: page 41)*	N logical functions program func. other functions	logical functions	
	4-11-2 logical functions	*logical functions (see: page 36)*		
	4-11-3 program functions	*program funct. (see: page 38)*		
	4-11-4 other functions	*other functions (see: page 38)*		
	4-11-5 active state With closing or opening contact	closing opening	closing	
	4-11-6 name	xxxxxxxx	dig.in 1	
4-12 digital input 2. • • • **4-18 digital input 8. ***	The setting is the same as that of item **4-11 digital input 1.** * *digital input 7-8 at VLD and VHD types only*			

4-21 virtual input 1.	Similarly to the built up digital inputs, with the use of the internal signal selected in the "Source" menu item selection of logical function commands, activation of programs or counter function can be done.			
	4-21-1 type selection N: means inactive input	N logical functions program func. other functions	logical functions	
	4-21-2 logical functions	*logical functions (see page 36)*		
	4-21-3 program functions	*program funct. (see page 38)*		
	4-21-4 other functions	*other functions (see page 38)*		
	4-21-5 signal source The input should comply with the state of what.	compare 1 compare 2 compare 3 period 1,2,3 period 1 period 2 period 3 MOD bus	compare 1	
	4-21-6 name	xxxxxxxx	vir.in 1	
4-22 virtual input 2. • • • **4-26 virtual input 6.**	The setting is the same as that of item **4-21 virtual input 1.**			

Explanation of the logical functions

start switch: continuous start command. If multiple inputs are programmed as start switch, they are in logic "AND" relation.

start switch inverse: its function is the same as that of the start switch, but it starts the motor in the opposite of the appointed direction.

start button: pulse type start command. If multiple digital inputs are programmed as start button, they are in logic "OR" relation therefore if any of them is activated the start command occurs!

⚠ CAUTION
If start is selected to more than one input at the same time, then starting and stopping the machine must be thoroughly considered regarding life protection!

i	Start switches and push buttons can exist also mixed. In such case, all start switches have to be active for the possibility of giving out start command with any of the start push buttons! If in menu **4-8-1** the terminal regulation is enabled, then the start button of the terminal functions as start push button, therefore at starting from terminal only, start switch must not be selected to any of the inputs. If in menu item **4-8-2** regulation through CAN bus is activated, the start switches selected to the inputs will have also in this case enabling role (they will be in „AND" conjunction with the start command arriving through the CAN bus).

start push button inverse: its function is the same as that of the start push button, but it starts the motor in the opposite of the appointed direction.

direction change switch: activation of the input acts as a command for changing the direction. If more than one input is programmed to direction change switch, then activation of any further input causes direction change.

For example: with two digital inputs programmed to direction change switch: activation of both inputs means two direction change commands, that is, the original direction will be valid.

direction change push button: pulse format direction change command. If more than one input is programmed to direction change push button, then they are in logical "OR" conjunction with each other. If any of them acts, the direction change occurs. If the direction change switch is also selected, the push buttons are ineffective.

jog normal: used generally for adjusting the machinery, it starts the motor with the parameters set in menu **8-4**. It is active from the stop state only, in the appointed direction. If the terminal regulation is enabled in menu **4-8-1,** also the jog button of the terminal activates the function, independently of the state of the jog input.

jog inverse: used generally for adjusting the machinery, it starts the motor with the parameters set in menu **8-5.** It is active from stop state only, reversely to the appointed direction.

external error: it makes the appliance run out with error message (e.g. motor thermal switch, emergency stop etc.)

external event: its activation causes writing "external event" in the event log, with the actual point of time.

acknowledgement: means accepting the error messages, cancels the inhibition state.

stop: effects stopping the motor according to the setting.

emergency stop: serves the emergency stopping of the motor. The frequency converter stops the motor with the fall steepness set in menu **3-13**.

spin out: effects stopping the motor with spin out. When activated, the frequency converter lets the motor freely stop

DC brake: effects stopping the motor with DC braking. When activated in stop state, with the emerging standing torque a hold function can be effected.

f hold: inhibition of the frequency change. When activated, the frequency change stops even at rising and falling run!

motorized potentiometer up: if the source of the actual reference signal or modifying signal is the motorized potentiometer, then this input effects its increase.

motorized potentiometer down: if the source of the actual reference signal or modifying signal is the motorized potentiometer, then this input effects its decrease.

i	Other parameters of the motorized potentiometer can be set in the menu **4-9-2**. The motorized potentiometer zero setting refers to the reference signal of the control or the regulation, depending on the actual operation state of the equipment. At switching off, depending on the setting in menu **4-9-2-3,** the equipment can store the motorized potentiometer reference signal corresponding to the actual operation state.

control / regulation: permits the dynamic switch-over of the operating mode.

analogue IN exchange: when activated, the analogue IN1 and analogue IN2 will be exchanged with each other. For example:

- analogue IN1: manual regulation with potentiometer, analogue IN2: PLC regulation with current signal.
- in case of pressure regulation, if the pressure feedback signal is measured in two places, and the active one needs to be changed.

RS485 exchange: this serves exchanging the functions of the RS485/T and RS485/R connectors.

There is possibility for remote controlling the equipment from computer (from PLC) through RS485/R line. Using a proper protocol the displayable values can be read out, various reference signal values can be set, and any function, which can be selected to the digital, can be used for accomplishing by the equipment. At the same time on a display connected to the RS485/T connector, or on a terminal, the operation of the equipment can be inspected, and also settings can be made. If the given equipment is not equipped with the RS485/R connection, with activating the RS485 exchange, the remote control can be made from the RS485/T connection. During the activated state of the RS485 exchange, the terminal connected to the RS485/T connector of the equipment cannot work.

CAN exchange: this serves exchanging the functions of two CAN lines of the equipment.

modifying: for the discrete altering if the preset reference signal, depending on an external condition. (**1-8-5 discrete value**)

IRE position zero setting: for position adjustment and for fixing the basic position at master/slave operation. The zero setting is made to rising edge. (In case of "IRE position zero setting" continuously until the input is active.
In case of master/slave operation, care has to be taken to the order of fixing the basic positions. At using „IRE position zero setting" it has to be started with the master equipment.

waiting: its activation effects waiting operation.

brake control: it serves the activation of the brake control digital output.

load sharing: in case of joint drivings, where more than one frequency converters drive more than one motor, and the aim is the even distribution of the loading, the frequency converters are to be connected through CAN bus. On activating this input, the pieces of the slave equipment receive the start and direction commands as well as the reference signal not from the terminal blocks but from the master equipment through the CAN bus.

regulation normal/inverse: when selected, the frequency converter disregards the setting of the **1-6-2 regulation profile.** The profile of the regulation depends on the state of the input. Active input means inverse regulation.

IRE zero setting: for position adjustment and for fixing the basic position at master/slave operation. Until this input is active, fixing of the basic position occurs continuously. (In case of "IRE position zero setting" input, to the rising edge only.

IRE zero setting (relative): On any pulse given to the input, the motor will make the rotation corresponding to the preset reference signal, and then it stops. The position errors occurring at each stop do not accumulate, because of the relative zero setting.

Explanation of the program functions

program inhibit: inhibits the running of the programs. It is in logic "AND" connection with menu item **9-10-1**.

program suspension: the time limitation of the actually active program (**9-x-3-6**) becomes longer by the time of the active state of the input.

program step: stepping over from the running program to the next activated program, disregarded the time limit.

program 1 - 15: activates the internal programs.

program binary activation: activates the internal programs by binary code.

In case of binary program start, so many inputs are to be selected to "binary" as it is required by the program of the highest serial number to be activated:

- at program 1: 1,
- at program 2-3 2,
- at program 4-7: 3,
- at program 8-15: 4.

The digital inputs correspond to the increasing positional values of the binary codes according to their decreasing serial numbers.

for example: selected to "binary": digital inputs 2, 3, 5
activation of program 6 (**110**): digital input 2: **1**, digital input 3: **1**, digital input 5: **0**

sequence 1-3: for activating program groups. (menu **9-26**)

Explanation of other functions

counter-3 F: input for shifting the given counter upward.

counter -3 L: input for shifting the given counter downward.

counter -3 B: input for writing the given counter. (in case of zero starting value zero setting input)

i	The counters can be programmed independently (direction, zero setting). They can be used for stopping and display.

memory 1-3: pulse loading command. Activating this input effects loading of the parameter set, if the equipment does not work, or during stop with spin out.

i	At these settings the naming of the parameter set does not appear, unlike in menu item **11-1-1-1**. (Parameter loading from memory) Independently from the naming, the selectable memories are always memory 1, memory 2 or memory 3!

knife up: in case of flying scissor the "knife up" sensor has to be connected to this input.

Virtual inputs

The virtual inputs permit to achieve the same effects as the digital inputs on the terminal block. However here the source of the input (**4-2x-5**) is an internal discrete signal (comparator output signal or time interval) or remote control. Thus, even more complicated tasks can be fulfilled without the use of any further device

Slave equipment parameters

The system supplements the signals received through (CAN bus) line for the slave equipment! (The master/slave conjunction can be implemented in both regulation and control operation mode!)

Readjustment of the frequency ratio or rotation speed ratio permits the slave motor to rotate with a rotation speed different from but fully proportional to that of the master motor. Necessary for this is, in case of regulation setting of the **4-30-1 frequency ratio** only, whereas in case of control setting of both the **4-30-1 frequency ratio** and the **4-30-2 rotation speed ratio**.

The master massages include the number of the pulses measured by the master (received from the signal transmitter) and the actual frequency of the master. The slave equipment applies these values together with the frequency and rotation speed ratio set in the slave equipment.

In case of using motors with different pole pairs in the master and slave equipment, this has to be considered at setting the frequency ratio, since with lower pole pair the same frequency means larger rotation speed. For example, if a 4-pole motor is connected to the master equipment and a 8-pole motor to the slave equipment, and both motors should be driven on the same rotation speed, the frequency ratio has to be set to 2 in the slave equipment, since to the same rotation speed belongs twice as high frequency in case of a motor with twice as high pole number.

Applying signal transmitters with different division will effect both the frequency and the rotation speed ratio. For example if the master equipment uses a signal transmitter with 1000 divisions and the slave equipment uses a signal transmitter with 2000 divisions, then for achieving the same rotation speed, in the slave equipment in the rotation speed ratio the multiplier has to be set to 1 and the divider to 2, because in the slave arrive from the signal transmitter twice as many pulses in one rotation as in case of the master.

Marker adjustment

Using the settings discussed above, it can be achieved that the slave motor operates on a rotation speed fully proportional with that of the master. However, there are applications where this ratio has to be adjusted to the motion of the material. In this case the marker adjustment can be used.

It can be used e.g. at printing or cutting paper. The slave equipment perceives the marker signal (e.g. where the material has to be cut). Between two marker signals, the slave motor has to make just the number of rotations, which release a cut. In case of stiff control of the rotation speed, with the strain of the material or with its slip on the moving cylinder, the place of the cut will also be shifted, thus the task cannot be fulfilled properly. In such case the rotation speed ratio needs to be slightly corrected from marker signal to marker signal. The solution is the dynamic rotation speed calculation. This can be enabled in menu **4-30-2-3**.

The adjustment parameters of the marker adjustment are available in menu **4-30-5 marker adjustment.**

i	The number of rotations of the driven axle to be made between two marker signals has to be considered!

Submenu	Explanation, further submenus	Values	Default setting	Unit
4-30 slave data				
	4-30-1 frequency ratio (slave multiplier) In control it can be used for pre-coupling depending on the frequency of the master.	0,01 - 10,00	1,00	
	4-30-2 rotation speed ratio Rotation speed of the slave related to that of the master. For accurate setting both multiplier and divider can be set! (e.g. the ratio of 14.5 can be set with multiplier 145 and divider 10.) This method permits even setting a ratio of e.g. 1/3! (multiplier: 1 and divider: 3) **i** During operation, the rotation speed ratio can only be modified by setting the multiplier and the divider jointly! For leaving any value unchanged without modification, it has to be approved with the "Enter" button.			
	4-30-2-1 multiplier	1 - 32000	1	
	4-30-2-2 divider	1 - 32000	1	
	4-30-2-3 dynamic Enables the marker adjustment	no yes	no	
	4-30-3 modification mode The modification concerns the position or the rotation rotation: it modifies the **4-30-2-1 rotation ratio multiplier**. position: it modifies the **4-31-3 position 100%**.	rotation position	rotation	
	4-30-4 angle position (slave lag)			
	4-30-4-1 degree It can enrol positive values only. (E.g. at 10° slave "delay" 10, whereas at 10° slave "hurry" 350.	0,0 - 360,0	0,0	°
	4-30-4-2 rot.	N - 50000	N	
	4-30-5 marker regulation			
	4-30-5-1 proportional	0 - 500	100	%
	4-30-5-2 integration	0 - 500	100	%
	4-30-6 transcript Here can be set the number of rotations of the driven axle until the motor makes one rotation.			
	4-30-6-1 multiplier	1 - 32000	1	
	4-30-6-2 divider	1 - 32000	1	

Incremental rotation speed signal transmitter (IRE) parameters

Incremental rotation speed signal transmitter inputs

At digital inputs, selecting „N" means inactive input, except for IRE inputs!

If both (A and B) IRE inputs are selected to "N", then they can be used as incremental rotation speed signal transmitter inputs (A or B).

In case of 2-phase IRE, if any IRE input (A or B) is used as function input, even the other cannot be used as IRE input!

In case of 1-phase IRE, the IRE B input can be used as digital input.

At V3D types, for IRE inputs input 5 and input 6 can only be used, at types VLD and VHD primary inputs 7 and 8, for a second IRS input inputs 5 and 6 can be used at proper configuration.

If no IRE input is needed, they can be used for digital input, as all other inputs.

Submenu	Explanation, further submenus	Values	Default setting	Unit
4-31 IRE data	Parameters necessary for rotation speed and position regulations.			
	4-31-1 resolution Its setting means the number of pulses during one revolution of the IRE.	0 - 10000	1000	imp/rot.
	4-31-2 rotation speed 100% At rotation speed regulations.	0 - 6000	1500	f/min
	4-31-3 position 100% At position regulations.	0 - 50000	1000	rot.
	4-31-4 position=0 Setting the basic position of the incremental signal transmitter given in menu **4-31-5**.	now by start to prg. cycle start	now	
	4-31-5 position 0 value Percent of the reference signal the basic position is to understand at.	0,00 - 100,00	0,00	%
	4-31-6 type 2 phases: Signal transmitter connected to IRS A and B inputs 1 phase: Uses the IRS A input only. To this input, the pulses arrive if the motor runs. With 1-phase signal transmitter, sensing of the rotation direction is not possible, thus in this case the direction will always be the designated direction of the frequency converter.	2 phases 1 phase	2 phases	
	4-31-7 filter	no yes	no	

The parameters of the primary IRE can be set in menu **4-31**.

The primary IRE can be used as feedback signal for:

- rotation speed control,
- torque control,
- position control,
- field oriented control with signal transmitter

as well as in case of demand for reference signal source, for

- regulation and
- control

The secondary IRE (IRE 2) which can be established in VLD and VHD types, can only be used as reference signal source.

The parameters of the primary IRE apply also to the secondary IRE.

If the reference signal source is an IRE, the frequency converter has to be set by the slave.

5. Outputs menu

In this menu the analogue and digital outputs on the SA and SR terminal blocks of the equipment, as well as the functions connected with the outputs can be set.

Followings can be set here:

- analogue outputs,
- digital outputs,
- timers,
- comparators,
- periods,
- PID extension

Analogue outputs

The analogue outputs are included in the VLD and VHD type equipment!

If necessary, optionally they can be built into V3D type equipment.

At each frequency converter identically, the analogue outputs feedback the percentual values of the nominal motor parameters (**fn, Un, In, Pn, n, n/IRE**), or other internal parameters (Analogue IN1-2, feedback signal, regulation reference signal, Tsink). Default ranges 0 ÷ 10V, or 0 ÷ 20mA → 0 ÷ 100% (100 ºC)

i	At selecting rotation speed, the nominal value is the theoretic "synchronous" rotation speed of the motor! Compared to this, the actual rotation speed is lower depending on the load (the nominal rotation speed of the motor belongs to the nominal load!). This permits the correct back indication proportional with the load.
	At selecting rotation speed IRE, the nominal value belongs to that rotation speed which was set as 100 % at setting the IRE data (Menu item **4-31-2**). This is important because the parameter the IRE measures is not necessarily the motor's rotation speed. It can be a rotation speed decreased or increased by gears.

Digital outputs

The number of possible digital outputs is at V3D types 2, at VLD and VHD types 3.

With built in relay (or optocoupler) outputs there is possibility for the indication of operation modes, indication of the state of comparators connected to internal parameters and for other programmable features (PID extender, period).

The PID extension makes it possible to supplement 1 regulated unit even with further 3 fix switchable units (e.g. pressure control for more than one pump).

The Timers can influence the operation of the digital outputs, the comparators and the time intervals, according to the setting of menu item **5-16-2**. The delay and also the period of time can be set. If "N" is set for limiting the period of time, the operation will be continuous until the event persists. Delay and period of time can be programmed also together. If the event persists for a shorter time than the delay time, the event will not make the system operate.

Submenu	Explanation, further submenus	Values	Default setting	Unit
5-1 analogue output 1.	When selecting a motor parameter take care of its correct setting! In case of feedback signal, the output displays the measured value related to 100%.			
	5-1-1 signal source The parameter, to deliver a voltage or current signal proportional to it, on the analogue OUT1 output. Interpretation of the 100% values: frequency 100Hz Imotor In Umotor Un Udc 1000V Unet 1000V Pinp Pn control ref. s. 100Hz mod. cont. ref. s. 100Hz reg. ref. s. 100% mod. reg. ref. s. 100% feedback 100% error signal 100% analogue IN 1,2,3,4 10V / 20mA analogue IN 1-2,3-4 10V / 20mA counter 1,2,3 10000 run time 1,2 1000h heatsink 100°C n n sync. n ENC n 100% (**4-31-2**) torque Mn Pbrake average 100% Pbrake current 100%	frequency Imotor Umotor Udc Unet Pinp. control ref. s. mod. cont. ref. s. reg. ref. s. mod. reg. ref. s. feedback error signal an. IN1 an. IN2 an. IN3 an. IN4 an. IN1-2 an. IN3-4 counter 1 counter 2 counter 3 run time 1 run time 2 heatsink n n ENC torque Pbrake average Pbrake current	frequency	
	5-1-2 range For setting the interval used for the signalling the selected parameter of the source			
	5-1-2-1 maximum	0,0 - 1000,0	100,0	%
	5-1-2-2 minimum	0,0 - 1000,0	0,0	%
	5-1-3 features	voltage current	voltage	
	5-1-4 voltage			
	5-1-4-1 upper The output voltage value belonging to **5-1-2-1 maximum**	0,0 - 10,0	10,0	V
	5-1-4-2 lower The output voltage value belonging to **5-1-2-2 minimum**	0,0 - 10,0	0,0	V
	5-1-5 current			
	5-1-5-1 upper The output current value belonging to **5-1-2-1 maximum**	0,0 - 20,0	20,0	mA
	5-1-5-2 lower The output current value belonging to **5-1-2-2 minimum**	0,0 - 20,0	0,0	mA
5-2 analogue output 2.	The setting is the same as that of item **5-1 analogue output 1.**			

Submenu	Explanation, further submenus	Values	Default setting	Unit
5-11 digital output 1.	Signalization of the operation modes or of the state of the comparators, timing function, setting of PID extension or inactive state ("N").			
	5-11-1 signal source The parameters of the comparators in menus **5-21**, **5-22** and **5-23**, PID extension parameters in menu **5-29**, The parameters of the time intervals can be set in menus **5-26**, **5-27 5-28**. ** PID extension 3 at VLD and VHD types only*	N ready start stop forward brake rel. compare 1 compare 2 compare 3 error code MOD bus PID ext. 1 PID ext. 2 PID ext. 3 * period 1,2,3 period 1 period 2 period 3 start forward start backward external error knife start error control / regul.	ready	
	5-11-2 active state opening or closing contact	closing opening	closing	
5-12 digital output 2.	The setting is the same as that of item **5-11 digital output 1.**			
5-13 digital output 3. *	** digital output 3 at VLD and VHD types only*			

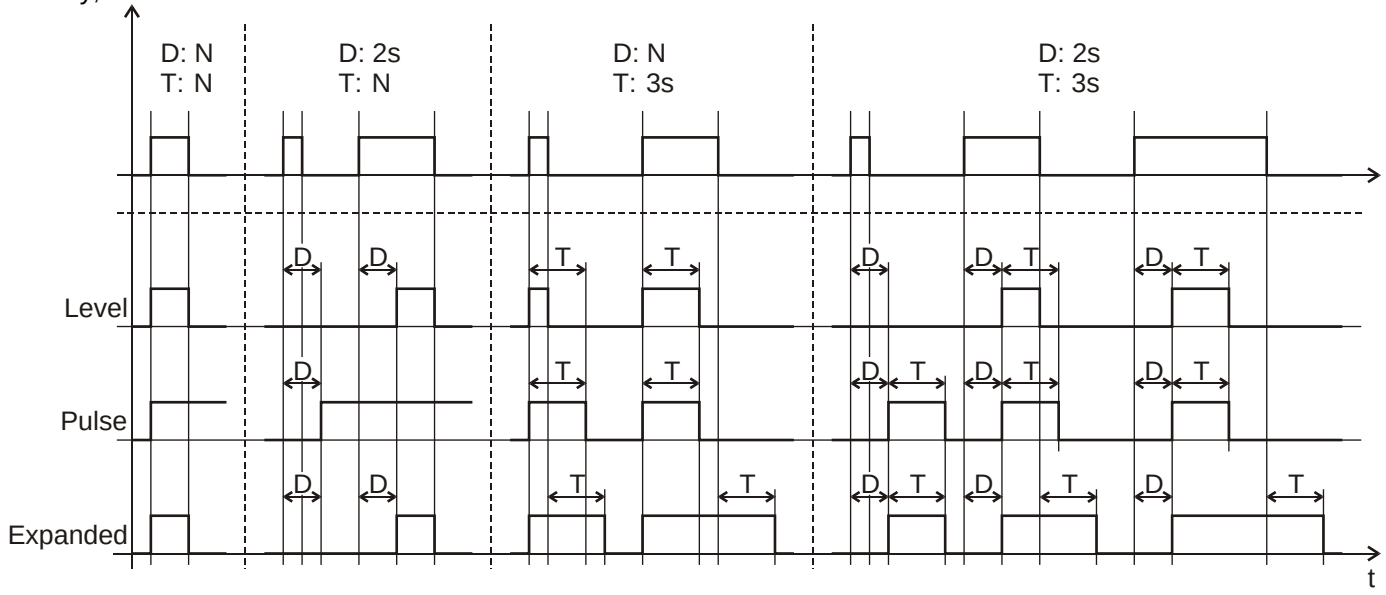
Timings

The timer serves delaying the active state of an internal signal, or limiting the active state. This internal signal can be digital output, comparator output, time interval or digital input.

Submenu	Explanation, further submenus	Values	Default setting	Unit
5-16 timing 1.	For filtering a signal or for limiting its duration.			
	5-16-1 type level: The timer's output will be active, if its input is still active even after the delay time has elapsed. pulse: If the timer's input was active even for a short time, then after the delay time has elapsed its output will be active. extended: The time limit starts after the falling edge and its output will be inactive only after it has elapsed.	level pulse extended	level	
	5-16-2 take effect The parameter, the timer should have effect on. In case of selecting a digital output, e.g. pulling of a relay can be delayed, and also its operating time can be limited. In case of selecting a digital input, e.g. delayed start, or operation for a given time can be achieved without using a time relay. ** digital OUT 3 at VLD and VHD types only* *** digital IN 7-8 at VLD and VHD types only*	digital OUT 1 digital OUT 2 digital OUT 3 * compare 1 compare 2 compare 3 period 1,2,3 period 1 period 2 period 3 digital IN 1-8 **	digital OUT 1	
	5-16-3 time Time interval limitation	N 0,01 - 3600,0	N	s
	5-16-4 delay After activation	N 0,01 - 3600,0	N	s
5-17 timing 2.	The setting is the same as that of item **5-16 timing 1.**			
5-18 timing 3.				

Example for the operation of the timer

D: delay, T: time limit



Comparators

With the comparators, different variables can be compared e.g. the actual value of the motor current can be compared with a preset value, and accordingly a digital output or a virtual input can be operated.

Submenu	Explanation, further submenus	Values	Default setting	Unit
5-21 comparator 1.	The comparator handles all parameters uniformly in percentage! For the motor parameters, the nominal value means the 100%.			
	5-21-1 type	one time window	one time	
	5-21-2 signal source Interpretation of the 100% values: frequency 100Hz Imotor In Umotor Un Udc 1000V Unet 1000V Pinp. Pn control ref. s. 100Hz mod. cont. ref. s. 100Hz reg. ref. s. 100% mod. reg. ref. s. 100% feedback 100% error signal 100% analogue IN 1,2,3,4 10V / 20mA analogue IN 1-2,3-4 10V / 20mA counter 1,2,3 10000 run time 1,2 1000h heatsink 100°C n n sync. n ENC n 100% (**4-31-2**) torque Mn Pbrake average 100% Pbrake current 100%	frequency Imotor Umotor Udc Unet Pinp. control ref. s. mod. cont. ref. s. reg. ref. s. mod. reg. ref. s. feedback error signal an. IN1 an. IN2 an. IN3 an. IN4 an. IN1-2 an. IN3-4 counter 1 counter 2 counter 3 run time 1 run time 2 heatsink n n ENC torque Pbrake average Pbrake current	frequency	
	5-21-3 value 1.	0,00 - 300,00	90,00	%
	5-21-4 value 2. (at window comparator only)	0,00 - 300,00	95,00	%
	5-21-5 hysteresis	0,00 - 300,00	1,00	%
	5-21-6 type normal: Gives signal above the comparation level. inverse: Gives signal below the comparation level.	normal inverse	normal	
	5-21-7 run in start: the comparator output changes in start only, according to the settings **5-21-1** to **5-21-6**. In stop its output is inactive.	always in start	always	
5-22 comparator 2.	The setting is the same as that of item **5-21 comparator 1.**			
5-23 comparator 3.				

Time periods

With the use of the time intervals operation according to the calendar can be set. There is possibility for setting every day, every weekday or operation intervals repeated in each week!

„Time interval1,2,3" is active, if any time interval is in switched-on state.

i	Take care of the correct setting of the calendar in menu **11 System**!

Submenu	Explanation, further submenus	Values	Default setting	Unit
5-26 period 1.	Here the times of the switch-on and switch-off of the first time interval can be set.			
	5-26-1 on			
	5-26-1-1 day	no every day Monday Tuesday Wednesday Thursday Friday Saturday Sunday weekdays	no	
	5-26-1-2 hour	0 - 23	0	
	5-26-1-3 minute	0 - 59	0	
	5-26-1-4 second	0 - 59	0	
	5-26-2 off			
	5-26-2-1 day	no every day Monday Tuesday Wednesday Thursday Friday Saturday Sunday weekdays	no	
	5-26-2-2 hour	0 - 23	0	
	5-26-2-3 minute	0 - 59	0	
	5-26-2-4 second	0 - 59	0	
5-27 period 2.	The setting is the same as that of item **5-26 time interval 1.**			
5-28 period 3.				

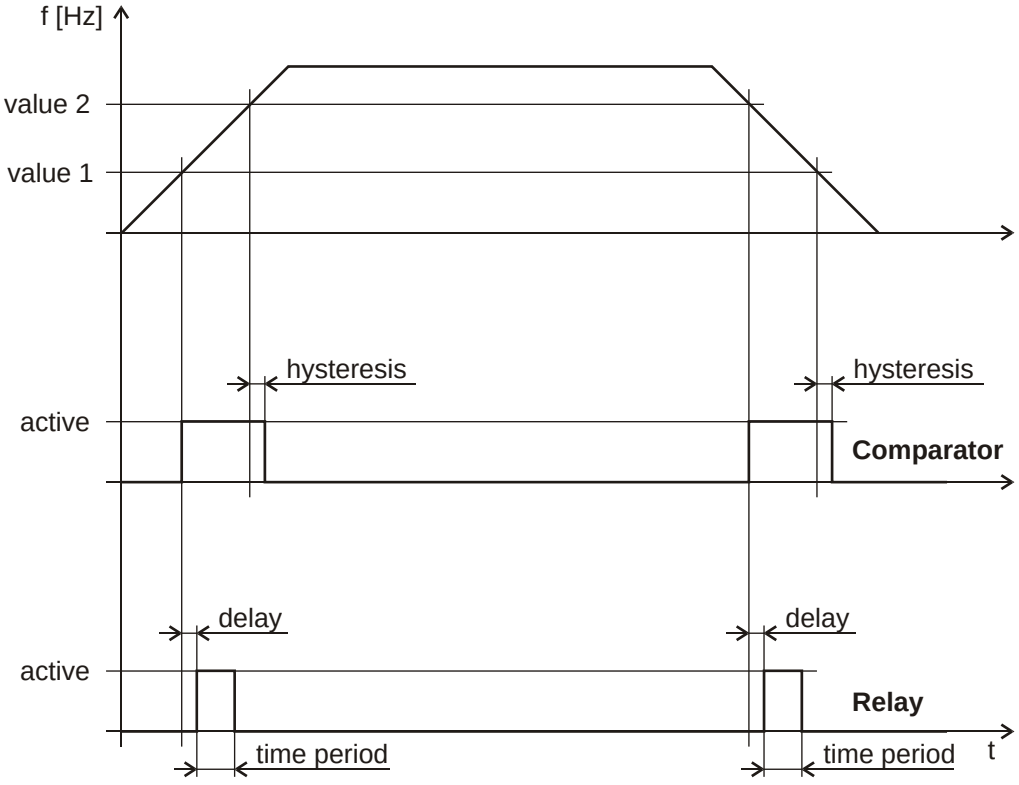
5-29 PID extension	The PID extension makes it possible to supplement 1 regulated unit even with further 3 fix switchable units (e.g. pressure control for more than one pump).			
	5-29-1 turn on delay The time elapsing after reaching fmax until the switch-on of the next unit.	0,0 - 5000,0	10,0	s
	5-29-2 turn off delay The time elapsing after reaching fmin until the switch-off of the next unit.	0,0 - 5000,0	10,0	s
	5-29-3 hysteresis The switch-on and switch-off delay starts in this distance from fmax and fmin.	0,0 - 100,0	1,0	Hz

Example for the operation of the digital output, timer and comparator

These settings make it possible to have a delayed signal assigned to any value of a selected parameter, which can be visualized at digital output, too.

Similar settings can be applied to any comparator and digital output

- comparator 1 mode: window
- comparator 1 source: frequency
  (at comparator 1, value 1, value 2 and the hysteresis set according to demand).
- digital output 1 source: comparator 1
- timer 1 effects: digital output 1
  (at timer 1, the time period and the delay set according to demand)



6. Motor menu

In this menu, the motor connected to the frequency converter, and the special parameters needed for the operation of the motor can be set.

Followings can be set here:

- nominal motor data,
- cooling mode,
- torque and motor current limits,
- tilt prevention,
- motor test,
- parameters of the vector mode,
- control modes

Submenu	Explanation, further submenus	Values	Default setting	Unit
6-1 Pn nominal power	Nominal output power of the motor. To be set accurately for the torque limitation.	type-dependent	type-dependent	kW
6-2 Un nominal voltage	The nominal line voltage of the motor. If fmotor ≥ fn, this voltage gets to the motor. This item sets the upper voltage corner point of the U/f curve.	90,0 - 440,0V	400,0V	V
6-3 fn nominal frequency	The frequency belonging to the nominal voltage. This item sets the upper frequency corner point of the U/f curve.	25,0 - 1000,0	50	Hz
6-4 In nominal current	Nominal motor current. The 100% thermal model belongs to this! The value of this current modified with the current limit can develop as a maximum, if it is lower than the I inverter limit!	type-dependent	type-dependent	A
6-5 nn nominal rotation speed	The rotation speed at nominal load. At the displays it can be used as orientation data in function of the load.	100 - 30000	1450	f/min
6-6 cooling type	For the thermal modelling of the motor. In case of forced cooling, even at low frequencies (below 10 Hz), the motor can be durably loaded up to the nominal torque. Beyond them, the thermal time constant of the motor depends also on the size of the motor, that is on Pn.	internal external	internal	
6-7 limit				
	6-7-1 current The current value the frequency converter does not permit to exceed. It modifies the frequency in order to reduce the load, or it stops with error message, if the load does not decrease or the tilt prevention is disabled. The 500% cannot always be utilized, because this depends also on the motor data and the maximum capability of the frequency converter! 100% means the nominal motor current.	10 - 500	110	%
	6-7-2 torque The torque value the frequency converter does not permit to exceed. It modifies the frequency in order to reduce the load, or it stops with error message, if the load does not decrease or the tilt prevention is disabled. The 500% cannot always be utilized, because this depends also on the motor data and the maximum capability of the frequency converter! 100% means the motor current producing nominal torque.	10 - 500	250	%

Submenu	Explanation, further submenus	Values	Default setting	Unit
	6-7-3 heat Correction of the calculated thermal model. (The user can make the modification according to the ambient thermal load of the motor.) In colder ambience, higher load is permissible for the motor.	50 - 200	120	%
6-9 torque limit	In case of motor overloading the frequency converter reduces the frequency, in case of generator overloading it raises the frequency according to the extent of the tilt prevention (menu **6-9-2**). If setting "No" here, the overloading cannot be reduced, thus at reaching the overcurrent it stops with error message.			
	6-9-1 permission	motor motor / gen. no	motor	
	6-9-2 extent The time needed for the frequency to be pulled back from fmax to 0 at 100 % current overrun.	4-10000	100	ms
6-10 test	**⚠ CAUTION** Prior to the test the nominal parameters of the motor have to be set! In case of testing the running motor, it has to be assured that the motor axle is not loaded and mechanical damage cannot occur! At activating the frequency converter performs a motor test. Test of the standing motor can be performed anytime.	no standing rotating	no	
6-11 R stator meas.	In vector mode (**6-28 mode**) after giving start, should the equipment perform a dc stator resistance measurement or not. The measurement limits the rotation of the motor for a short time, it will start later, but the equipment will operate with a more accurate stator resistance value.	no yes	no	

i	The default values in the motor menu depend on the nominal current and voltage of the frequency converter, too. For reliable motor protection, the nominal motor parameters must be set. (Pn , In ,Un , fn , cooling type, thermal limit)..
	Setting the motor parameters affects the scaling of the analogue outputs (see at menu **5 Outputs**).

Programming vector mode frequency converters (with IRE)

Parameters to be set at vector type operation

6.1 nominal power (Pn) from the motor data plate
6.2 nominal voltage (Un) from the motor data plate
6.4 nominal current (In) from the motor data plate
6.5 nominal rotation speed (nn) from the motor data plate
6.9.1. tilt prevention enable motor type/generator type

Setting of the other parameters is to be made in the usual way. (control reference signal, source of the regulation reference signal, IRE, etc.)

6.10 test in this menu motor test has to be performed, first on the standing motor, then on the running motor!

Submenu	Explanation, further submenus	Values	Default setting	Unit
6-12 n maximum	The maximum rotation speed occurring at the given application. At identifying the magnetization curve, the motor test suits the section with weakened field between the nominal point and this point.	1 - 30000	3000	fp
6-13 R stator	Resistance of the stator in %, given from the nominal parameters of the motor. The frequency converter measures it with test on the standing motor. It effects the parameters of the current control	0,00 - 100,00	5,00	%
6-14 L stator	Stator dispersion inductivity in %. The frequency converter measures it with test on the standing motor. It effects the parameters of the current control.	0,00 - 100,00	10,00	%
6-15 magnetizing current	The magnetizing current belonging to the nominal flux, given in % of In. It will be measured by the frequency converter with the running motor test. If the motor is to be used with reduced flux, then prior to performing the running motor test the nominal voltage and power of the motor has to be reduced to 80-90% of the clamp data. When reducing the frequency, the motor runs more silently, around 50 Hz it runs more quietly, but the available torque slightly decreases.	0,0 - 100,0	50,0	%
6-16 linearity of the magnetizing current	Specifying the magnetization curve: 100% → fully linear approximation. 60% → in the nominal point, 60 % of the curve is given by the linear component and 40 % by the non-linear component. The frequency converter measures here using the running motor test.	0,0 - 100,0	100,0	%
6-17 exponent of the magnetising current	Exponent of the non-linear component of the magnetization current. **6-16 linearity of the magnetizing current** = at 100% it does not make sense. If both weakening of the field and high dynamic is required, the magnetization curve of the motor has to be identified accurately. The more suitable one is to be selected.	0 - 31	7	
6-18 R rotor correction	Correction of the rotor resistance calculated from the motor clamp data. If given not right, the same torque can only be achieved with larger current. For good dynamic with cold motor, this value is to be set typically lower by some percent. The nominal motor data concerns warm motor.	0,0 - 200,0	100,0	%
6-19 nominal start time	The time needed for achieving the nominal rotation speed with the nominal current. Its setting makes influence to the rotation speed control.	10 - 6500	40	ms

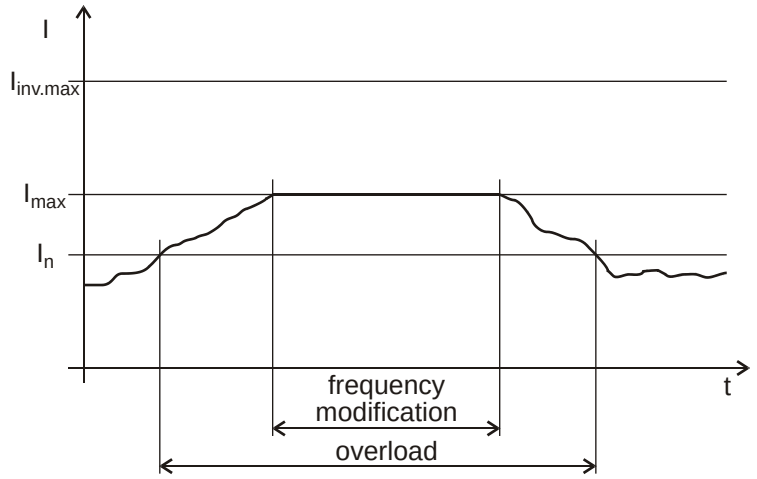
Submenu	Explanation, further submenus	Values	Default setting	Unit
6-20 I regulator	Correction of the regulator parameters calculated from the motor data. Higher values permit faster response, while lower values permit more quiet and silent running.			
	6-20-1 proportional effect	0 - 500	100	%
	6-20-2 integrating effect	0 - 500	100	%
6-22 n regulator	Correction of the regulator parameters calculated from the motor data and the nominal starting time. Higher values permit faster response, while lower values permit more quiet and silent running. Slow-down of the regulator may be necessary typically because of the eccentric fastening of the rotation speed signal transmitter. In this case, in order to prevent overshot, the integrating effect is to be taken back in a larger extent than the proportional effect.			
	6-22-1 proportional effect	0 - 600,00	100,00	%
	6-22-2 integrating effect	0 - 600,00	100,00	%
6-23 field weakening	In interval with field weakening, the extent the motor voltage approaches the sinusoidal voltage, which can be given out based on the actual DC voltage. To this value the U reserve belongs. If the U reserve is larger than 100%, it tries to give out a larger voltage than U sinusoidal, but this can succeed only, if **11-8-2 Umotor sinusoidal** is set to "No".			
	6-23-1 U spare Reference signal belonging to the drive.	80 - 120	90	%
	6-23-2 drive regulation			
	6-23-2-1 proportional effect	0 - 30000	100	%
	6-23-2-2 integrating effect	0 - 3000	100	%
	6-23-2-3 filter	0 - 3000	100	%
	6-23-3 flux regulation proportional effect Proportional parameter of the flux regulation.	30 - 500	100	%
	6-23-4 minimum Minimum value of the field weakening.	10 - 100	40	%
6-24 sensorless				
	6-24-4 t speed filter The filtering time constant of the angular speed calculation in the switching period time.	1 - 100	10	
	6-24-5 v=0 Ulim. Voltage limit of the zero speed estimation.	0,00 - 10,00	1,00	%
	6-24-7 Uerror limit Allowed error in the estimation of the voltage. If the induced voltage is durable below this value, then for the protection against getting stuck the equipment tries to move in the direction opposite to the reference signal, using the **6-24-8 excitation fmax** reference signal.	0,00 - 10,00	1,00	%
	6-24-8 excitation fmax Excitation frequency limit.	0,01 - 10,00	1,00	Hz
6-25 blocking	At operation with signal transmitter, it can be checked if the rotation speed feedback signal arrives from the incremental rotation speed signal transmitter.			
	6-25-1 n minimum	N 1 - 1500	150	fp
	6-25-2 blocking time The equipment gives blocking error signal, if over the preset time, the perceived rotation is under the minimum and the equipment runs with torque limit. The error signal can be inhibited if the **6-25-1 Minimum rotation speed** is set to N.	0,01 - 60,00	1,00	s

Submenu	Explanation, further submenus	Values	Default setting	Unit
6-26 R rotor adaptation	Whether the effect of warming should be considered at the rotor resistance. With the warming of the motor the rotor resistance changes.	no yes	no	
6-27 sync. offset	It is important for the synchronous motor. The angular position between the absolute position sensor and the rotor can be set here.	0 - 360	0	°
6-28 type	Operating modes: U/f: Voltage/frequency control. encoder: Field oriented drive with incremental rotation speed signal transmitter. vector: Field-oriented drive without signal transmitter.	U/f FOC Sensorless	U/f	

Procedure of the empirical setting of the rotation control parameters in vector operation mode:

- **6-22-2 integrating effect** = in case of 0 the **6-22-1 proportional effect** has to be increased until high frequency swingings occur (they can also be heard). This is expedient to be tested at both lower and higher rotation speeds.
- Reduce the **6-22-1 proportional effect** value to its half or two-thirds.
- Raise the **6-22-2 integrating effect** until the motor follows the rotation speed reference signal without overshot.

The motor current vs. time

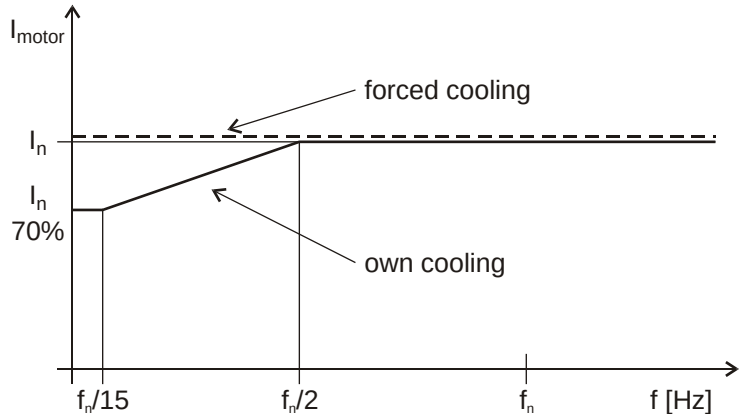


$I_{max}=I_n \cdot$current limit

e.g.: I_n=4 A
current limit=120 %
$I_{inv.max}$=9 A
I_{max}=4 A ·1,2=4,8 A
$\hat{I}_{max}=4{,}8\cdot\sqrt{2}=6{,}79$ A

Since $I_{inv.max}>\hat{I}_{max}$, if necessary even this current can develop.

Permissible steady motor current vs. frequency



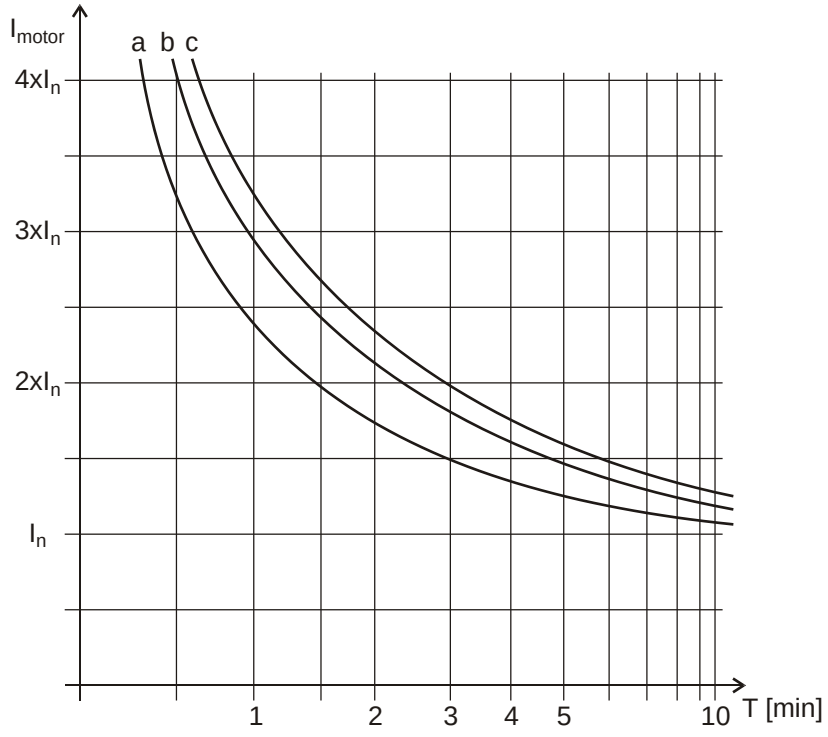
If the motor has its own cooling only, to avoid overheating, it can only be loaded with a portion of its nominal current as given in the graph in the function of the frequency!

With forced cooling the motor can be loaded with its nominal current in the whole frequency range.

The effect of the ambient temperature can be taken into consideration using the heat limit.

E.g. the 120% heat limit puts each point of the curve upwards by 20%.

Permissible motor overcurrent vs. time



- **a** motor power below 3kW
- **b** motor power between 3 kW and 20kW
- **c** motor power above 20kW

In case of forced cooling, for the time given in the graph the motor can be loaded with a current higher than the nominal current, without overheating!

The effect of the ambient temperature can be taken into consideration using the heat limit.

E.g. the 120% heat limit puts each point of the curve upwards by 20%.

In case of own cooling, this curve will modify in function of the frequency according to the previous graph

7. U/f ratio menu

In this menu the voltage vs. frequency curve can be given or modified.

Followings can be set here:

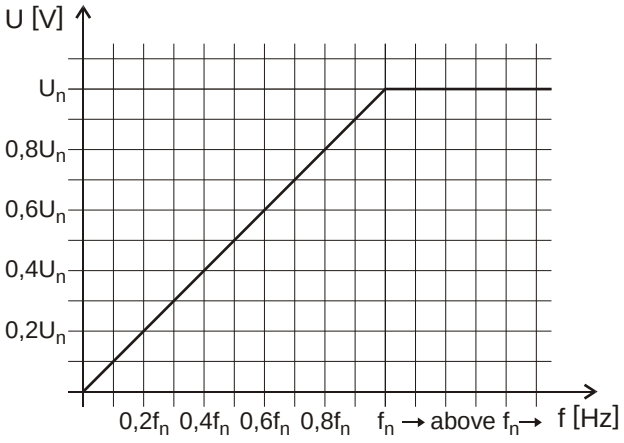
- typical characteristics,
- U/f modifications,
- points of any frequency vs. voltage curve

Submenu	Explanation, further submenus	Values	Default setting	Unit
7-1 characteristic types	This value has to be set according to the torque requirement of the driven machinery. In general case for normal (linear) pump or ventilator a characteristic modified to quadratic is desirable. (In the torque vs. frequency curve the first means a curve with constant torque and the second means a curve with linear increasing torque.)	linear user	linear	
7-2 U/f modification	Here the voltage value necessary to assure the initial flux can be set, and the normal characteristic can be corrected. (See picture with U/f characteristics)			
	7-2-1 U boost The starting voltage to be given to the standing motor.	0 - type-dep.	type-dependent	V
	7-2-2 Quadratic characteristic modification Here the state between linear and quadratic characteristic can be set according to demand. At 0% linear, at 100% quadratic.	0 - 100	0	%
7-3 user characteristic	Creating an arbitrary voltage vs. frequency characteristic by stating corresponding points. (Between two points stated, the voltage will change in linear way.) The points have to be stated according to increasing frequencies! First point of the characteristic is always "f1" frequency - "U1" voltage, the upper corner point of the characteristic is "f6" frequency - "U6" nominal voltage below „f1" frequency - the output voltage is "U1", above „f6" frequency - "U6"			
	7-3-1 first point			
	7-3-1-1 frequency	0,1 - 1000,0	1,0	Hz
	7-3-1-2 voltage	0,0 - 440,0	8,0	V
	7-3-2 second point • • • **7-3-6 sixth point**	The setting is the same as that of item **7-3-1 first point**.		

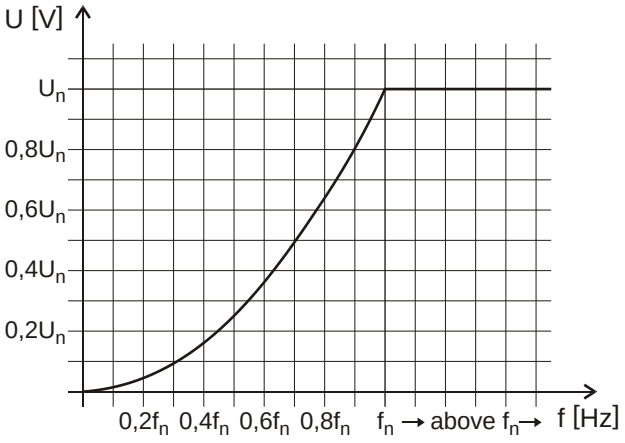
- It is practical to choose a small value for f1.
- It is practical to choose f nominal for f6. (This can substitute for setting Un.)
- At lower frequencies, it is practical to state the points closer to each other
- The U starting voltage exerts its effect at each characteristic.
- In the output motor voltage the U starting voltage is summed up quadratically with the selected characteristic, that is:

$$U_{motor}=\sqrt{U_{boost}{}^2+U_{characteristic}{}^2}$$

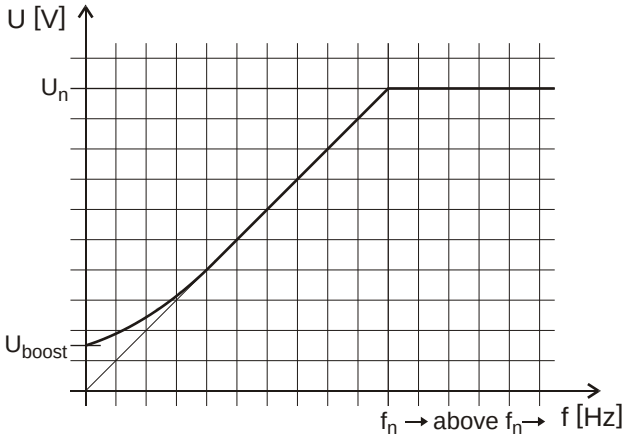
U/f characteristics



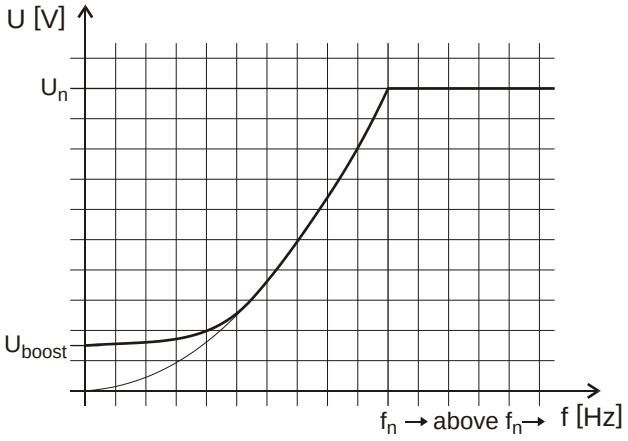
Linear U/f basic characteristic
Type characteristic: normal
Quadratic modification: 0%
U boost: 0V



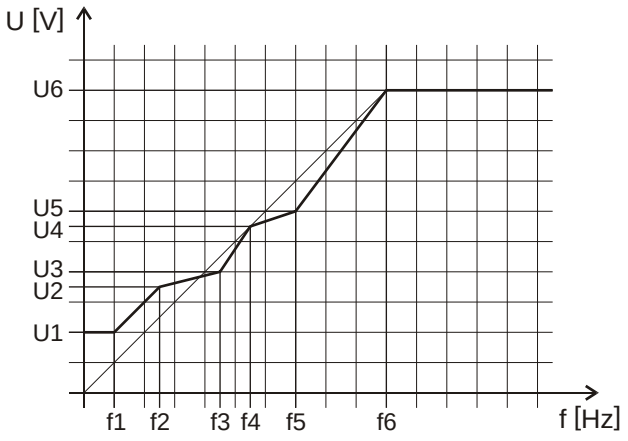
Quadratic U/f basic characteristic
Type characteristic: normal
Quadratic modification: 100%
U boost: 0V



Linear U/f user characteristic
Type characteristic: normal
Quadratic modification: 0%
U boost: preset



Quadratic U/f user characteristic
Type characteristic: normal
Quadratic modification: 100%
U boost: preset



Arbitrary U/f user characteristic

At an arbitrary U/f characteristic, between the frequency limits "0" ÷ "fmax" the voltage values "0" ÷ "Umax." can be set.

Frequencies: f1 < f2 < f3 < f4 < f5 < f6

Voltages: U1, U2, U3, U4, U5, U6

Beyond "fn" the voltage takes up the value "U6"!

The frequency value which does not fulfil the condition of monotone increase will not be taken into consideration by the program!

At any U/f characteristic, the quadratic modification is effectless.

The U starting voltage exerts its effect in this characteristic, too.

8. Frequencies menu

In this menu the frequencies connected with the complete driving can be set.

Followings can be set here:

- maximum frequency,
- minimum frequency,
- frequency inhibit limit,
- jog frequencies,
- prohibited frequencies

Submenu	Explanation, further submenus	Values	Default setting	Unit
8-1 f maximum	The highest frequency that can be given to the motor. It has priority over the minimum frequency! Even if the frequency reference signal is set higher, the f maximum will prevail! * *For V3D types without setting terminal the default setting is 100Hz*	0,01 - 1050,0	50,00 *	Hz
8-2 f minimum	The lowest frequency that can be given to the motor, except for the starting and stopping procedure. Even if the frequency reference signal is set lower, the f minimum will prevail!	0,01 - 1000,0	1,00	Hz
8-3 frequency inhibit limit	This provides protection against overrolling the driven mechanical system. (It has to be set to above fmax, to a value the driven machinery can still withstand) If the motor operated by the frequency converter will be overrolled from the driven side, the frequency converter increases the frequency to this value to avoid generator mode then stops with overfrequency error.	0,1 - 1100,0	105,0	Hz
8-4 jog normal	Low frequency discontinuous operation mode in the actual direction used generally for adjustment of the machinery. Independently of the selection of the operation mode (regulation or control), it can be operated from stop state only. It can be activated from digital (virtual) input, or depending on the setting of menu **4-8-1** from terminal. The setting time means the time of running up to the jog frequency. The mode of stopping and the fall time will comply with the default setting (menu **3**)!			
	8-4-1 frequency	0,1 - 100,0	5,0	Hz
	8-4-2 set-in time	0,1 - 300,0	5,0	s
8-5 jog inverse	The operation is similar to the normal jog operation, however in the opposite direction to the actual one. The setting is the same as that of item **8-4 jog normal**			
8-6 inhibited bands	Generally, these provide protection for the driven unit against mechanical resonance. The prohibited band lies in increasing direction from the given frequency in a width of Δf. The equipment does not give out durably the frequency in the prohibited band except for the running up and running down state. If the frequency to be given out falls in this band, the next frequency that can be given out will be given the motor.			
	8-6-1 f1 position Inhibited frequency 1.			
	8-6-1-1 frequency	0,1 - 1000,0	0,1	Hz
	8-6-1-2 band Δf inhibited bandwidth	0,0 - 10,0	0,0	Hz
	8-6-2 f2 position The setting is the same as that of item **8-6-1 f1 position**			
	8-6-2 f3 position The setting is the same as that of item **8-6-1 f1 position**			

9. Programs menu

In this menu, parameters connected with special process control services can be set.

Followings can be set here:

- counters,
- program activations,
- programs,
- program sequences

The program menu includes the counters, by which the pulses given to the input can be counted and accordingly the comparator can be activated if necessary or the equipment can be halted with stop.

With the programs the reference signal, the rise and fall steepness and the data of the PID controller can be altered in order to facilitate the adjustment of one or more technology steps.

The programs can be activated from the input. If the time of the program elapsed, it can come back to the original operation or it can switch off the machinery.

Using the sequences, the programs can be stringed in groups, thus more programs can be operated one after another.

Submenu	Explanation, further submenus	Values	Default setting	Unit
9-1 counter 1.	**i** If a program is selected as sequence cycle, its cycle counter will be the counter with identical number.			
	9-1-1 type The actual value of the counter corresponds to the commands of the "up", "down" and "write" inputs selected to the digital or virtual inputs. normal: The actual value can only be inspected, intervention will not be made. start 0: On start it takes the state of „value". stop 0: On reaching the 0 value it effects stop, but at start it takes the state of „value". store: The equipment saves the value of the counter even after switching off the operating voltage.	normal start 0 stop 0 store	normal	
	9-1-2 level	0 - 10000	0	
9-2 counter 2.	The setting is the same as that of item **9-1 counter 1.**			
9-3 counter 3.				

9-10 program activation	Setting the individual activation of the programs			
	9-10-1 selection disabled: when set, the individual activation of the programs can be disabled simultaneously, independently of their selections.	disable connect. direct by start	disable	
	9-10-3 error signal At program run, the time limitation will be effectuated on the decrease of the absolute value of the error signal below the preset value.	N 0,01 - 100,00	N	%

Submenu	Explanation, further submenus	Values	Default setting	Unit
	9-10-4 type This refers to the input activating the program! level: The program runs until the input is active. pulse: The program starts on pulse, its stop can be effectuated by the end of the time limit, a stop given from an input, or program disabling etc. The time of the pulse has to be longer than the bounce filtering time set in menu **4-9-5**.	level pulse	level	
	9-10-5 filter The time elapsing between setting the inputs and activating the program, at activating a binary program. Filtering is useful, if selecting the binary program will be made manually, with switches, or with a rotating knob giving binary code. With setting the proper value of the filtering, any incidental program start can be avoided. The bounce filtering of the digital inputs has its effect even before that.	0 - 60000	500	ms
	9-10-6 end The event to be happen after finishing the program. normal: Finishing the programs does not release stop command. stop: Finishing the programs releases also stop.	normal stop	normal	
9-11 program 1.	Enabling the program 1, setting the program parameters level. The lower is the number of the program, the higher is its priority. The priority of the programs is higher than that of the sequences.			
	9-11-1 selection The programs which need to be operated are to be set from "disabled". Selecting regulation or control overrides the operation mode of the default setting, but not the operation mode assigned at the input!	disable active control regulation	disable	
	9-11-2 operation normal: When selected, the direction set in the default setting remains unchanged. inverse: When selected, the default direction will be changed. waiting: Its setting effects waiting mode.	normal inverse wait	normal	
	9-11-3 parameters The parameters set not to „N" overwrite the originally valid values during the program run. The rise and fall times, depending on the mode, set the steepness limit of the regulation or control.			
	9-11-3-1 frequency Control reference signal	N 0,01 - 1000,0	N	Hz
	9-11-3-2 regulation reference signal	N 0,01 - 100,00	N	%
	9-11-3-3 rise time	N 0,1 - 3000,0	N	s
	9-11-3-4 fall time	N 0,1 - 3000,0	N	s
	9-11-3-5 PID selection	N 1 - 4	N	
	9-11-3-6 time limit	N 0,00 - 3276,7	N	s

Submenu	Explanation, further submenus	Values	Default setting	Unit
9-12 program 2. • • • **9-25 program 15.**	The setting is the same as that of item **9-11 program 1.**			
9-26 sequence 1.	Program group can be created by appointing any number of programs (programs 1 to 15). On activating the sequence, the programs in the sequence run down one after another, according to their priority. A running program in the sequence can be interrupted by a program of higher priority or by a sequence of higher priority than that of the actual sequence. Also among the sequences, the one with lower number has the higher priority.			
	9-26-1 activate Setting the mode of activating the sequence.	disable connect. direct by start	disable	
	9-26-2 type single: The programs in the sequence will be performed once only, after that the operation continues according to the setting in menu item **9-26-5**. cyclic: The programs in the sequence will be performed cyclic until some inhibitory condition prevents it. e.g.- change of the activating input - the cycle counter got to zero - other input causes interruption The cycle counter is always the counter with the number identical with the given sequence, if the sequence is of cyclic type. In this case attention has to paid to the right setting of the counter. endless: The programs in the sequence repeat continuously.	once cyclic endless	once	
	9-26-3 error signal At running the program, the time duration limit is released by the decrease of the error signal below the preset value.	N 0,01 - 100,00	N	%
	9-26-4 type This refers to the input activating the sequence! level: The sequence runs until the input is active. pulse: The sequence starts on pulse, and its stop can be effected by the end of the cycle, by the cycle counter or by a stop, program inhibit etc. given from an input. The time of the pulse has to be longer than the bounce filtering time set in menu **4-9-5**.	level pulse	level	
	9-26-5 end The event to be happen after finishing the program or program group. normal: Finishing the programs does not cause stop command. stop: Finishing the programs causes stop at the same time.	normal stop	normal	

Submenu	Explanation, further submenus	Values	Default setting	Unit
	9-26-6 group			
	9-26-6-1 begin The program group starts at the program with this number.	N 1 - 15	1	
	9-26-6-2 end The program group stops at the program with this number. If the end of the program group is smaller than its beginning, the sequence will not be performed.	1 - 15	1	
9-27 sequence 2.	The setting is the same as that of item **9-26 sequence 1.**			
9-28 sequence 3.				

Activation of the programs and sequences (programs 1 - 15, sequences 1 - 3)

At activation from the **terminal blocks** the permitted programs, sequences (even more than one) can be activated from digital or virtual inputs, at any point of time. The condition of their operation is that the frequency converter is in start state.

At direct start, the activation effects also start at the same time, independently of the start switches.
At the end of the sequence, according to the menu items **type** and **end**, the program returns to the default setting, it stops or repeats cyclic.
In case of selecting cycle, if the activation ceases, the equipment returns to the default setting or stops, according to the settings. At repeated activation, the cyclic operation starts again!
The programs and sequences in case of activation (in order of their priorities) take over the operation from the default setting. If a program or sequence gives over the control because its time elapsed, it can only be started again, if it will be activated after an inactive state! (That is, the input is to be switched off and on!)

At activation in case of **Start,** the permitted program or sequence will be started by the start command. In this case, no digital inputs are needed for running.

At the end of running, it returns to the default setting according to the menu item **end**, it stops, or repeats cyclic.

The commands stop, spin out and DC brake can stop the operation!

Example for activating from the terminal block

If for any parameter the value "N" is set, it means that in case of this parameter the program takes into consideration the default setting!

If in Program 1 the setting is N, 32.0%, N, N, 5s, then at activating the actual digital input:

- in case of regulation the default setting prevails, because the regulation reference signal is not active,
- in case of control, the reference signal of the used control is 32.0%, independently of the value of the selected reference signal source (potentiometer, terminal),
- rise and fall of the reference signal occurs according to the default setting,
- the time duration is limited to 5s.

Since the time duration is set to 5s, this state will exist for 5s after the beginning of the program run, and independently of the level the drive reached, after 5s the reference signal of the originally selected reference signal source will prevail.

However, if also **program 2** is activated, then after the elapse of time 1, the operation continues with the parameters set in **program 2**.

Consequently, if e.g. a 4-steps program is to be performed, then activating inputs **program 1 to program 4** have to be joined up, and activated at the same time during start, when the programs are to be started.

(In lack of start, the run of the programs written on the activated inputs starts at the appearance of the start command.)

A simpler solution of the previous task is if the previous 4 programs will be designated as the programs to be performed of a sequence, since in this case only the sequence needs to be activated with an input, and the programs will run in the way described previously.

If during operation an input of higher priority activates again, then it will take back the operation from the one of lower priority!

10. Displays menu

In this menu settings connected with the appearance of the display can be made.

Followings can be set here:

- the values to be displayed by row,
- productivity matchings,
- individual dimensions,
- display with large characters,
- consumption meter,
- active menu setting

Submenu	Explanation, further submenus	Values	Default setting	Unit
10-1 row 1.	Here, the parameter to be displayed in row 1 in DISPLAY mode can be selected	*values which can be displayed (see below)*	status	-
10-2 row 2.	The setting is the same as that of item **10-1 row 1.**		operational mode	-
10-3 row 3.			f	A
10-4 row 4.			Imotor	Hz

i	The **11-5-1 remote control identifier** appearing on the last one or two characters of the first row has priority over the displayed value. At selecting it, it has to be assured that the text to be written in this row will be not too long.

Displayable items

Parameter	Description	Unit
status	status feedback	-
mode	mode feedback	-
prod.1	productivity 1	-individ.-
prod.2 (–)	productivity 2	-individ.-
prod.3 (–)	productivity 3	-individ.-
prod.4 (–)	productivity 4	-individ.-
f	frequency (actual)	Hz
Imotor	motor current	A
Umotor	motor terminal voltage	V
Udc	Intermediate circuit dc voltage	V
Unet	power line voltage (calculated)	V
Pinp.	power consumption	kW
c. ref.	control reference signal	Hz
m. c. ref. (–)	modified control ref. signal	Hz
reg. ref.	regulation reference signal	%
mod. ref. (–)	modified regulation ref. signal	%
feedback	regulation feedback signal	%
err.sig.	error signal	%
an. IN1	analogue IN1 input	-individ.-
an. IN2	analogue IN2 input	-individ.-
an. IN3 (–)	analogue IN3 input	-individ.-
an. IN4 (–)	analogue IN4 input	-individ.-

Parameter	Description	Unit
an. IN1-2 (–)	difference of analogue IN 1-2	-individ.-
an. IN3-4 (–)	difference of analogue IN 3-4	-individ.-
counter 1 (–)	counter 1 actual state	-
counter 2 (–)	counter 2 actual state	-
counter 3 (–)	counter 3 actual state	-
run time 1	total service hour counter	hour
run time 2	"Run" service hour counter	hour
heatsink	heat sink temperature	°C
n	motor rot. speed (calculated)	rpm
n ENC (–)	rotation speed (measured)	revol.
torque	calculated torque	Nm
P br. ave.(–)	average resistor brake load	%
P br. curr.(–)	momentary resistor brake load	%
dig. IN	state of digital inputs	-
dig. OUT	state of digital outputs	-
mod.mpot (–)	modified mot. potentiometer	%
clock	date and time	-
Econs.a. (–)	total energy consumption	kWh
En.cons. (–)	energy consumpt. (resettable)	kWh
empty row (–)		-

Editing paged values

In row 4, the items paged with knobs ▲ ▼ in the display can be edited.

Any item can be removed from the items paged in the display, using the ◄ push button. This is marked with "-" in the beginning of the row 4.

These items can be replaced among the paged items using the ► push button.

In the factory default setting some items are removed from the paged items. These items are marked with (-) in the displayable items table.

Dynamic state back indications

These items are displayed in the mid if the status row. Display happens in the moment of occurrence, and it lasts at least until the minimum perception time (approx. 0.4 sec), or until the dynamic operation state exists.

In case of more than one status to be displayed the frequency converter displays all of them sequentially one after the other (changing approx. in each 0.8 sec).

The possible dynamic operation states

Displayed text	Explanation
! Error !	Error occurred. On pushing the "Escape" button, it will be jumped to the error menu where the error can be inspected
U DC<>	The DC voltage in the intermediate circuit is too low or too high for the operation. The equipment cannot receive start command
Stop	Stop state is forced to the equipment (e.g. from digital input). The equipment cannot receive start command
DC brake	This signals the operation of the DC brake (**3-5 mode of stop** mixed or DC brake, or continuous DC brake command from digital input)
Spin out	Signals the motor stop with spin out (**3-5 mode of stop** spin out or continuous spin out command from digital input)
Stop	Appears in case of stop during the run down of the frequency.
f hold	Frequency change inhibited (e.g. from digital input)
Jog	Jog command is active (e.g. from digital input or from programming terminal)
Counter stop	Some of the counters programmed to **stop 0** reached the 0 value and released stop.
Mpot.stp	Stop command given with motorized potentiometer.
AnIN.stp	Stop command given with analogue input.
Virt.stp	Virtual input programmed to stop is active (e.g. active comparator)
Waiting	Suspension of the start state (e.g. regulation stop or waiting command from digital input)
R brake	Signals the operation of the resistor brake.
Prog.1-15.	The program with the given number is active.
Tiemint.	Some of the time intervals is active.
U DC lim	The DC voltage in the intermediate circuit is in the lower or upper operation limit.
M.limit	The frequency converter reached the preset torque limit.
I.limit	The frequency converter reached the preset current limit.
Gen.mode	The motor feeds back in the frequency converter (e.g. fast stop)
Mot.pot.	The value of the motorized potentiometer changed.
St.confl.	Conflicting start inputs (start normal and start inverse) are selected.
Contr.stp	Stop command given because of low error signal.

Productivities

Using the productivity parameters, there is possibility to display any technology value, which is in linear conjunction with some parameter selectable in the **10-x-1 selection** menu.

This proportionality can be established with a compliance value assigned to the nominal value or to 100%.

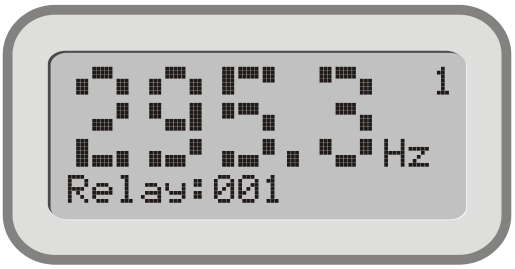
Four different productivity values can be set.

Submenu	Explanation, further submenus	Values	Default setting	Unit
10-7 productivity 1.				
	10-7-1 selection Interpretation of the 100% values: frequency 100Hz Imotor In Umotor Un Udc 1000V Unet 1000V Pinp. Pn control ref. s. 100Hz mod. cont. ref. s. 100Hz reg. ref. s. 100% mod. reg. ref. s. 100% feedback 100% error signal 100% analogue IN 1,2,3,4 10V / 20mA analogue IN 1-2,3-4 10V / 20mA counter 1,2,3 10000 run time 1,2 1000h heatsink 100°C n n sync. n ENC n 100% (**4-31-2**) torque Mn Pbrake average 100% Pbrake current 100%	frequency Imotor Umotor Udc Unet Pinp. control ref. s. mod. cont. ref. s. reg. ref. s. mod. reg. ref. s. feedback error signal an. IN1 an. IN2 an. IN3 an. IN4 an. IN1-2 an. IN3-4 counter 1 counter 2 counter 3 run time 1 run time 2 heatsink n n ENC torque Pbrake average Pbrake current	frequency	
	10-7-4 correspondence	0,1 - 6000,0	1,0	
	10-7-5 dimension In menu items **10-11-1** and **10-11-2** further two dimensions can be defined.	- percent % quantity mass kg mass t length mm length m speed m/s speed m/m speed km/h volume l volume m3 rpm pressure bar pressure Pa temperature °C frequency Hz user 1 user 2	-	 % pcs kg t mm m m/s m/m km/h l m3 f/p bar Pa °C Hz
	10-7-6 name	xxxxxxxx	prod1	

Submenu	Explanation, further submenus	Values	Default setting	Unit
10-8 productivity 2.	The setting is the same as that of item **10-7 productivity 1.**			
10-9 productivity 3.				
10-10 productivity 4.				
10-11 user define	Setting the individual dimensions up to 4 characters.			
	10-11-1 unit 1	xxxx	page	
	10-11-2 unit 2	xxxx	lath	

Display image with big characters

Submenu	Explanation, further submenus	Values	Default setting	Unit
10-12 big characters	Visualizes row 3 of the display in the size of the first three rows After the value, the dimension is displayed in normal size. If the row to be displayed cannot be written in maximum 4 characters + dimension format (e.g. status, dig. IN etc.), the big character display is not available!	no yes	no	



← Row 3 of display **(295,3 Hz)**

i	In case of big character display, at the item in row 4 the accented characters will be displayed with normal characters!

Submenu	Explanation, further submenus	Values	Default setting	Unit
10-13 consumption meter clear	Sets the consumption meter to zero. Useful e.g. at measuring the energy consumption in a month. The counters of all consumption meters will only be cleared using clear with log.	clear		
10-14 active menu	Sets the menu that can be accessed with the setting terminal. With setting "quick" only the quick menu can be accessed, with "all" the whole menu system can be accessed.	quick all	quick	

11. System parameters menu

In this menu, the factory set parameters and the individual system parameters relating to the frequency converter can be inspected or set.

The items here:

- operations connected with parameters,
- macros,
- remote control,
- modulation,
- slip compensation,
- data relating the output,
- language of the menu,
- CAN bus,
- terminal function,
- automatic error acknowledgement,
- event save,
- introducing password,
- menus with password.
- read only parameters (serial number, software version number)
- parameters that can be set by the manufacturer only (currents, voltages, special data, delete log)

Parameter sets

Submenu	Explanation, further submenus	Values	Default setting	Unit
11-1 parameters	memory: user parameter charts stored in the frequency converter terminal: user parameter charts stored in the terminal default: factory set parameter chart			
	11-1-1 load parameters Here factory parameters or settings saved earlier can be loaded, e.g. for setting another application. When loading from terminal, even the whole parameter set or a part of it can be uploaded from another equipment.			
	11-1-1-1 memory The parameter sets stored in the equipment can be uploaded here, according to menu items **11-1-1-3** and**11-1-1-4**.	default memory 1 memory 2 memory 3	memory 1	
	11-1-1-2 terminal The parameter sets stored in the programming terminal can be uploaded here, according to menu items **11-1-1-3** and **11-1-1-4**.	terminal 1. terminal 2. terminal 3. terminal 4.	terminal 1.	
	11-1-1-3 menu item Appointing the menu item for loading the parameters belonging under the given menu item. With appointing the menu item, the parameters will not be uploaded yet.	X-X-X-X	0-0-0-0	
	11-1-1-4 group The parameter groups to be uploaded will be given here. menu: Only the parameters belonging under the menu item given in menu **11-1-1-3** will be uploaded. all: All parameters will be uploaded. In the other cases, only the parameters belonging to the given macros will be uploaded from the memory or the terminal. With appointing the parameters to be uploaded the parameter set will not be uploaded yet.	menu all minimum ctrl.an. ctrl.ENC master/slave user.1 user.2	all	

Submenu	Explanation, further submenus	Values	Default setting	Unit
	11-1-2 save parameters The actual parameter settings can be stored in memory or terminal. After the successful setting of an application, it is worth saving the parameter set. In case of similar settings of more equipment, after having saved in the programming terminal, the parameters can be uploaded in other equipment, too.			
	11-1-2-1 memory The actual parameter set can be saved in any of the memories here. If the name of the parameter set to be saved (**11-1-4 name**) is the same as the name of a parameter set saved in the memory, then only that setting can be overwritten. More than one parameter set with the same name cannot be saved in the memory at the same time.	memory 1 memory 2 memory 3	memory 1	
	11-1-2-2 terminal The actual parameter set can be saved in a memory of the terminal here. If the name of the parameter set to be saved (**11-1-4 name**) is the same as the name of a parameter set saved in the programming terminal, then only that setting can be overwritten. More than one parameter set with the same name cannot be saved in the programmer terminal at the same time.	terminal 1. terminal 2. terminal 3. terminal 4.	terminal 1.	
	11-1-3 enable parameter modification Here can be set if the modification of the parameters is allowed.	yes no	yes	
	11-1-4 name The name of the actual parameter set can be set here in 8 characters. The name to be given should refer to the setting of the equipment or the application, so that it can easily be identified. For example: mixer, lifter, grinder, etc…	xxxxxxxx	Param 1	

Saving the parameter set

For saving the parameter set of the frequency converter, first give name to the parameter set in menu (**11-1-4 name)**. After that the parameter set can be saved in a memory of the equipment (menu item **11-1-2-1**), or in a location of the terminal (menu item **11-1-2-2**)

Loading up the parameter set

Parameter set can be loaded up from the memory (menu item **11-1-1-1**), or from terminal (**11-1-1-2** menu item). Within the menu item, selection can be made upon the names of parameter sets saved earlier. On pushing "Enter", upload of the earlier selected parameters starts.

i	Certain parameters will be loaded not in every case, or even never!

Exceptions at loading the parameters set

Depending on the source of loading or on the parameter set to be loaded, the parameters and settings below will be loaded in the following cases only (**X**):

Parameters, settings	From the frequency converter memory	From terminal memory	
		At matching type	At not matching type
3-8-1 maximum DC brake current	**X**	**X**	**-**
3-8-4 DC brake de-excitation time	**X**	**X**	**-**
3-9-2 resistor brake value	**X**	**X**	**-**
3-9-3 resistor brake value maximum load	**X**	**X**	**-**
3-9-4 resistor brake voltage	**X**	**X**	**-**
4-9-3 DC brake current	**X**	**X**	**-**
6 Motor menu (full menu item)	**X**	**X**	**-**
7-2-1 U boost	**X**	**X**	**-**
11-6-1 modulation carrier frequency	**X**	**X**	**-**
11-6-3 modulation changing frequency	**X**	**X**	**-**
11-18 manufacturing number (full menu item)	**-**	**-**	**-**
11-19 version (full menu item)	**-**	**-**	**-**
11-20 date (full menu item)	**-**	**-**	**-**
11-21 currents (full menu item)	**X**	**-**	**-**
11-22 voltages (full menu item)	**X**	**-**	**-**
11-23 special data (full menu item)	**X**	**-**	**-**
11-27 menus with password (full menu item)	**-**	**-**	**-**
User password	**-**	**-**	**-**
Installer password	**-**	**-**	**-**

Modifying parameters based on saved parameter set

There is possibility for uploading not only complete parameter sets, but also for modifying certain parameters only, based on the saved parameter set. Whether to load the complete parameter set or only a part of it can be set in menu **11-1-1-4 group**. Here macros are listed, and the parameters included in the given macro can be appointed for being uploaded. At loading a parameter set of **11-1-1-1 memory** or **11-1-1-2 terminal,** only the parameters appointed in the **11-1-1-4 group** menu item will be loaded.

There is also possibility for loading parameters belonging under a given menu (submenu) only. E.g. if the same control is used in more equipment then it is enough to set it once, save the parameter set in the terminal, and load in the other equipment only the parameters belonging under menu **1** (or **1-6**).

For this, the menu item is to be selected in the menu **11-1-1-4 group** and in menu **11-1-1-3 menu item** the menu to be loaded is to be set: **1-0-0-0** (or **1-6-0-0**)

After this, the parameters can be loaded from the terminal in menu **11-1-1-2 terminal** as already known. By selecting in **11-1-1-3 menu item** the value **0-0-0-0,** the structure of the quick menu can be appointed for loading.

By setting in **11-1-1-3 menu item** the value **4-9-2-0,** e.g. the parameter '4 motorized potentiometers' can be loaded.

Macros

Submenu	Explanation, further submenus	Values	Default setting	Unit
11-4 Macro	This serves the limitation of the parameters displayed in the menu system. Some parameters can always be seen. Such are the **11-4-1 macro select**, the **11-25-1 select password**, and the **11-25-2 give password**.			
	11-4-1 select all: The whole menu structure is displayed. regulation base: The parameters of the regulation with base setting are displayed. control analogue: The parameters of control by analogue feedback signal are displayed (e.g. pressure control). control IRE: The parameters of control by IRE feedback signal are displayed (e.g. position control). master/slave: The parameters of equipments connected in a system are displayed. user 1 and 2: The menu items available for the user are displayed.	all minimum ctrl.an. ctrl.ENC master/slave user.1 user.2	all	
	11-4-2 change For editing the quick menu or the user macro, the macro (quick menu) to be edited can be selected here. With the programming terminal, stepping in the menu by the right and left arrows, parameters can be added to or removed from the quick menu or the user macro. At each switch-on, the equipment goes in the editing quick menu mode!	quick menu user 1. user 2.	quick menu	
	11-4-3 copy This copies one macro into the user macro set in menu **11-4-2 change**. Thus a user macro only slightly differing from a setting can easily be created. menu item: Copies the parameters belonging under the menu item given in **11-1-1-3 menu item**.	empty menu all minimum ctrl.an. ctrl.ENC master/slave user.1 user.2	all	

Using macros

The macro serves the easier overview of the huge amount of parameters in the menu system. By its use, only certain parameters will be displayed, permitting an easier overview. E.g. in case of a regulation task, select the **regulation base** setting in menu **11-4-1 load,** thus only the parameters connected with the regulation will be displayed.

Also own macros can be edited by selecting **user macro 1** or **user macro 2** in menu item **11-4-2 change**.

Those menu items will be displayed in the menu system that are listed in the macro. At stepping in the menu by the right and left arrows, parameters can be added to or removed from the user macro.

As a further possibility, also password can be assigned to the parameters in the macro, using **11-27 Password menu**, thus preventing unauthorized parameter changes.

Variable system parameters

Submenu	Explanation, further submenus	Values	Default setting	Unit
11-5 remote control	Settings needed for the remote control of the equipment. Equipments connected to the same bus must have different identifiers, but identical data transmission rates!			
	11-5-1 identifier	1 - 16	1	
	11-5-2 baudrate Data transfer rate	9k6Baud 19k2Baud 38k4Baud	38k4Baud	
	11-5-3 mode Communication mode of the MOD bus	ASCII RTU	ASCII	
	11-5-6 parity Communication parity bit of the MOD bus	no even odd	even	
11-6 modulation	Setting of the parameters connected with the PWM output voltage.			
	11-6-1 carrier frequency This menu item sets the switching frequency of the frequency converter end stage.	2000 - 15000	8000	Hz
	11-6-2 type ** flat-top in case of VLD and VHD types only*	symmetric mixed flat-top *	symmetric	
	11-6-3 changing frequency Setting the switch-over frequency is necessary at mixed The modulation. is symmetrical below and flat-top type above.	type-dep. - 500,0	type-dependent	Hz
	11-6-4 dead time compensation none: Compensation switched off. software: Estimated compensation of the threshold voltage of the diode and the IGBT, and the switch-over times. hardware: The equipment measures back the place of the switch-over and the compensation will be made based on this. This is to be used in signal transmitter or in vector mode in order to accurately establish the voltage getting on the motor.	none software hardware	software	
11-7 slip-compensation	This item permits the automatic modification of the motor frequency so that the rotation speed remains relative stable. The degree of the compensation is adjustable but care has to be taken at overcompensation (tendency to swinging, increase of the rotation speed upon load etc.)			
	11-7-1 permission	no yes	no	
	11-7-2 measure The slip calculated on the nominal and synchronous rotation speed is the 100%, therefore the right setting of the nominal rotation speed is very important. (menu **6-5**)	0,00 - 100,00	0,00	%

Submenu	Explanation, further submenus	Values	Default setting	Unit
11-8 output	Item for setting the special output parameters of the frequency converter.			
	11-8-1 no motor Option for setting error signalisation in case of not connected motor terminal block or underload.	error no error	error	
	11-8-2 Umotor sinusoidal no: The equipment tries to hold the motor voltage, until possible even on the expense of the sinusoidal form. yes: Depending on the DC voltage, the frequency converter can only compensate the motor voltage until it remains sinusoidal.	no yes	no	
11-9 language	Language of the menu system.	magyar English	magyar	
11-10 CAN bus	At master/slave relation, the slave devices receive the operation commands from the master. The contents of the CAN message – depending on the application – can be set.			
	11-10-1 type	master slave	slave	
	11-10-2 CAN message f inp: Slave hurry during running up f out: Synchronous slave application ref. signal: Load sharing in case of torque control feedback s.: Application similar to PID extension, with more frequency converters.	f inp f out ref.signal feedback signal	f out	

Explanations to the CAN bus

At selecting „**master**" the CAN bus operates as output, and sends data to the connected „**slave**" device or devices!

At selecting „**slave**" the CAN bus operates as input, and receives data from the connected „**master**" device!

In case of more independent master/slave relations, the devices can be connected through RS 485 line. Thus the devices can be operated from a common terminal or computer. In such case, the identifier of each device must be different!

Features and capabilities of the master/slave connection

- **control**

  The slave device (devices) uses the frequency reference signal received from the master device, and it has possibility for changing the frequency ratio (e.g. because of different number of poles) (menu **4-30-1**)

  slave settings: control,
  control reference signal source: CAN,
  CAN bus: slave,
  slave frequency ratio

- **regulation to rotation speed**

  slave settings: regulation,
  regulation reference signal source: CAN,
  CAN bus: slave,
  feedback signal: IRE position,
  slave data,
  IRE data

  The master and the slave(s) run at the same rotation speed from the moment of start on.

- **regulation to rotation speed, along with angle position monitoring or rotation speed ratio**

  slave settings: regulation,
  regulation reference signal source: CAN,
  CAN bus: slave,
  feedback signal: IRE position,
  slave data,
  IRE data

  After starting the slave(s) take(s) the position given by the master then the master and the slave(s) run at the preset rotation speed ratio.

  If after adjusting the machinery (jog command) the synchronous running has to be ensured from these new positions, prior to start the IRE positions must be set to zero!

  The preset angle positions are valid at rotation speed ratio = 1 only!

Submenu	Explanation, further submenus	Values	Default setting	Unit
11-12 terminal function	Selects the function of the ▲ ▼ push buttons of the programming terminal during display mode. prog. step: The programs can be stepped forward only, with the ▲ push button. The ▼ push button restarts the running program.	no display change motor. potm. program step	display change	
11-13 automatic error acknow-ledgement	In case of error due to overvoltage, overcurrent, overload, the equipment tries to acknowledge the error itself, without external intervention. This can be successful, if the cause of the error ceased in the meantime. If start state exists, even the motor starts again. The prescribed period of the errors, that can be acknowledged is ten times of the delay time. The external errors and from the virtual errors those with even numbers can be acknowledged also with automatic acknowledgement. At other errors (e.g. parameter error, RS 485 error, too hot heatsink etc. the error cannot be acknowledged, its cause has to be ceased!)			
	11-13-1 number of trials The number of allowed trials for the equipment to cease the error state. If these trials remain successful, the acknowledgement can be done with external intervention only.	N 1 - 5	N	
	11-13-2 delay time Wait out time prior to the acknowledgement trials.	1 - 5000	3	s
11-14 save event	Setting the events that will be entered in the log.			
	11-14-1 power on/off Setting if the time of the switch off and switch on will be entered in the log.	no yes	no	
	11-14-2 start/stop Setting if the time of the start and stop events will be entered in the log.	no yes	no	

Read only parameters

Submenu	Explanation, further submenus	Value
11-18 manufacturing number	Manufacturing date, type, serial number of the equipment and description of the options.	
	11-18-1 year, month	pl.: 1208
	11-18-2 power	pl.: 7,50 kW
	11-18-3 serial number	pl.: 426
	11-18-4 option	pl.: DC 700 V
	11-18-5 voltage	pl.: 400 V
	11-18-6 type	pl.: VLD
11-19 version	Version number of the program loaded in the equipment and the identifier of the hardware.	
	11-19-1 software	pl.: 8.94.11
	11-19-2 hardware	(information necessary for the manufacturer)

Date

Submenu	Explanation, further submenus	Values	Default setting	Unit
11-20 date	This setting has to be made carefully for the right use of the intervals and the logging of the events and errors!			
	11-20-1 year	2006 - 2099	2006	
	11-20-2 month	1 - 12	1	
	11-20-3 day	1 - 31	1	
	11-20-4 days	Monday Tuesday Wednesday … Sunday	Monday	
	11-20-5 hour	0 - 23	0	
	11-20-6 minute	0 - 59	0	
	11-20-7 second	0 - 59	0	

System parameters changeable with the manufacturer password

Submenu	Explanation, further submenus	Values	Default setting	Unit
11-21 currents	This item permits the calibration of the frequency converter's current measuring unit, and the setting of the limit currents to be used at different temperatures. Each of them is I peak value!			
	11-21-1 I measuring range	type-dependent	type-dependent	A
	11-21-2 I inverter limit t=40 °C	type-dependent	type-dependent	A
	11-21-3 I inverter limit t=80 °C	type-dependent	type-dependent	A
	11-21-4 I inverter maximum	type-dependent	type-dependent	A
11-22 voltages	Internal voltages of the frequency converter			
	11-22-1 Umin	type-dependent	type-dependent	V
	11-22-2 Ustart	type-dependent	type-dependent	V
	11-22-3 Udecel.	type-dependent	type-dependent	V
	11-22-4 Uaccel.	type-dependent	type-dependent	V
	11-22-5 Umax	type-dependent	type-dependent	V
11-23 special data	Internal parameters of the frequency converter.			
	11-23-1 cooling fan switch on	0 - 90	45	°C
11-24 clear log	Serves to clear the event log, the error log, operation hours1, operation hours2 and the consumption meters!	clear		

Submenu	Explanation, further submenus	Values	Default setting	Unit
11-25 password	Passwords can be entered here for setting password parameters and different priority levels. The installer has a higher priority than the user, so the installer password permits also the change of those parameters protected with user password. (The highest priority has the manufacturer password)			
	11-25-1 select password Selects the type of password to be set (priority)	manufact. user installer	manufact.	
	11-25-2 code Setting the password. After having been set, the password will be displayed for 5 minutes.	0 - 9999		
	11-25-3 change Selecting the password to be changed	user installer	user	
	11-25-4 new password Entering of the changed password	0 - 9999		
11-27 menus with password	With the menu with password, passwords can be assigned to menu items in the macros. If change of a parameter is not desirable, it can be protected with password. Password can be assigned here to two priority levels, the user level and the installer level. The installer password permits of course also access to the parameters protected with user password. Assignment of a password and termination of the assignment can be performed after the successful setting of the password only.			
	11-27-1 user	none all minimum ctrl.an. ctrl.ENC master/slave user.1 user.2	none	
	11-27-2 installer	none all minimum ctrl.an. ctrl.ENC master/slave user.1 user.2	none	

Remarks to the system parameters

- Changing the switching frequency is activated only in stop state!
- Parameter load (factory, memory1-3, terminal1-4) can only be made in stop state.
- After parameter loading, the equipment will restart automatically. (when loaded from the terminal, the progress of the load in % format will be displayed in row 4 of the display.)
- When changing the parameter table completely, all parameters will be transcribed in the current table except for the **read-only** parameters. (e.g. serial number, software version number).
- The type-dependent parameters will be transcribed only when the equipment and the setting to be loaded are reconciled

12. Events menu

The event log can store 256 events along with the belonging point of times.

Event with number 0 is the latest one, the earlier events can be accessed with the „🡻" button.

Date display:

- In case of Hungarian language: YYYY.MM.DD
- In case of English language: DD/MM/YYYY

The events that can be stored:

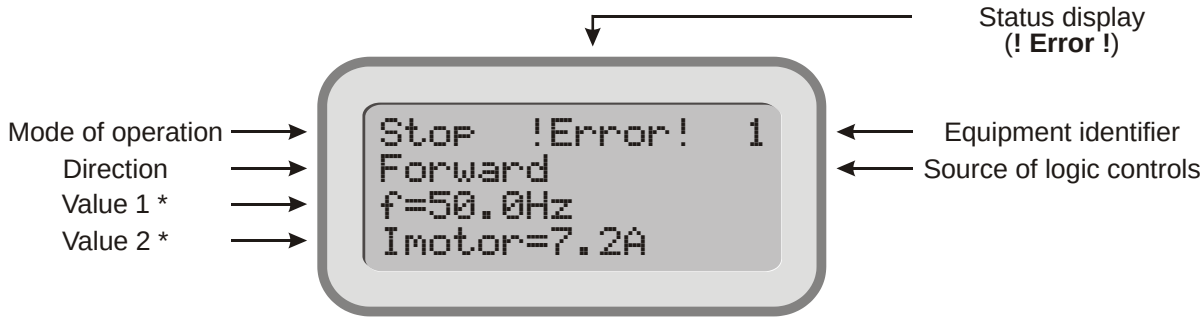
- mains switch off and on depending on the state of menu item **11-14-1**
- occurrence of start, stop events depending on the state of menu item **11-14-2**
- occurrence of an external event from a digital or virtual input
- the temperature of the heat sink reaches 60°C.
  (in this case also cooling back of the heat sink will be entered in the log, at reaching 55°C)

13. Errors menu

The error log can store 256 errors along with the belonging point of times.

The frequency converter can be started only after acknowledging the „**0**" error.

In case of an error the frequency converter stops, the ERROR LED is flashing and in the status display **!Error!** appears:



** In case of error certain displayable items at the occurrence of the error show their actual values, helping to eliminate the error.*

These items are following:

- dynamic operation states,
- operation mode,
- productivity (prod.1-4),
- frequency (f),
- motor current (Imotor),
- motor clamp voltage (Umotor),
- intermediate circuit DC voltage (Udc),
- mains voltage (Unet),
- received power (Preceived),
- regulation reference signal (r.r.signal),
- modified regulation reference signal (m.r.r.s..),
- control reference signal (c.r.signal),
- modified control reference signal (m.c.r.s.),
- control feedback signal (fb.signal),
- error signal,
- motor rotation speed (calculated) (n),
- motor rotation speed (measured) (n IRE),
- torque,
- total energy consumption (E. cons.tot.),
- energy consumption (E.cons.)

If only a display is connected to the equipment, also the cause of the error is displayed in the lower row.

Pushing the "Escape" button, menu item **13 Errors** appears along with the identification number of the concerned frequency converter in the right upper corner.

- the second row shows the name of the error.
- at the beginning of the rows 3 and 4, the time of the error is shown.
- at the end of row 4 is Operation hours 1.
- the number at the end of row 3 shows the number of the error.
  (The last error is the one with „**0**", the previous with „**-1**". The earlier errors can be accessed with button ↓.)

The equipment stores the last 256 errors. The frequency converter can be started only after the acknowledgement of the error „**0**".

Date display:

- In case of Hungarian language: YYYY.MM.DD
- In case of English language: DD/MM/YYYY

Error acknowledgement

The errors can be acknowledged in the following ways:

- switching the frequency converter off and on,
- giving a rising and falling edge to the input programmed for acknowledgement,
- from the terminal, pushing the **"Enter"** button in the **13 Errors** menu, at the last error

After acknowledgement the display image appears.

i	The „**Erased**" display gives the date of erasing the error log

If the operation voltage is low, writing the error log is disabled. In this case, the equipment cannot receive start command either!

List of errors

On 16 character display the upper (e.g. **External error 2.**), on 8 character display the lower (in shortened form, e.g. **Extern. 2**) „Displayed text" appears at the actual error.

LED	Aut. ack.	Displayed text	Short description of the error	Troubleshooting
-		**Deleted!** (Deleted!)	No more error in the log (in base state this will be shown only)	
1	✓*	**External error 1-8.** (Extern.1-8)	Error signal produced with activating the Digital IN1-8. (e.g. signal from the thermal switch on the motor, field inhibition etc.)	Checking the device causing the external error.
1	✓*	**Virt. error 1-6.** (Virt. 1-6)	Error signal produced with activating the Virtual IN1 – IN6. (e.g. inhibition through a comparator assigned to the value of an analogue signal).	Checking the source of the virtual input, e.g. the input signal of the comparator or its settings
1		**Term. trip out** (Term.tri)	The terminal regulation is not enabled, but a stop command was given out from it!	Enabling the terminal regulation, if necessary
1		**An. ref. high!** (An.ref.h)	The frequency converter senses the 10 V reference voltage higher.	Check that the SA1 and SA3 connectors are not receiving a voltage from the outside.
1		**An. ref. low!** (An.ref.l)	The frequency converter senses the 10 V reference voltage lower.	Check if the reference voltage is shorted or excessively loaded.
1		**Term.par.Chksum** (Term.par)	CHKSUM error in the parameter set stored in the terminal thus it cannot be loaded.	Loading another proper parameter set or repeated setting of the equipment.
1		**Blocking error** (Blocking)	Based on the incremental rotation speed transmitter, the frequency inverter senses that the motor does not rotate. It is mechanically stuck or the transducer is faulty.	Check the connections.
2		**Motor overtempt.** (Mot.temp)	The motor temperature is too high according to the thermal model.	• Setting forced cooling in menu item **6-6** or reducing the load. • Raising the temperature limit in menu item **6-7-3**. • Checking the setting of the motor parameters.
2	✓	**No motor** (No motor)	No motor connected to the motor clamps or the motor power is too low. (observation: from 4Hz to 400Hz, if Imotor < 6% of In)	The error observation can be set in menu item **11-8-1**.
2		**Motor test error** (Motor te)	The parameters calculated by the motor test are outside the adjustable range.	Check: • Setting of the motor param. (menu **6**) • Cabling and connections of the motor (star, delta)

* The external errors and the virtual errors with even number can be acknowledged also with automatic error acknowledgement.

LED	Aut. ack.	Displayed text	Short description of the error	Troubleshooting
2	✓	**Phase error** (Phase er)	The motor phase U, V or W is broken (not connected) or high current asymmetry on the motor.	Check the cabling and connections between the equipment and the motor.
2		**Brake overload** (Brake ov)	Based on its adjusted data, the braking resistor load is high.	• increasing the run off time, • check (value of R, its loadability, • installing a resistor with higher loadability.
2	✓	**Line phase error** (Line pha)	One of the input phase voltages is either failing or abnormally smaller than the others.	Check the availability of the three phases and network wiring and connections.
2	✓	**Uphase overcurr.** (Uphase o)	The U phase output of the frequency converter is overloaded, that is I motor Uphase> I inverter max.	• reducing the load, • installing a frequency converter with higher power.
2	✓	**Vphase overcurr.** (Vphase o)	The V phase output of the frequency converter is overloaded, that is I motor Vphase> I inverter max.	
2	✓	**Wphase overcurr.** (Wphase o)	The W phase output of the frequency converter is overloaded, that is I motor Wphase> I inverter max.	
3	✓	**Heatsink hot** (Heats.ho)	The measured temperature of the heatsink is too high	Check: • in case of built in ventilator, above 45°C the rotation of the ventilator • if mounted in rack, the ventilation of the rack • the load of the equipment
4	✓	**IGBT prot.** (IGBTprot)	The IGBT module indicated an error. A typical phenomenon of output shorting.	Check the cabling and connections between motor and equipment
4	✓	**HW voltage prot.** (HWvoltage)	Intermediate DC voltage has reached the maximum HW inhibit limit or the charging relay is not pulled	• network interference filtering, • phase correction
4		**Charge relay err** (Ch.relay)	The charging relay is not pulled.	Internal error. The manufacturer is required to troubleshooting.
4	✓	**DC overvoltage** (DC ov.v.)	The intermediate DC voltage raised above the permitted limit.	If there is phase correction in front of the equipment: • Connecting a mains choke in front of the unit. If it occurs during run down: • increasing the run down time
4	✓	**DC volt. curly** (DC curly)	The DC voltage is overloaded or the mains voltage is too low.	• reducing the load, • slower run up and run down
4	✓	**DC error** (DC erro)	The intermediate circuit capacitor cannot be charged.	Internal error. (e.g. capacitor short circuit) The manufacturer is required to troubleshooting.
4	✓	**Thyristor com.e.** (Thyrist.)	Communication error between the thyristor controller and the drive control processor.	Check the internal connecting cable.
4	✓	**Break IGBT prot.** (Br. IGBT)	The brake module indicates IGBT error.	Check the brake resistor (e.g. short circuit).
5		**Overfrequency** (Overfreq)	Due to the load on the side of the load, the frequency exceeded the permitted value (f inhibit).	Modification of the settings.
5		**Overfrequency** (Overfreq)	The measured rotation speed is greater than the maximum rotation speed calculated from the nominal motor speed and the ratio of the nominal frequency and the frequency inhibit limit.	Check: • IRE parameters(menu **4-31**) • frequency inhibit limit (menu **8-3**) • motor parameters (menu **6**)

LED	Aut. ack.	Displayed text	Short description of the error	Troubleshooting
6		**Par.err.An.IN1-4** (P.An.IN1-4)	Insufficient parameter selection for the given number of analogue inputs. (The selected input has more than one function.)	Checking and improving the setting of the parameter
6		**Parameter error** (Par.err.)	Not coherent parameters have been selected to the selected mode. (e.g. flying start with brake loosening, at master equipment source of reference signal CAN)	Checking and improving the setting of the parameter
6		**Not user macro** (Non user)	At macro copying, in **11-4-2** not a user macro is selected. Copying cannot be performed.	In menu **11-4-2** selecting user macro 1, or user macro 2 then copying.
7		**EEPROM error** (EEPROM e)	Error in the saved data. (e.g. not proper value in the parameter table)	By pressing the exit button, the program skips to the wrong parameter. The parameter is offered with the factory value. In case of several faulty parameters, the program shows them in line.
7		**EEPROM write er.** (EEPROMwr)	Memory write error	Internal error. The manufacturer is required to troubleshooting.
7		**IIC error** (IICerror)	Indicates error in the internal communication (I^2C). (clock, EEPROM)	Internal error. The manufacturer is required to troubleshooting.
7		**Interface error1** (Interfac)	No connection with the unit performing the procession of the analogue and digital inputs.	Internal error. The manufacturer is required to troubleshooting.
7		**Interface error2** (Interfac)	Error in processing the analogue inputs or several digital inputs.	Internal error. The manufacturer is required to troubleshooting.
7		**Par. CHKSUM err.** (Par.CHKS)	CHKSUM error of the parameter set. If this error occurred at powering the equipment, the equipment will continue operating with the factory settings.	Loading a proper parameter set saved earlier, or repeated setting of the equipment.
7		**Turn off CHKSUM** (Turn off)	CHKSUM error of the switch-off buffer.	Internal error. The manufacturer is required to troubleshooting.
7	✓	**Iu measure error** (Iu measu)	Large offset error of the motor current measuring in the U phase.	Internal error. The manufacturer is required to troubleshooting.
7	✓	**Iv measure error** (Iv measu)	Large offset error of the motor current measuring in the V phase.	
7	✓	**Iw measure error** (Iw measu)	Large offset error of the motor current measuring in the W phase.	
7	✓	**Unidentified!** (Unidenti)	The error the frequency converter stopped with cannot be defined.	If it occurs several times even after the error has been cleared, the manufacturer is required to troubleshooting.
8		**Terminal 1 error** (Terminal)	Faulty parameter loading from terminal.	Loading of the proper parameter set.
8		**CAN error** (CAN erro)	Indicates error in the CAN transmissions. (e.g. master/slave connection broken)	Check: • if the master device is turned on and it is set up as a master, • CAN bus cabling • Connections
8		**MOD bus timeout** (MODB.to.)	In start state, the device did not receive a message during the time set in the MOD bus timeout.	Check: • if the master device is turned on • MOD bus cabling • Connections

If the error cannot be repaired with the troubleshooting and acknowledgement described here, the manufacturer needs to be contacted!

Programming guide

Below, sample programs are shown for some frequently used control and regulation tasks.
They may help at programming.

Control from terminal between 5 and 60 Hz

Submenu		Setting
1-5-1	**source of the control reference signal**	terminal
4-8-1	**terminal control**	yes
8-1	**f maximum**	60 Hz
8-2	**f minimum**	5 Hz
8-3	**frequency inhibit limit**	70 Hz
1-1	**control reference signal**	5 - 60 Hz
4-11-1	**digital input 1 type selection**	N
4-12-1	**digital input 2 type selection**	N

The commands start, stop, direction and frequency change can be given from the terminal.

Control from terminal blocks with potentiometer between 10 and 50 Hz

At the lower extreme position of the potentiometer the driven unit has to stop.

Submenu		Setting
1-5-1	**source of the control reference signal**	analogue IN 1.
4-1-1	**analogue input 1. type**	potentiometer
4-1-2-2	**analogue input 1. stop range**	3%
4-1-2-3	**analogue input 1. hysteresis**	1%
8-1	**f maximum**	50 Hz
8-2	**f minimum**	10 Hz
8-3	**frequency inhibit limit**	55 Hz

The commands start, stop and direction, can be given through the digital terminal blocks (SD), the frequency can be changed with the potentiometer connected to the analogue terminal blocks (SA).

The lower extreme position of the potentiometer sets "waiting" mode!

Control from terminal, reference signal change between 1 and 100 Hz with motor potentiometer function

The motor potentiometer function should be activated from the Digital IN1 and IN2 inputs or from the terminal!

Submenu		Setting
1-5-1	**source of the control reference signal**	motor potentiometer
4-8-1	**terminal control**	yes
4-11-1	**digital input 1 type selection**	N
4-12-1	**digital input 2 type selection**	N
8-1	**f maximum**	100 Hz
8-2	**f minimum**	1 Hz
8-3	**frequency inhibit limit**	110 Hz
4-14-1	**digital input 4 type selection**	logical functions
4-14-2	**logical functions**	motor potentiometer up
4-15-1	**digital input 5 type selection**	logical functions
4-15-2	**logical functions**	motor potentiometer down
4-9-2-1	**motor potentiometer up time**	10,0 s
4-9-2-2	**motor potentiometer down time**	10,0 s
4-9-2-3	**motor potentiometer clear**	no
11-12	**terminal function**	motor potentiometer

The commands start, stop and directions can be given from the terminal.

Changing the frequency can be effected with Digital IN 4. and IN 5. or in display mode with the terminal push buttons ▲ and ▼ (motor potentiometer up and down).

Regulation on pressure using a 4 to 20 mA pressure remote transmitter

Let the pressure remote transmitter be of measuring range of 0 to 10 bar, the pressure to be kept should be adjustable between 4 and 8 bar.

The pressure to be kept should be 6 bar, reaching the pressure should last at least 30 seconds after start (for taking care of the supplying unit e g. the well)

The pump starts to convey from 20 Hz on, cannot be driven above 50 Hz, it cannot be operated more than 1 minute at the minimum frequency (it must be stopped), but in the case of 0.5 bar pressure drop it must be started again.

The reference signal of the regulation has to be given from the terminal

Remark: according to the remote transmitter data, 10 bar corresponds to 100%

Submenu		Setting
1-3	**operation mode selection**	regulation
1-6-1	**source of the regulation ref. signal**	terminal
1-6-2	**type of the regulation**	normal
1-6-3-1	**regulation reference signal maximum**	80%
1-6-3-2	**regulation reference signal minimum**	40%
1-6-4-1	**regulation reference signal acceleration**	30,0s
1-6-5-1	**regulation start / stop time limitation**	60s
1-6-5-2	**regulation start error signal**	5%
1-6-5-3	**regulation start / stop hysteresis**	5 Hz
1-7-1	**source of the feedback signal**	analogue IN 1.
4-1-1	**analogue input 1. type**	current
4-1-4-1	**analogue input 1. current upper level**	20mA
4-1-4-2	**analogue input 1. current lower level**	4mA
1-2	**regulation reference signal**	60%
2-6	**direction change disable**	always
8-1	**f maximum**	50 Hz
8-2	**f minimum**	20 Hz
8-3	**frequency inhibit limit**	55 Hz
1-11-1	**PID 1 Ap** (proportional gain)	0,5
1-11-2	**PID 1 Ti** (integration time)	1000ms
1-11-4	**PID 1 Ad** (diff. element overdriving factor)	0

At simple pressure regulation the most suitable regulation type is "PI" or "I".

The value of Ad is 0.00. By this, the effect of the differentiating elements (Ad, Td) is switched off.

Setting of the PID parameters depends on the system, they always have to be adjusted to the actual requirements

The start/stop commands can be given out from the terminal blocks, the control reference signal modification from the terminal.

Regulation on rotation speed, using IRE

Let the IRE be of 1000 pulse/revolution and the maximum rotation speed 5000.

The rotation speed should be adjustable between 50 and 3000,

The rotation speed to be kept should be 2000.

The motor should have two poles.

Remark: upon the maximum rotation speed, 5000 corresponds to 100%

Submenu		Setting
1-3	**operation mode selection**	regulation
1-2	**regulation reference signal**	40%
1-6-1	**source of the regulation ref. signal**	terminal
1-6-2	**type of the regulation**	normal
1-6-3-1	**regulation reference signal maximum**	60%
1-6-3-2	**regulation reference signal minimum**	1%
1-7-1	**source of the feedback signal**	IRE rotation
4-8-1	**terminal control**	yes
4-11-1	**digital input 1 type selection**	N
4-12-1	**digital input 2 type selection**	N
4-31-1	**IRE resolution**	1000
4-31-2	**IRE rotation speed 100%**	5000
6-5	**nominal rotation speed**	2920
8-1	**f maximum**	86 Hz
8-2	**f minimum**	1 Hz
8-3	**frequency inhibit limit**	105 Hz
1-11-1	**PID 1 Ap** (proportional gain)	0,5
1-11-2	**PID 1 Ti** (integration time)	100ms
1-11-3	**PID 1 Td** (differentiation time)	100ms
1-11-4	**PID 1 Ad** (diff. element overdriving factor)	0,5

For rotation speed regulation, "PI" or "PID" is the most proper regulation type.

Setting of the PID parameters depends on the system, they have always to be adjusted to the actual requirements.

To maintain the high dynamics and avoid swingings be especially careful at setting Td and Ad!

Commands start, stop and directions as well as changing the regulation reference signal can be effected from the terminal

i	At setting fmax consider the rotation speed of the motor belonging to its nominal frequency and set the maximum frequency to a value at which the adjustable maximum rotation speed can still be controlled securely! (Allowance for the slip)

Explanation of important definitions / abbreviations

analogue input	analogue signal source which can be connected to the terminal block (voltage, current, potentiometer)
analogue output	analogue signal output on the terminal block (voltage / current)
breakpoint	point of a curve where it changes some of its characters (e.g. slope)
CAN bus	system bus (for master/slave connections)
control	the output frequency refers to the reference signal value of the control process
counter	internal counter that can be operated with digital or virtual input
DC brake	braking with leading a DC voltage to the terminals of the motor
default	factory setting according to the most frequent user demands
digital input	permits logic commands to be activated (e.g. start, direction, counter, program etc.)
digital output	freely programmable built-in relay (or optocoupler)
direction	command for changing the direction of rotation
error signal	the signed difference of the reference signal and the feedback signal
f hold	inhibition of the frequency change
feedback signal	the measured back value at control
fmax	maximum frequency
fmin	minimum frequency
forced cooling	refers to the motor (the motor is cooled with a fixed ventilator mounted on it)
IRE reception	incremental rotation speed signal transmitter interface circuit
jog	command for starting at a low frequency (e.g. for adjustment of the machinery).
master / slave	controlling unit / subordinated unit
memory 1-3	storage places for the user settings in the frequency converter
MOD bus	standard RS485 protocol used to remote control and supervision.
modification	the regulation or control is extended so that an external element can change the actual reference signal through an analogue or digital input
modifying signal	at regulation or control it modifies the value of the reference signal
motor potentiometer	changing the analogue signal with digital signals (up and down)
n	rotation speed of the motor
n IRE	rotation speed measured by the incremental rotation speed encoder
operation mode	main menu for setting the main operation conditions at programming
own cooling	refers to the motor (the motor is cooled by its own blower)
Pconsumed	wattage consumption from the power line
PID data	they contain the parameters applied for the regulation process
PID extension	controlling 1 unit, and operating further fix units with the digital outputs
position control	this control operates the motor until it is in the proper position according to the signal transmitter
potentiometer	signal source with own supply voltage connected to the analogue input
productivity	data of the technology process (to be defined along with dimension by the user)
program	operating according to preset parameters
program activation	starting mode of programs written to the programmable digital inputs

quick menu	collection of the most common parameters used for programming
reference signal	the value to be set at regulation or control
regulation	according to the external conditions, the output frequency will set in to the value at which the feedback signal becomes equal with the preset value of the reference signal.
resistor brake	braking with directing the surplus energy to a resistor (at generator mode).
roll out	the motor's coming to standstill with free roll out (coasting)
RS 232 / 485 interface	interfacing the RS485 serial line of the equipment to computer or PLC
RS485/R	system serial line (for remote control with MOD bus)
RS485/T	terminal serial line (general serial line for programmer units, displays)
run time 1	total number of operating hours of the frequency converter
run time 2	operating time of the frequency converter output (the time elapsed during start)
S curve	means the soft transition of the corner points (break points) of the run up (and run down)
selector switch	selection possibilities at programming (if the item to be set is not numeric value)
sequence	programs running down one after another
slip compensation	load depending frequency correction (for keeping the rotation speed constant)
start / stop	start command / stop command
stop band	analogue input signal range, at start this range includes "waiting" mode)
synchronous systems	master/slave connections
Tdown	normal deceleration time (may differ at control and regulation)
terminal	unit used for programming and displaying
terminal 1, 2, 3, 4	storage places for the user settings in the terminal
torque control	this control adjusts the motor rotation speed in order to produce the preset torque
Tsink	temperature of the frequency converter's heatsink
Tup	normal acceleration time (may differ at control and regulation)
U boost	starting voltage (at start, at 0 Hz, this appears on the motor clamps to counteract the magnetization loss)
U/f ratio	ratio of the voltage and the corresponding frequency
Udc	voltage across the capacitor of the intermediate circuit
Uline	calculated value of the line voltage (from Udc)
Umotor	voltage delivered to the motor
unbouncing	filtering the switching uncertainty of a mechanical switch
USB / RS 485 interface	interfacing the RS485 serial line of the equipment to computer or PLC
virtual input	internal input that can be used with the features of digital inputs
waiting	the equipment is in start state but the operation is suspended

User settings

Submenu	Explanation	Setting	Unit

Notes

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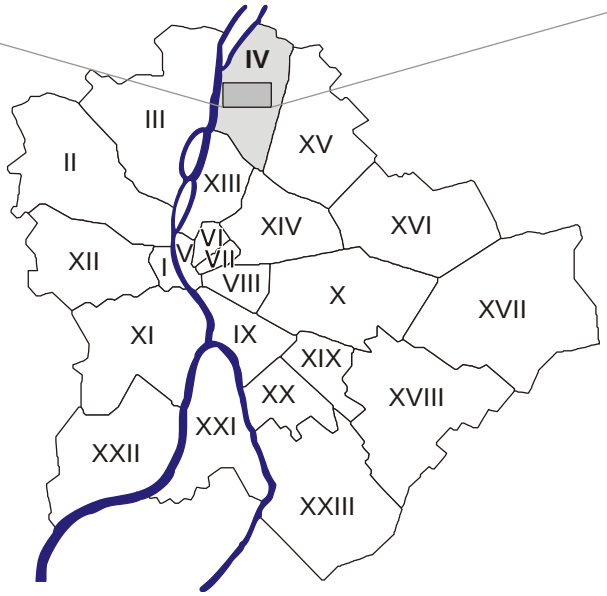

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