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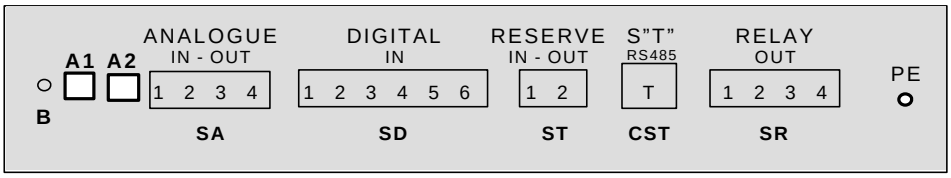
Dear User!

We, at Procon Ltd. express our thanks for your decision to buy the frequency converter developed and manufactured by our company. We are proud of being in the position to serve you with a state of the art equipment of excellent quality. We believe, its use will justify your decision and by its technical parameters your new equipment will be a useful and reliable tool in solving even the most sophisticated tasks in the field of electric drives. This manual describes the programming of the converter. For the right and effective use of the converter please read through this manual carefully, even if you have already practice in programming. We would be pleased to receive your remarks and suggestions referring to this manual or the frequency converter.

INTRODUCTION

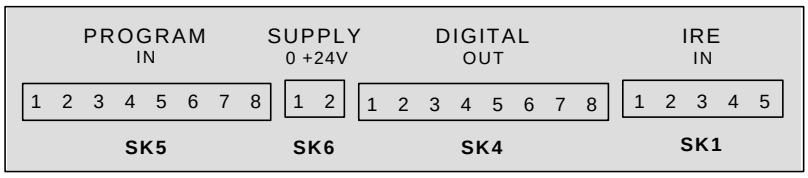
This manual describes those capabilities the programming of ISD, ILD and IHD type frequency converters provide for digital and analogue inputs and outputs.

- **ISD OPERATING INTERFACE**



- **ILD AND IHD OPERATING INTERFACE**

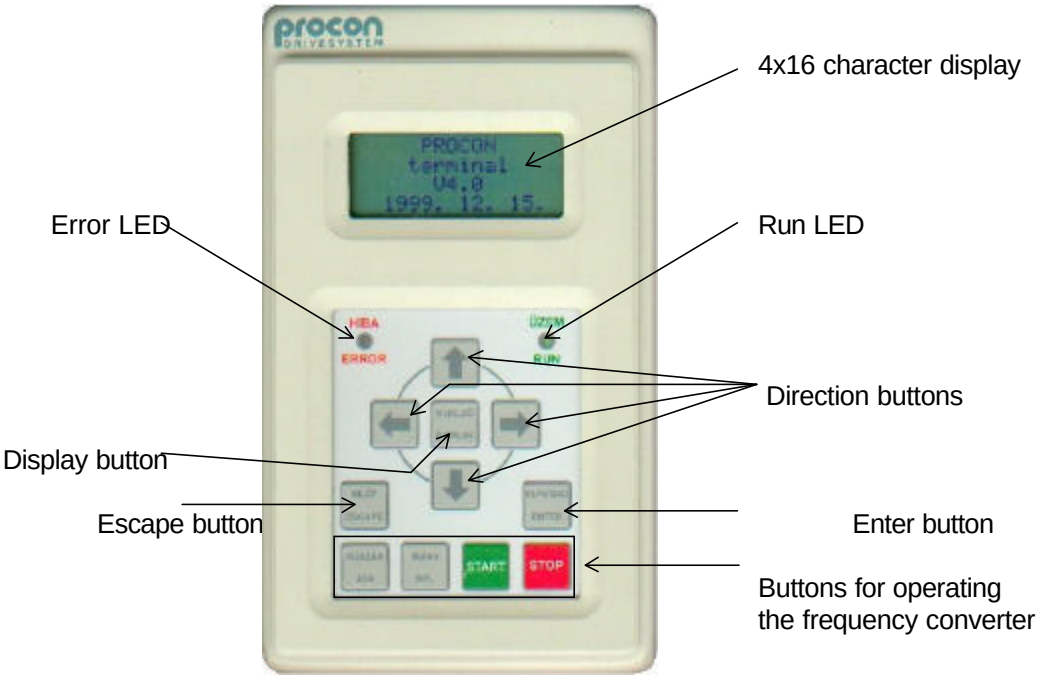
- **ILD AND IHD OPTIONAL OPERATING INTERFACE**



- **Operating interface for the frequency converter**

The operating interface is the program running on PC and the push button terminal **(further on: terminal**). The PC and the terminal can be connected to the frequency converter simultaneously and they can be operated in parallel, too.
The connecting cable includes two signal wires and supply voltage.
The length of the cable (RS485) can be arbitrary which permits the terminal to be installed separately from the frequency converter (e. g. onto the door of the control cabinet).

After switching on, the terminal looks like shown in the following figure:



The PC screen also displays the above figure, which is active: it can be operated in the same way as the terminal. The frequency converter can be connected to the PC through the RS485-T serial line using an RS485 / RS 232 adapter.

The push buttons of the terminal are arranged in two groups.:

The lower group includes push buttons **"Jog"**, **" Direction"**, **"Start"** and **"Stop"**.

The upper group includes push buttons for the **four directions**, **"Display"**, **"Escape"** and **"Enter**".

- **Functions of the terminal's lower push buttons:**

The lower push buttons permit the frequency converter to be operated if earlier the terminal was appointed for this. These lower four buttons work indepentently from the upper ones, thus – if the terminal is the operating control – the motor can be stopped, started etc. also during data setting.

"Jog" – when held pushed, the motor starts rotating at a preset low frequency in the preset direction, when released, the motor stops, when pushed again, it starts again etc. The Jogging mode serves for the adjustments needed by the technology (e g. threading the paper in the printing industry etc.). The "Jog" button is only effective if the driving was in standstill before, that is, the "Stop" button has been pressed and the motor definitely stopped, and also just after switching on the driving.
"Direction" - this button permits changing the direction of rotation. 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!)

- **Functions of the terminal's upper push buttons:**

The push buttons in the upper group permit moving between the menu items of data setting and display.
Data can be entered and the data to be displayed can be selected.

The operation data (e g. maximum frequency, acceleration time etc.) are entered in a 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:

e g. **"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.

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". After having reached the end of the series of the menus, the setting can be made, as follows:

- In case of options offered by the menu, select the desired option with push buttons **"-"** and **"¯"**. E g. in menu **1- 3** (Operation mode) it can be chosen between **Control** and **Regulation**.
- In chase of numeric setting, setting is made by digits. Moving between the digits is made with buttons **"¬"** and **"⊗"** then at the selected digit place the value is increased or decreased with buttons **"-"** and **"¯"** respectively. Setting upwards, after "9" follows "0", downwards after "0" follows "9", and the next higher digit changes properly. Beyond the operation limits the push buttons become ineffective!

Note: 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!
After the requested parameter has been selected, and each digit has been set, pushing the "Enter" button validates the data (and also stores it in the non-volatile memory). After that, the "Escape" button can be used to go back in the menu system to the next parameter to be set.
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.

The default values and the limits of the variable range are different
with frequency converters of different power ratings

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:

In the **1st** row, followings are shown:
Run/Stop then status indication (dynamic mode e g. **U DC<**) and the last two characters are the identifier of the respective frequency converter (e g. **1**).
In the **2nd** row:
Forward / Reverse and in the end of the row **terminal block / RS 485- R / terminal** (source of the logic controls)
In the **3rd** and **4th** row, two selected parameters are displayed (see at 9. Display Menu)

Notes:
If more than one frequency converters are 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 **"-"** and **"¯"** buttons can also be selected (e g. operating the motor potentiometer, changing the parameter to be displayed etc.).
In case of error, in the status indication **! Error !** warning is displayed. By pushing the "Escape" button, the error can be inspected!

Features and capabilities of the frequency converter and the program:

1. At choosing the type of the frequency converter, consider if it meets the power, voltage and current requirements of the motor (system).

Consider whether a special design is needed due to the environment (ambient temperature, dusty or wet ambiency, vibration etc.).

If changing the parameters is often needed use programming terminal.

If programming terminal is needed, what version should be used? (built into the frequency converter, or stand-alone)

For PID extension or back indications, should the appliance be equipped with an additional relay?

Are program inputs needed for running programs or for special function comands?

Are digital outputs needed for back indications?

Is a second analogue input needed? (e.g. at regulation the source of both the reference signal and the feedback signal is analogue etc.)

Is a second analogue output needed? (available beyond 2.2 kW only)

Should the appliance be equipped with an incremental rotation speed encoder (IRE) for checking up the rotation speed?

Is connection through system serial line needed? (e.g. master-slave drive or demand for remote control)

2. 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 operation possibilities are shown in the following:

- Programmability of procedures up to 8 steps (even different in each parameter chart),
  Arbitrary acceleration and deceleration times, frequencies, regulation parameters, durations etc.
- Up to 8 digital back indications about the inner status of the frequency converter (at outputs or relays).
- Two free programmable analogue output back indications (over 2.2kW),
- Two free programmable analogue input signal to be used for control or regulation
  (control or regulation reference signal, regulation feedback signal, signal for the modification of the reference signal),
  Programmable potentiometer (normal, signed, including stop, etc.),
  Voltage and current inputs with deliberate limit value settings,
- Three free programmable relays can be built-in (basic configuration includes one over 2.2kW),
- Three free programmable auxiliary digital inputs with special functions (e.g. external error etc.),
- **"S"**-curve type soft start and stop (for materials handling and passenger transport),
- - Timing functions (to be programmed to the built-in relays),
  Delayed starts and stops, preset operation periods,
- Daily or weekly timed programs linked up with the calendar (up to 3),
- Counting functions (to be activated with the digital inputs, or program cycle counter),
  Counting by piece, or operation depending on the counted value (counting down and stop at zero)
- Multifunction display,
  Operation mode, status, unit identifier (first row)
  Direction, source of the logic control (second row)
  1. Optional parameter (third row)
  2. Optional parameter (fourth row)
- Modification of the main parameter values from analogue input (eg. acceleration time, fmax, fboost etc.),
- Multiple regulation tasks (one regulated and up to three fixed 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,
- Master/slave operation tasks,
- Synchronous systems,
- 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 (eg. for special motors),
- Internal calendar and clock,
- Keeping an error log with error numbers and chronology (more than 500 errors can be stored inspected),
- Handling from a single terminal even up to 32 frequency converters,
- Optional computer connection (query, program editing, data processing, help etc.),
- Simple remote control through serial line (RS485-R) (reference signal, logic control, etc.),
- Multilingual handling, etc.

- **Information about the serial lines:**

Beyond the analogue and logic control inputs, the frequency converter's most important interfaces are the RS 485 serial lines.

Using the serial line, a remote terminal can be connected to the frequency converter, several frequency converters can be coupled (e g. single terminal control) and system connections can be established (e g. master/slave operation or remote controlled systems).

Important:

Since the serial line connectors also carry supply voltage (+9 V),

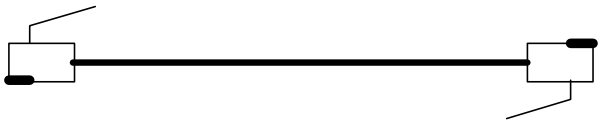
--- the assignment of the connector socket pins is identical in any case! ---

This applies to all connectors regardless of their placings (on frequency converter, terminal unit, RS485 / RS232 adapter, connector extender, distributor, etc.)

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)

The length of the cable should match the demand coming from the use of the equipment!

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



Attention:

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!

Length of the serial line:

In principle, the length of the cable is not limited, however it must comply with the following requirements:

In case of a remote located display terminal, 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 20 m can be used, at which the terminal can still work from the 9 V supply voltage. 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 coupling several frequency converters, the above limitation applies to the total length of the connecting cables because the power supply voltage for the display terminal may be delivered by the farthest frequency converter, if this is only one being switched on!

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

Establishing a connection through serial line:

Even in lack of an existing serial system line (RS485-R.), the coupling can be installed without distributor connectors, but in this case the RS485-T (terminal serial line) has to be led to both connectors at each appliance (for special request only!)

When coupling several appliances, always use "loop through" connection.

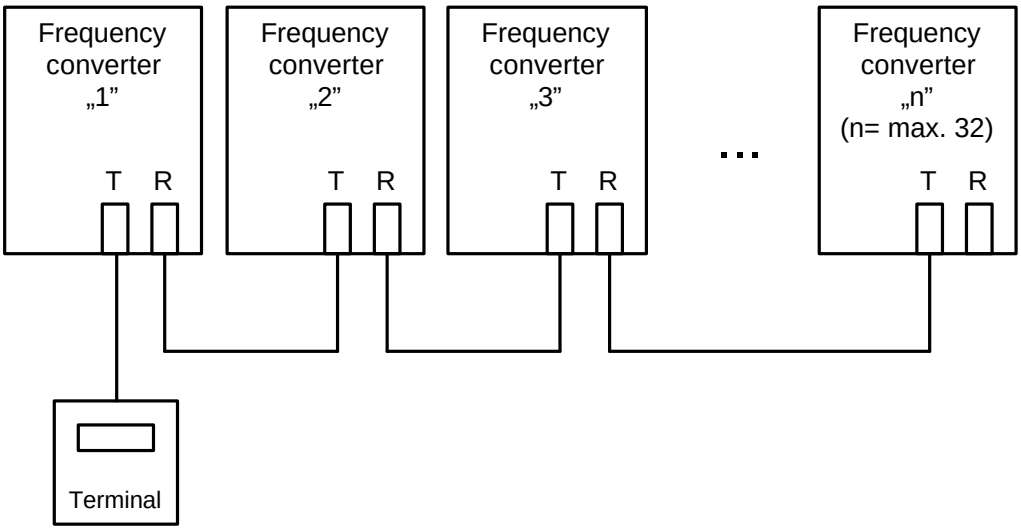
If within the connection system a system serial line connection is also needed, use distributor connectors for looping the units on the serial line! In case of such loopings even several RS485-R serial line connections can be made (master/slave arrangements), while apart from that even all of the frequency converters can be controlled from a single terminal through the RS485-T serial line.

Important:

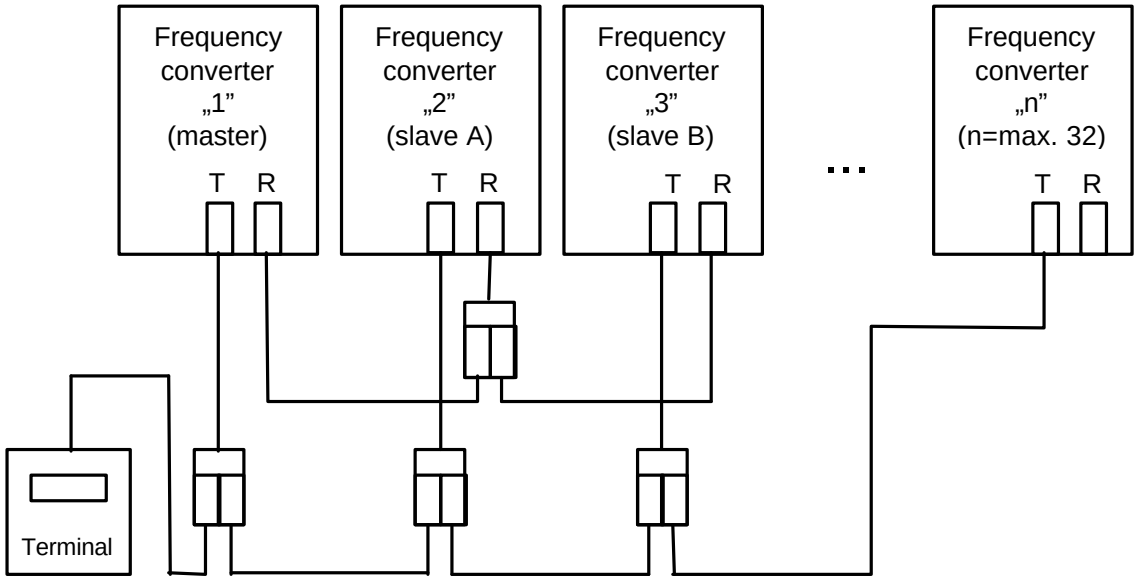
- When using long cables, shielded cable or at least twisted-pair cable should be used!
- If the frequency converters are coupled with the terminal serial line, a single display terminal is only allowed to be connected! Additionally, a display, a quick programmer and a computer can be connected to the serial line at the same time. They work in parallel with the terminal and do not disturb each other.

- **Serial line connections:**

Looping onto the terminal serial line (RS485-T), if RS485-T is led to both of the connectors:



Looping onto the system serial line (RS485-R.), and the terminal serial line (RS485-T) with the use of distributors:



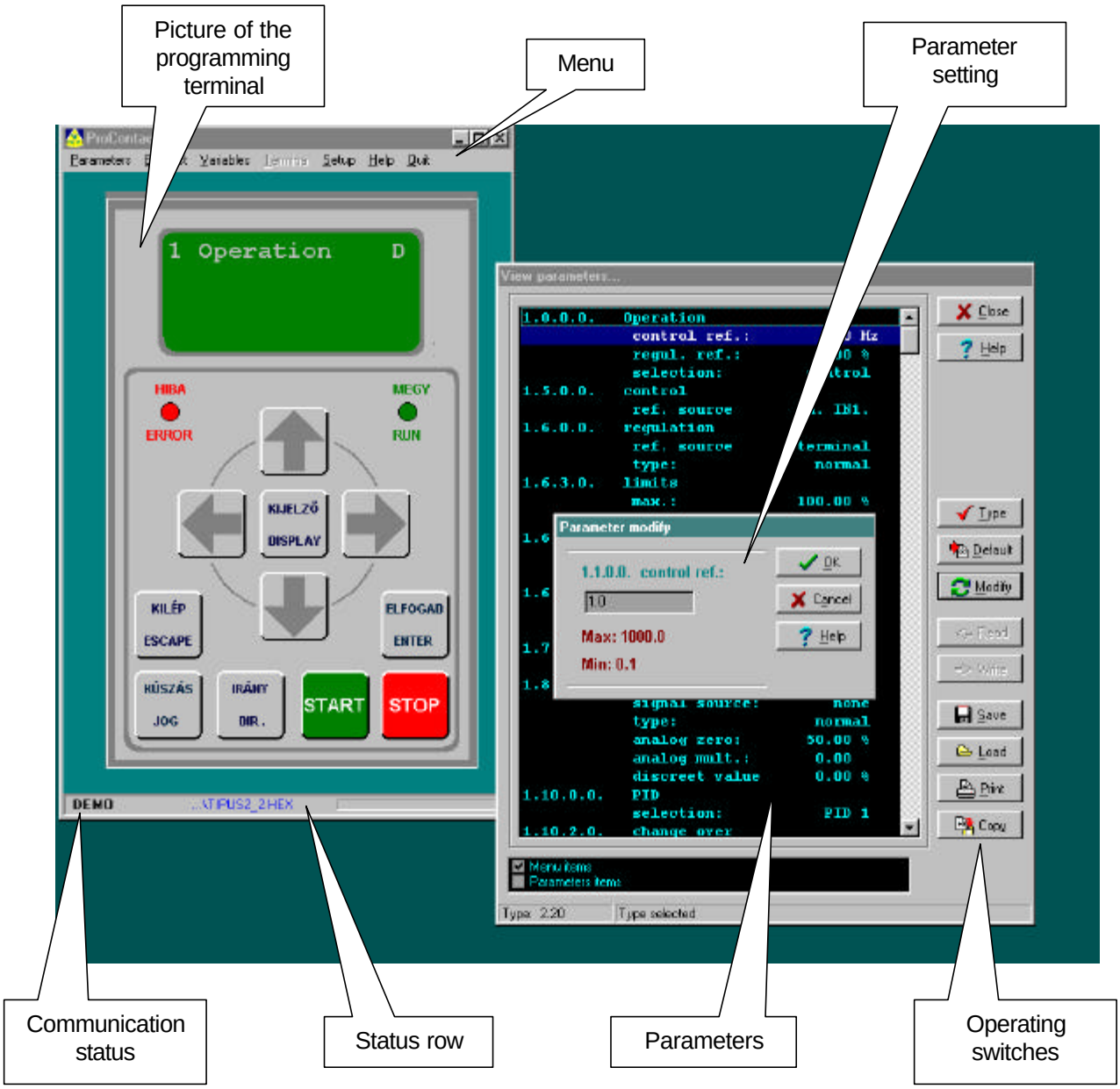
- **Connecting a computer to the frequency converter:** (program **ProContact**)

The computer is always connected to the serial line RS485-T.
A push button terminal may also be connected to this serial line.
The computer performs process control, or manages the customer's complex requirements regarding the operation of the frequency converter(s).
Using the handling program provided by the manufacturer, each parameter can be queried, analysed, modified.
The error log can be analysed and stored.
Parameter sets can be prepared and any of them can be downloaded into the frequency converters.
Graphic visualising of each parameter (even 4 at the same time) is available thus the changes can be visually followed, stored and printed, during operation.
The operator's push button terminal can be modelled for teaching or demonstration. The frequency converter can be operated also from this model, similarly as from the real push button terminal.
At any point a Help list is available, describing the actual mode of operation.

- **Using the ProContact software:**

This Windows based software developed by Procon Ltd. permits setting the parameters and monitoring the operation behaviour of ISD, ILD and IHD type frequency converters.

The ProContact software is started from the Start menu.



The picture of the programming terminal is active: by clicking the terminal buttons with the left mouse button the same tasks can be performed from the PC as from the programming terminal. The terminal buttons can be operated from the keyboard, too!

If the program simulates the operation of the frequency converter, the wording „DEMO” is displayed.

In the menu row further program windows can be activated (e.g. error log, oscilloscope etc.)

- **Explanation of the terms used in the menus:**

terminal	unit used for programming and displaying
RS485-T	terminal serial line (general serial line)
RS485-R	system serial line (for master/slave operation and remote control connections)
default	factory setting according to the most frequent user demands
memory 1-2-3	storage places for the user settings in the frequency converter
terminal 1-2-3-4	storage places for the user settings in the terminal
control	the output frequency will refer to the reference signal value of the control process
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.
modification	the control or regulation process is extended in such a way that the actual reference signal can be modified by some external element
start /stop	start command / stop command
direction	command for changing the direction of rotation
jog	command for starting at a low frequency (eg. for adjustment of the machinery)
flying start	restart at the frequency necessary to operate the rotating unit
roll out	the motor's coming to standstill with free roll out (coasting)
DC brake	braking with leading a DC voltage to the terminals of the motor
resistor brake	braking with directing the surplus energy to a resistor (at generator mode)
potentiometer	signal source through analogue input
stop band	voltage band (in case of start, within this band "waiting" mode is effective)
analogue input	analogue signal source which can be connected to the terminal block (voltage, current, potentiometer)
digital input	permits special logic commands to be activated (eg. start, direction, counter, Prg. IN etc.)
program input	for external activation of programs (Prg. IN1-IN8)
analogue output	analogue signal output on the terminal block (voltage)
digital output	for back indication of internal particulars (eg. error, forward, loaded status etc.)
relay output	optional free programmable relay
breakpoint	point of a curve where it changes some of its characters (e g. slope)
Tup	normal acceleration time (may differ at control and regulation)
Tdown	normal deceleration time (may differ at control and regulation)
fmax	maximum frequency
fmin	minimum frequency
S-curve	soft transitions of the breakpoints of acceleration and deceleration
master / slave	controlling unit / subordinated unit
program activation	starting mode of programs written to the programmable digital inputs
f hold	holding the frequency
motor potentiometer	changing the analogue reference signal by digital signals (up and down)
motor pot. up/down	with this input, the reference signal can be increased or decreased if its source is a motor potentiometer
PID data	they contain the parameters applied for the regulation process
PID extension	regulation of 1 unit + operating fixed units with the relay outputs
IRE	incremental rotation speed encoder
own cooling	refers to the motor (the motor is cooled by its own blower)
forced cooling	refers to the motor (the motor is cooled by a fixed blower)
U/f ratio	ratio of the voltage and the corresponding frequency
Uboost	starting voltage (this voltage is delivered th the motor terminals when started at 0 Hz)
f boost	frequency modification point of the **U/f** characteristics (see **7 U/f ratio menu**)
Tsink	temperature of the frequency converter's heatsink
counter	internal counter to be operated from the digital input
cycle counter	internal counter to be activated with the program cycle
n	rotation speed of the motor
n IRE	rotation speed measured by the incremental rotation speed encoder
P consumed	wattage consumption from the power line
Uline	calculated value of the line voltage (from Udc)
Utermination	voltage delivered to the motor
Udc	voltage across the capacitor of the intermediate circuit
productivity	data of the technology process (to be defined along with dimension by the user)
working hours 1	total number of operating hours of the frequency converter
working hours 2	running hours of the frequency converter's output (time in start phase)
time program	daily or weekly operation locked to calendar
slip compensation	load depending frequency correction (for keeping the rotation speed constant) 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 Instruction Manual and the **11 System** menu of the frequency converter (e g. 6.00)

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

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)
The higher the figure after the decimal point is the more opportunities are offered by the given program.

Always use the manual with the same version number as that of the frequency converter!

In any uncleared question contact the manufacturer!

Important:

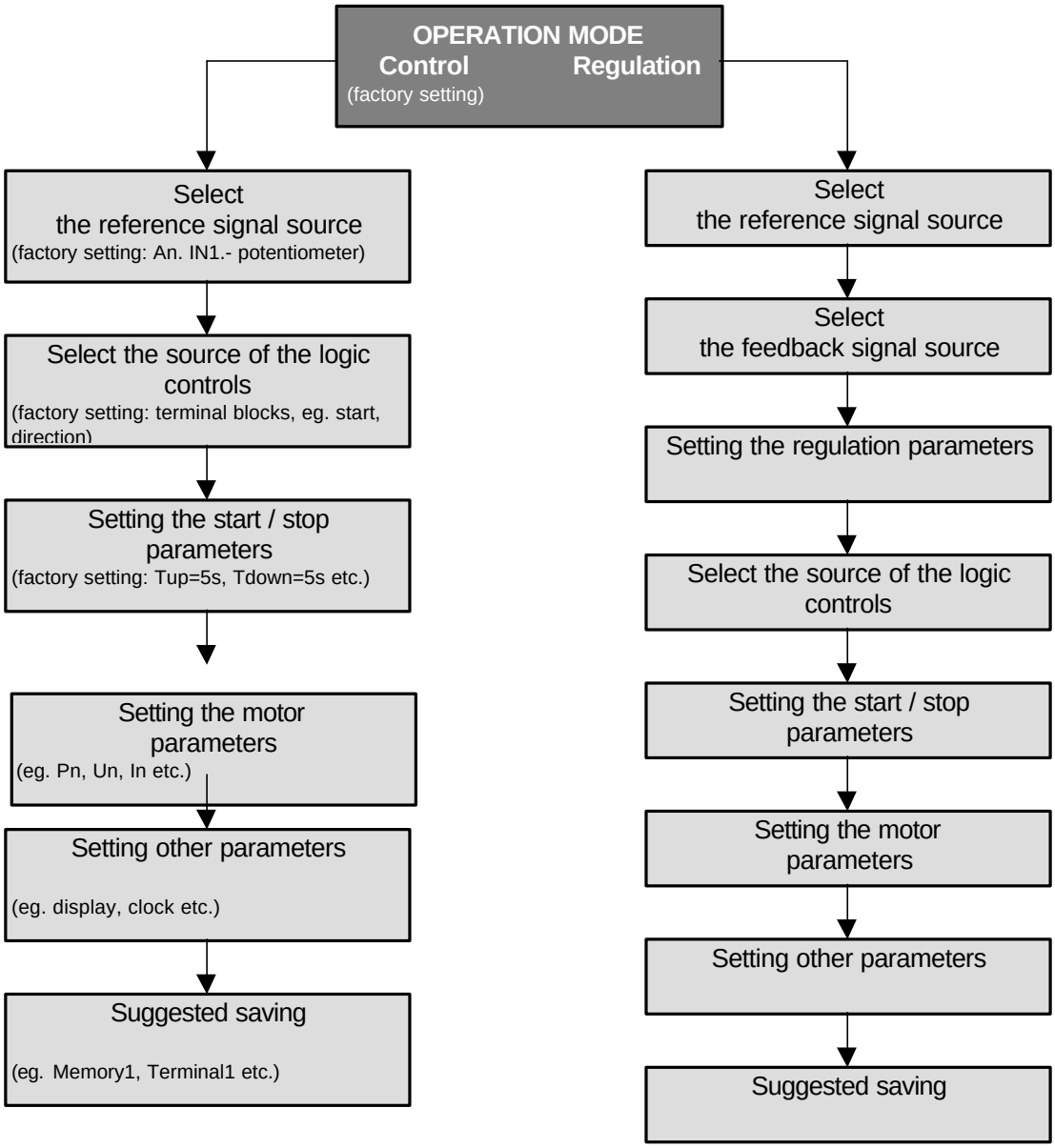
The manufacturer provides all users with the latest program version free of charge, but they have to bring the frequency converter to the manufacturer's premises! The new program is downloaded while you wait!

The user can request program upgrading on the site of the frequency converter to avoid interruption of the production procedure (or for other reasons).

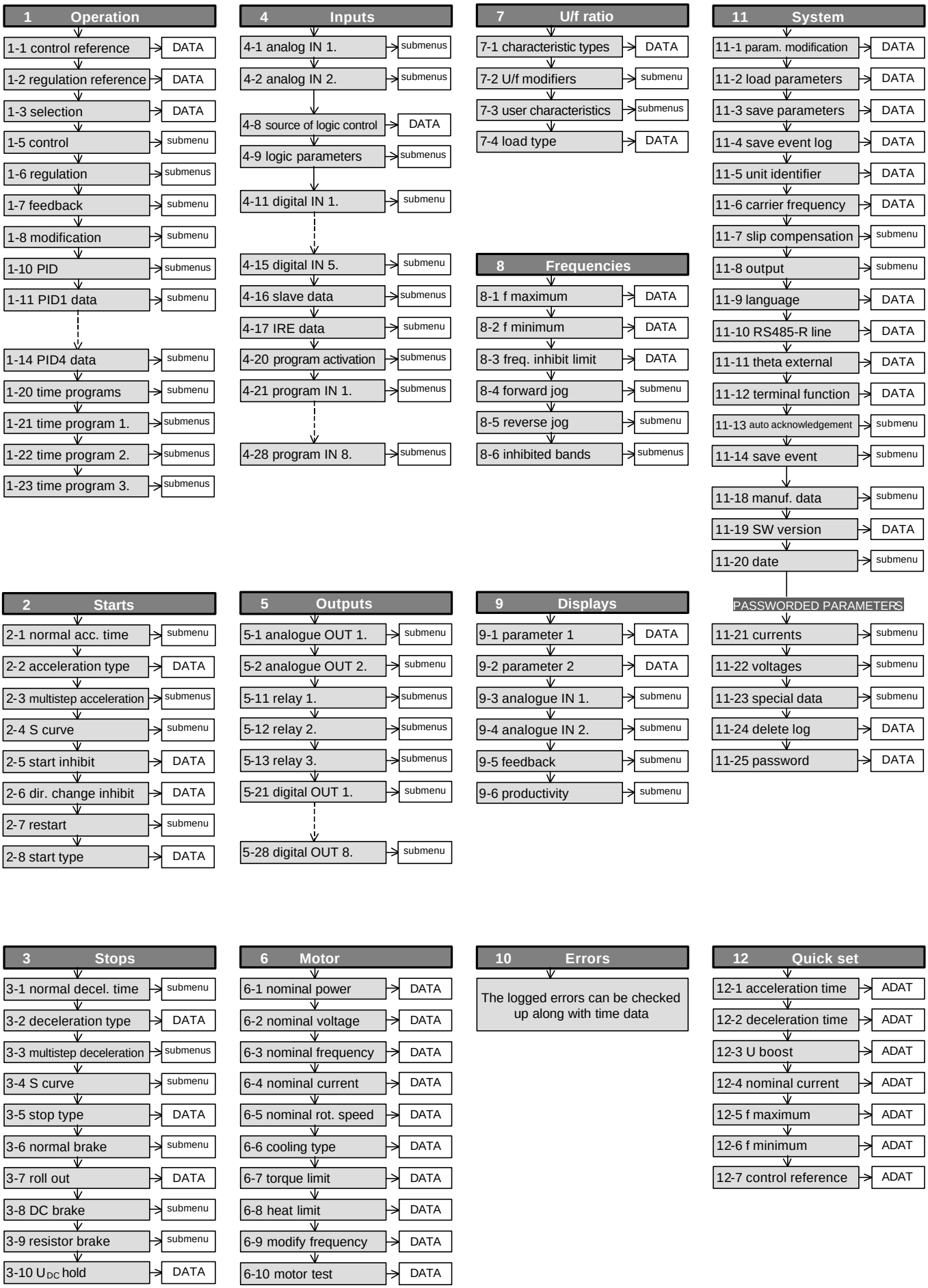
The program upgrading is free of charge in this case, too. The user has to bear the costs of the field-work only!

- **Procedure of programming:**

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



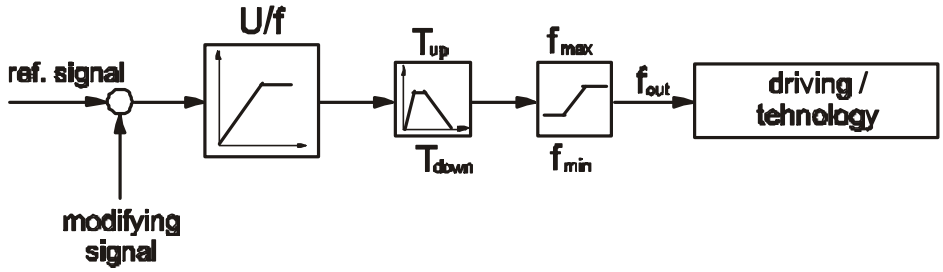
- **PACKED MENU SYSTEM:**



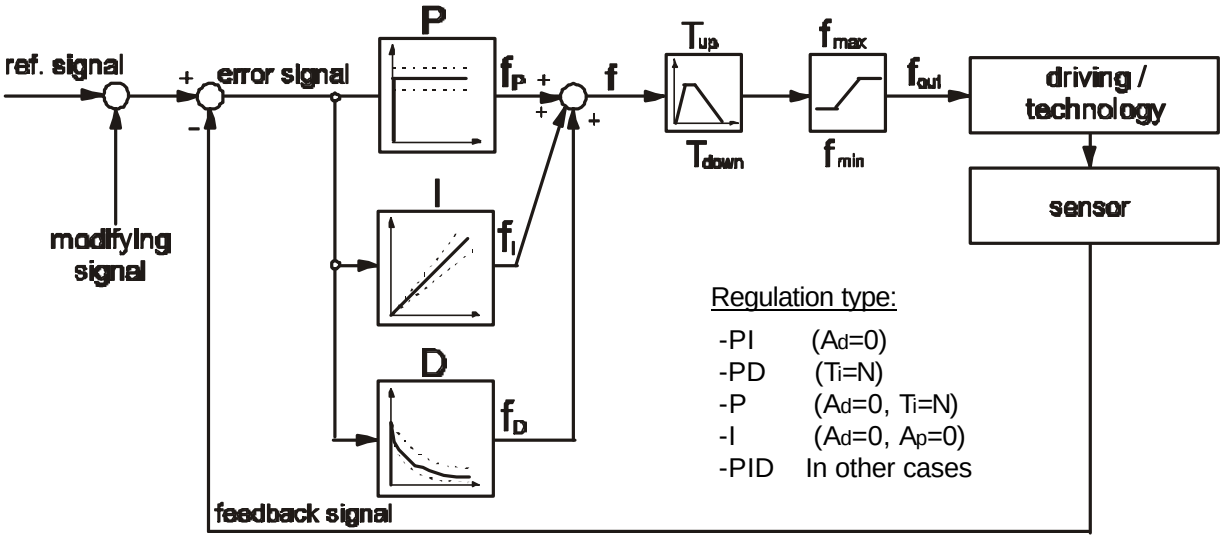
- **1. OPERATION MODE MENU**

- **Control:**

Determined by the reference signal, the output voltage and frequency will set in with regards to the limits according to the figure below



- **Regulation:**



Explanation of the parameters:

P: $f_P = f_{max} \times \frac{100}{100} \times A_P$

I: Change of f during the time of TI: $\Delta f_I = f_{max} \times \frac{\text{Error signal [\%]}}{100}$

D: In the moment of the error occurrence: $f_D = f_{max} \times \frac{\text{Error signal [\%]}}{100} \times A_d$,

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

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.	0.1 - 1000.0	1.0	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!)	terminal analogue IN 1. analogue IN 2. motor potentiometer RS485-R (option)	analogue IN 1.	
1-6 Regulation	Permits the settings of the parameters used with regulation tasks.			
	1-6-1 Source of the regulation reference signal: Selects the source of the regulation reference signal. (Setting the parameters of the regulation reference input is made in the **4. Inputs** menu!)	terminal analogue IN 1. analogue IN 2. motor potentiometer RS485-R (option)	terminal	
	1-6-2 Type of the regulation: Normal: increasing error signal effects increasing frequency. Inverse: increasing error signal effects decreasing frequency.	normal inverse	normal	
	1-6-3 Regulation reference signal limits			
	1-6-3-1 Maximum:	0.00-100.00	100.00	%
	1-6-3-2 Minimum:	0.00-100.00	0.00	%
	1-6-4 Regulation reference signal set-in times			
	1-6-4-1 Acceleration:	0.0-5000.0	0.0	s
	1-6-4-2 Deceleration:	0.0-5000.0	0.0	s
	1-6-5 Regulation start/stop In regulation mode, if the frequency converter operates at fmin for a prolonged time, this item sets the time after which this makes the frequency converter to go into "waiting" state, and the error signal value at which the regulation starts 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)	0.0 - 3000.0 N	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	%

Submenu	Explanation, further submenus	Values	Default setting	Unit
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: At torque regulation, the motor parameters are effective! (**6. Motor** menu) The output frequency sets in to that value between "0" and fmax at which the motor delivers at most that percentage of its torque which is adjusted with the regulation reference signal!	analogue IN 1. analogue IN 2. IRE rotation IRE position IRE torque torque	analóg IN 1.	
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 An. IN1....IN2. Dig. IN1...IN5. PID extender	N	
	1-8-2 Type of the modification: Normal or Inverse, depending on whether increasing (or active) modification signal effects increase or decrease of the reference signal	normal inverse	normal	
	1-8-3 Analogue zero point: At analogue inputs, at this value of the modification signal the **modification is 0 %.**	0.00 - 100.00	50.0	%
	1-8-4 Analogue multiplier: (**K** = correction)	0.00 - 10.00	0.00	
	1-8-5 Discrete value: At active digital IN1 - IN5 or PID extender	0.00 - 100.00	0.00	%
1-10 PID parameters	Extension of the PID parameters. Permits to avoid overdriving which may be caused by the differentiation element.			
	1-10-1 Activated PID: In regulation mode this PID parameter setting will be valid	PID1.....PID4 frequency-dependent	PID1	
	1-10-2 PID switch-over points The switch-over frequencies of the PID regulators, if frequency depending PID regulation has been selected. (The switch-over is implemented with hysteresis to avoid possible swingings!)			
	1-10-2-1 PID2: (Switch-over to PID2)	0.1 - 1000.0	20.0	Hz
	1-10-2-2 PID3: (Switch-over to PID3)	0.1 - 1000.0	30.0	Hz
	1-10-2-3 PID4: (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 PID1 data	Setting of the PID1 regulation parameters (Proportional regulation can be implemented if Ti is programmed to **"N"**!)			
	1-11-1 Ap: (proportional gain)	0.00 - 9.99	0.50	
	1-11-2 Ti: (integration time)	0 - 20000 N	1000	ms
	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 PID2 data	Setting the PID2 regulation parameters. (Its setting is the same as that of menu item **1-11 PID1 data**!)			
1-13 PID3 data	Setting the PID3 regulation parameters. (Its setting is the same as that of menu item **1-11 PID1 data**!)			
1-14 PID4 data	Setting the PID4 regulation parameters. (Its setting is the same as that of menu item **1-11 PID1 data**!)			

- **Explanations to the PID regulations:**

The frequency converter has 4 independent PID parameter sets. Using these permits implementing both value-saving and follow-up regulations in a demanding but simply way.

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:

$$f = \left(A_p + \frac{1}{sT_s} + A_d \cdot \frac{sT_d}{1+sT_d} \right) \cdot \frac{\text{Error signal [\%]}}{100}$$

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 incremental rotation encoder measures some geared lower (or higher) rotation speed, the modified value has to be entered as the number of divisions of the IRE.

(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!

- **Function of the modification 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.
. A modification of 1 % means a change of fmax/100 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 %, however it cannot exceed the limits preset for the minimum and maximum values of the regulation reference signal.
In case of digital input, the percentual value of the modification is the value set in menu item **1-8-5** for each + input.
Also at PID extension, the percentual value of the modification is the value set in menu item **1-8-5** for each + switched on unit. (Modification with PID extension can only be construed in regulation mode.)

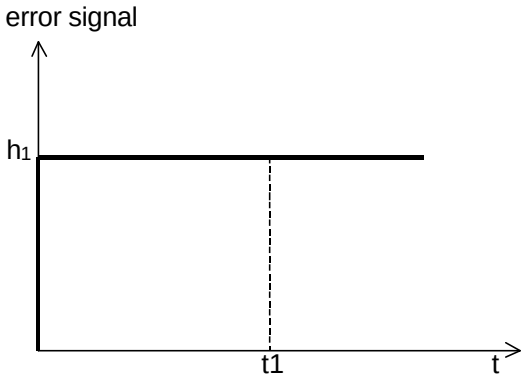
At analogue inputs the relative magnitude and sign of the modification percentage is to be understood related to the initial value of the modification signal (e g.: choosing 70 % of the input signal for initial value, it can vary between +30 % and –70 %).

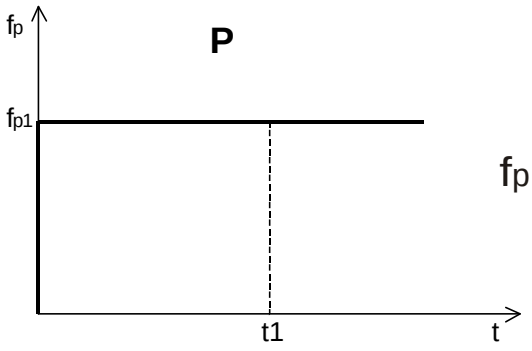
In case of analogue input, the modification signal can change the reference signal according to the following equation:

Modified reference signal [%] = Reference signal [%] + Modification [%] x K

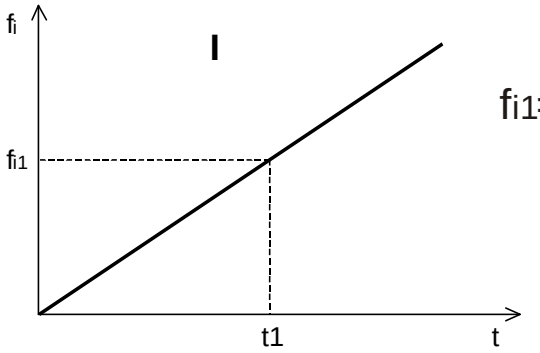
(where **"K"** is the modification correction for analogue inputs. (menu item **1-8-4**)

- **An example for the regulation:**

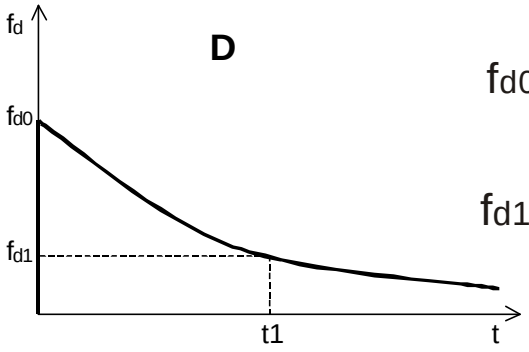




$$f_{p1}=f_{max}\cdot\frac{h_1}{100}\cdot\ pA$$



$$f_{i1}=f_{max}\cdot\frac{h_1}{100}\cdot\frac{t_1}{T_s}$$



$$f_{d0}=f_{max}\cdot\frac{h_1}{100}\cdot A_d$$

$$f_{d1}=f_{d0}\cdot e^{-\frac{t_1}{T_d}}$$

Remarks:

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

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

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

4. 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 kind of applications. (Ti = N, Td = N)

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.). (Td = N)

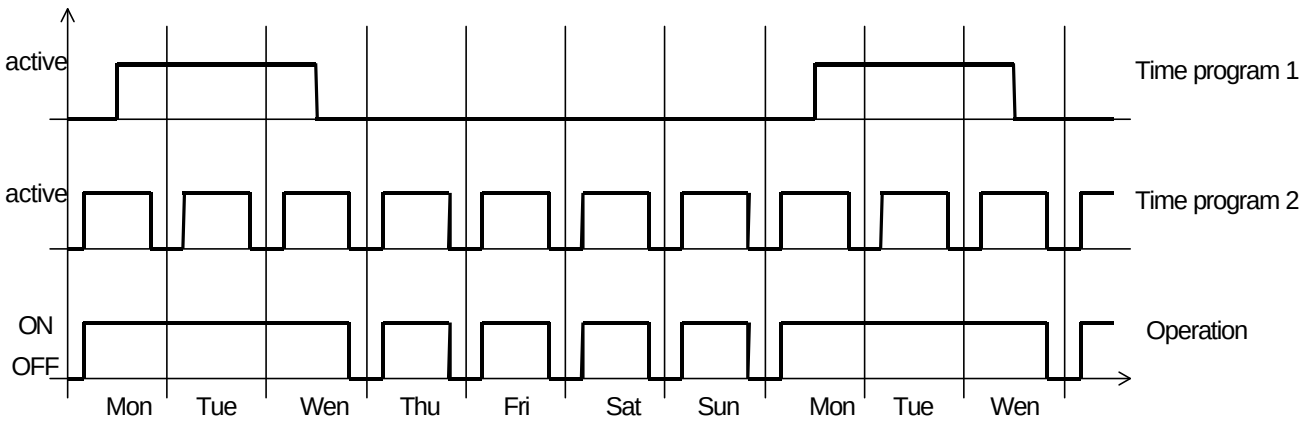
PID regulation has to be used for fast regulations
(e g. regulation of the rotation speed).

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

Submenu	Explanation, further submenus	Values	Default setting	Unit
1-20 Time programs	Operation according to the calendar can be set. Take care of the correct setting of the calendar in menu **11 System**!			
	1-20-1 Enable With setting "No", the time programs are inhibited simultaneously regardless of their settings!	yes no	no	
1-21 Time program 1.	Setting the switch-on time and switch-off time for Time program 1. Operation durations can be set with repetitions every day and weekly!			
	1-21-1 Switch-on			
	1-21-1-1 day	none every day Monday Tuesday Wednesday Thursday Friday Saturday Sunday	none	
	1-21-1-2 Hours	0 - 23	0	
	1-21-1-3 Minutes	0 - 59	0	
	1-21-1-4 Seconds	0 - 59	0	
	1-21-2 Switch-off			
	1-21-2-1 Day	none every day Monday Tuesday Wednesday Thursday Friday Saturday Sunday	none	
	1-21-2-2 Hours	0 - 23	0	
	1-21-2-3 Minutes	0 - 59	0	
	1-21-2-4 Seconds	0 - 59	0	
1-22 Time program 2.	Setting the switch-on time and switch-off time for time program 2. (Its setting is the same as that of **1-21 Time program 1.**)			
1-23 Time program 3.	Setting the switch-on time and switch-off time for time program 3. (Its setting is the same as that of **1-21 Time program 1.**)			

- **Using the time programs:** (figure to menu item 1-20)

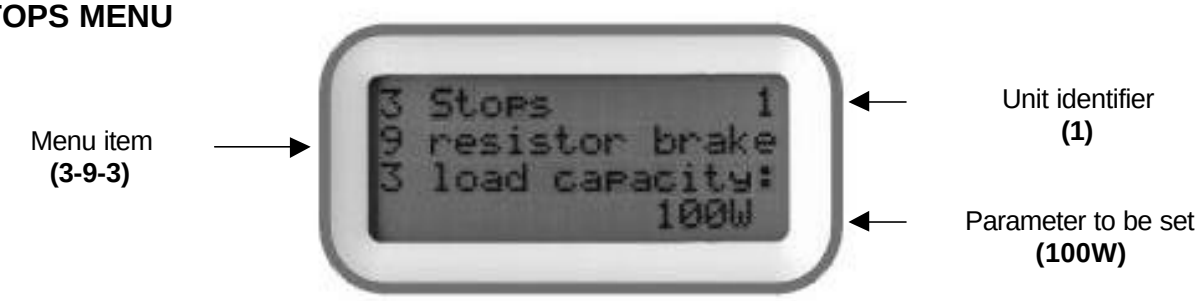
  In the figure below an overlapping time program is shown. Of course, the timings can be set according to demand and even all three time programs can be active!



- **2. STARTS MENU**

Submenu	Explanation, further submenus	Values	Default setting	Unit
2-1 Normal acceleration time	It means at both control and regulation the limitation of the slope of the frequency rise. (The time necessary to reach fmax, starting from 0 Hz)			
	2-1-1 Control Tup:	0.1-5000.0	5.0	s
	2-1-2 Regulation Tup:	0.05-50.00	0.50	s
2-2 Acceleration type	Acceleration without breakp. (normal) and with breakp. (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:	0.1 -3000.0	1.0	s
	2-3-1-2 Frequency:	0.0 - 1000.0	1.0	Hz
	2-3-2 Second breakpoint (f1 → f2) . (Its setting is the same as that of item **2-3-1 First breakpoint**)			
	2-3-3 Third breakpoint (f2 → f3) . (Its setting is the same as that of item **2-3-1 First breakpoint**)			
	2-3-4 Fourth breakpoint (f3 → f4) . (Its setting is the same as that of item **2-3-1 First breakpoint**)			
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! Remark: transition time and enabling of the **S**-curve are the same at acceleration and deceleration, and can be set at any place. (Without programmed **S**-curve, the form of the transitions is "angled")			
	2-4-1 Enable:	no yes	no	
	2-4-2 Transition time:	0.01 - 200.00	0.01	s
2-5 Start inhibit:	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 inhibit:	At selecting "Yes", the function change direction is ineffective, independently of its source. (Terminal, terminal block etc.)	no yes	no	
2-7 Restart	If in the start phase a power break occurs, followed by a switch on within the restart time, the unit starts automatically. If the frequency converter receives the start command from the terminal blocks, the restart time can only become effective at start inhibit or impulse start command. In opposite case, the active start input effects always starting, independently of the restart enable!			
	2-7-1 Enable:	no yes	no	
	2-7-2 Restart time:	1 - 60	10	s
2-8 Start type:	The frequency converter starts from 0 Hz or seeks the frequency necessary for operating the rotating motor.	normal flying start	normal	

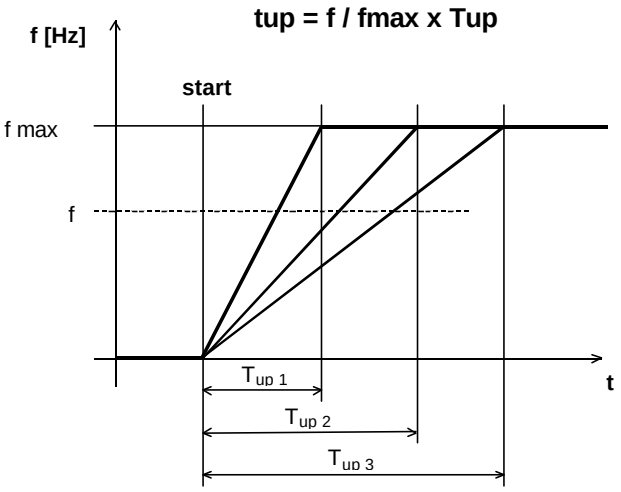
3. STOPS MENU

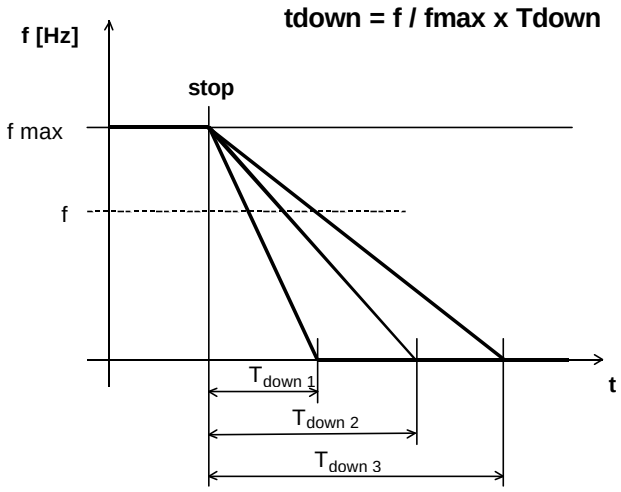


Submenu	Explanation, further submenus	Values	Default setting	Unit
3-1 Normal deceleration time	In means at both control and regulation the limitation of the frequency decrease slope. (The time necessary to reach 0 Hz, starting from fmax)			
	3-1-1 Control Tdown:	0.1-5000.0	5.0	s
	3-1-2 Regulation Tdown:	0.05-50.00	0.50	s
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:	0.1- 3000.0	1.0	s
	3-3-1-2 Frequency:	0.0 - 1000.0	1.0	Hz
	3-3-2 Second breakpoint (f1 ← f2) . (similar to the setting **3-3-1 First breakpoint**)			
	3-3-3 Third breakpoint (f2 ← f3) . (similar to the setting **3-3-1 First breakpoint**)			
	3-3-4 Fourth breakpoint (f3 ← f4) . (similar to the setting **3-3-1 First breakpoint**)			
3-4 S curve	Remark: transition time and enabling of the **"S"** curve are the same for acceleration and deceleration and can be set at any place! (Its setting is the same as that of the **2-4 S curve**)			
3-5 Stop type:	Mixed braking with simultaneous use of normal braking (with the frequency converter) and DC braking.	normal brake DC brake mixed roll out	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:	0.0 – 100.0	0	%
	3-6-2 Excitation time:	0.0 – 10.0	type-dependent	s
3-7 Roll out:	During this time the start command is ineffective. The rotating motor cannot be restarted.	0.1 – 999.9	4	s
3-8 DC brake	(The motor nominal current, parameter **In** in menu **6-4** overrides the braking current. Even at setting higher current value, the frequency converter transmits the nominal motor current only.) The operation of the DC brake is shown in the status display ("DC brake").			
	3-8-1 Highest DC brake current:	0.0 – 999.9	type-dependent	A
	3-8-2 Switch-over frequency:	0.1 – 25.0	2	Hz
	3-8-3 Duration:	0.0 – 5.0	2	s
	3-8-4 De-excitation time: (at pure DC brake)	0.0 – 10.0	type-dependent	s
3-9 Resistor brake	(The basic configuration does not include connection facility for the brake resistor!) 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! The operation of the resistor brake is shown in the status display ("R brake").			
	3-9-1 Enable: (connection permitted?)	no yes	no	
	3-9-2 Value of R:	10 – 200	type-dependent	Ohm
	3-9-3 Load capacity:	100 – 50000	type-dependent	W
	3-9-4 U brake: (brake switch-on level)	600 – 800	type-dependent	V
3-10 Udc hold:	At switching off the supply voltage, the appliance exerts to hold the minimum value of the dc voltage necessary for the operation (generator mode)!	0.0 – 100.0...N	N	%

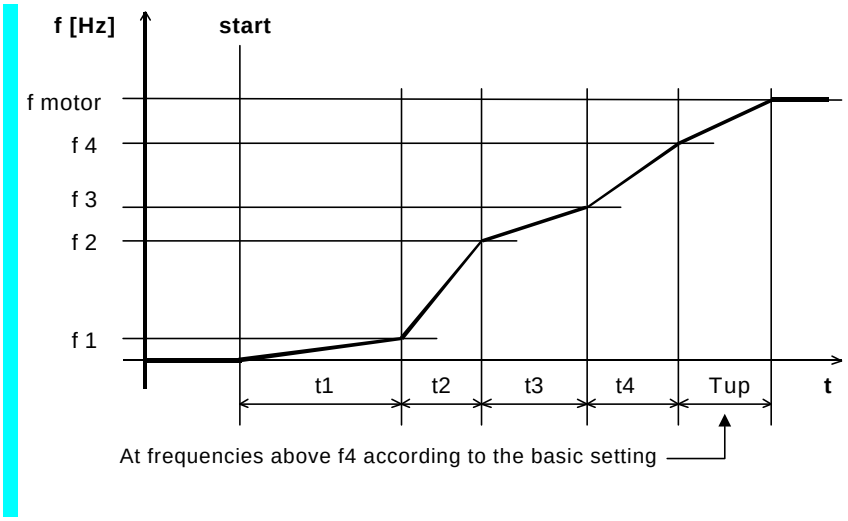
- **Explanation of the acceleration and deceleration times:** (the preset times **Tup** and **Tdown** are to be understood between 0 Hz and fmax)

The effective acceleration and deceleration times (**tup** and **tdown**) belonging to a given frequency can be calculated.



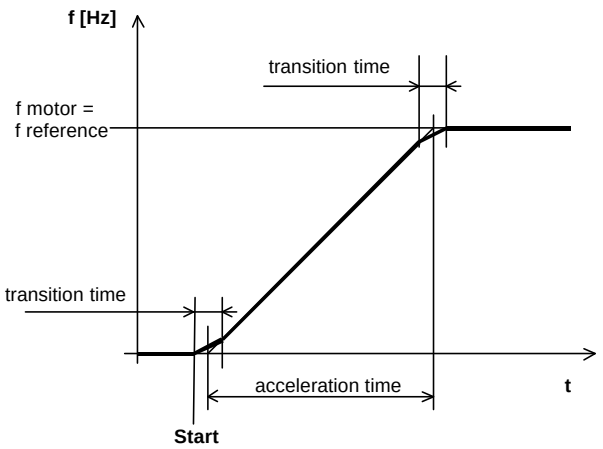


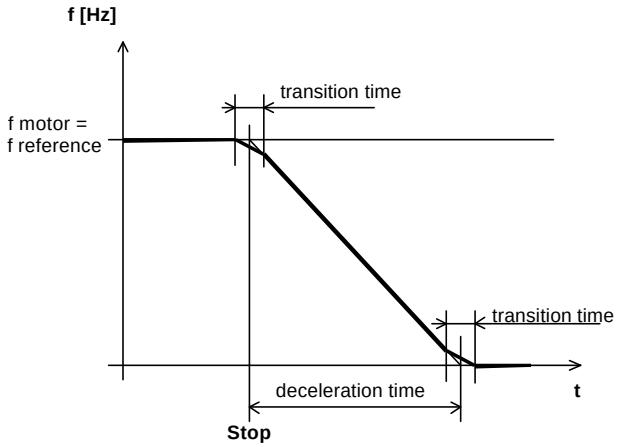
- **Explanation of the acceleration with breakpoints:** (the deceleration with breakpoints can be explained in the same way)



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

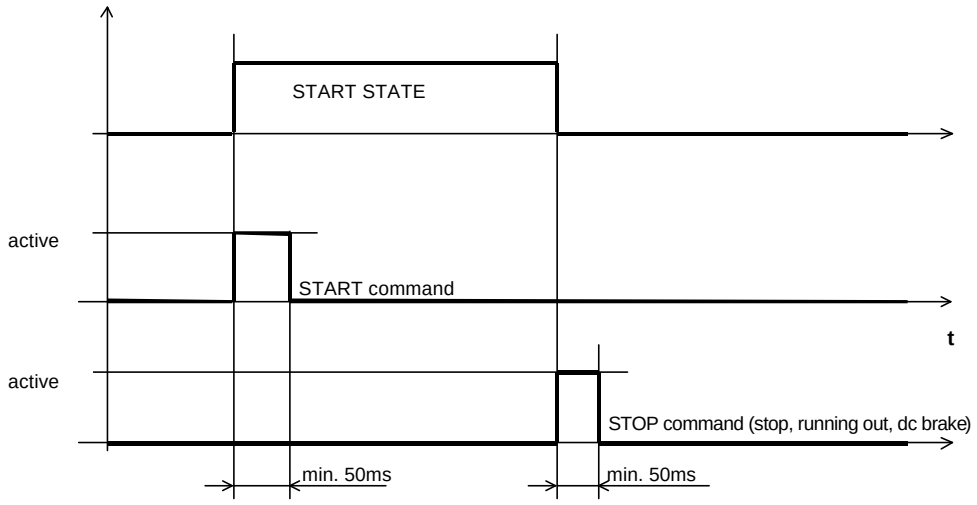
(The acceleration and deceleration times become longer by the transition time. The transition from one slope value to another occurs without breaks, continuously. The slopes of the acceleration and deceleration do not change. At acceleration and deceleration with breakpoints it makes its effect in each breakpoint!)



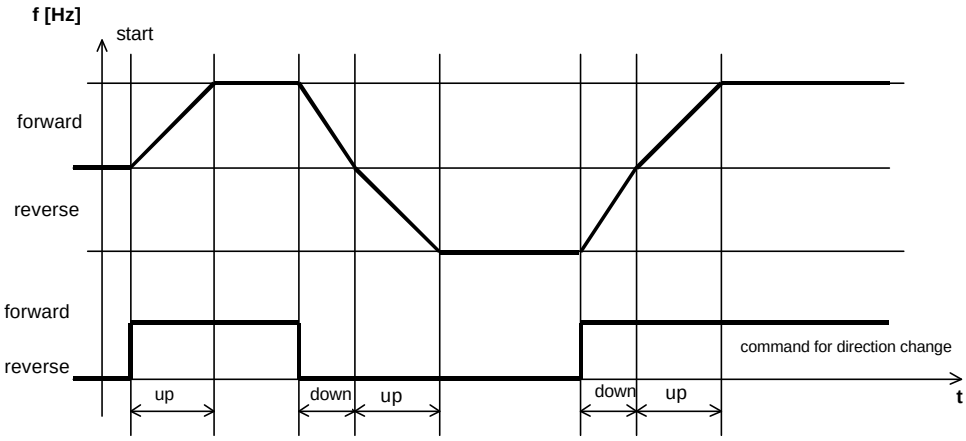


- **Start command with pulse control, from terminal blocks:**

(using a terminal similarly to the operation of the start and stop buttons)



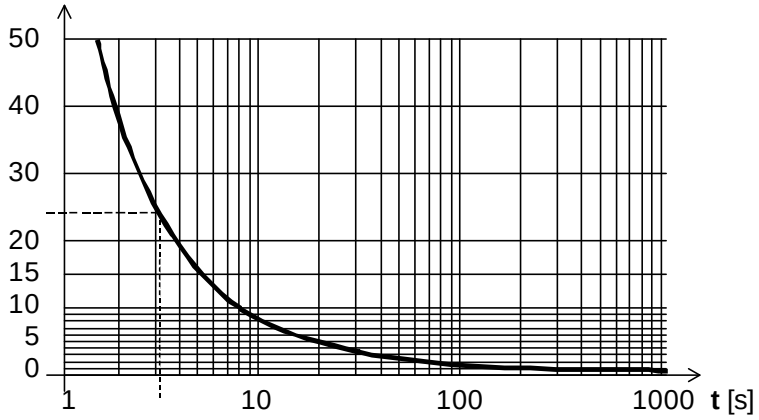
- **Direction change while running:**



- **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!

Overloading

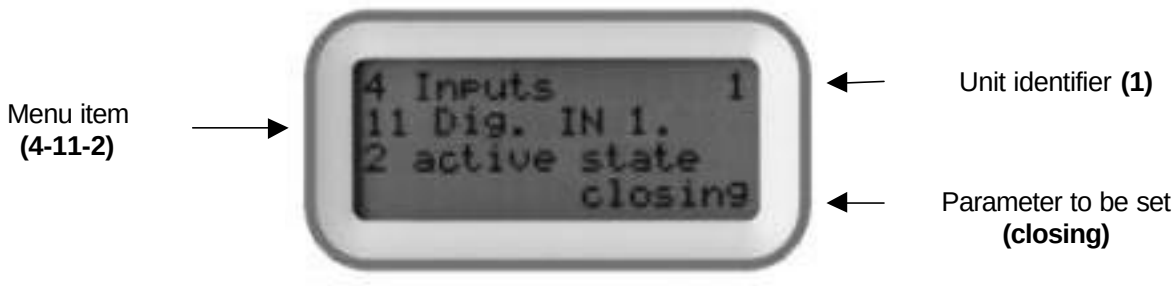


Example:

Rbrake = 100 Ohm
P (Rbrake) = 200W
Ubrake = 700V
$P = 700^2 / 100\ W = 4900W$
Overloading = 4900 / 200 = 24.5

The overloading curve shows that the braking time should not exceed 3 s. The pause between brakings should be longer than 24.5 x brake time!

- **4. INPUTS MENU**



Items of the Inputs menu:

- Analogue inputs
- Digital inputs
- Program inputs (options)

- **ANALOGUE INPUTS:** (basic configuration is Analogue IN 1 input, the Analogue IN 2 input is optional)

The parameters of the potentiometer (mode, stop band, hysteresis) are only valid at setting the reference signal!

The potentiometer setting can be used also for control by voltage, the mode and stop band can also be utilised, but the voltage received by the input is always between 0 and +10 V. The stop band is to be understood above 0 V in normal case and symmetrical to +5 V in case of voltages with sign! In this voltage band, with start command, the unit is in waiting state. The start will be active again by the hysteresis value from the stop band.

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

In **control** mode, the upper level corresponds to → f max, the lower level corresponds to → f min,
In **regulation** mode, the upper level → corresponds to the maximum % value and the lower level → to the minimum % value!

At starting, if the actual analogue input is outside the interval, error indication occurs!

Control function:

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

Features of the comparator mode:

The analogue inputs permit also switching functions.
The settings are to be understood as percentages related to the extreme values!

In "waiting" state, switch on-off mode regulation can be implemented (two point regulation).
The levels of the switch-on and off are determined by the signalisation value and the hysteresis.

At "Stop" setting, the unit stops when the signalisation level is reached. It can be restarted with the Start command if the input level goes below or beyond the signalisation level modified by the value of the hysteresis.

With setting "Error", the unit stops at reaching the signalisation value (with AN comparator error).
(e g. monitoring the motor overheating in analogue way).
Restarting is possible after acknowledging the error and with input level going below or beyond the signalisation level modified by the value of the hysteresis.

With setting "None" the analogue comparator function is ineffective.

Special functions: (T up, T down, U start, In, fmax, fmin)

These permit the most important parameters to be set during operation.
The analogue input permits the programmed parameter to decrease only therefore at programming it should be set to the highest value to be used!
(Remark: the coverage is max. 1:50)

Submenu	Explanation, further submenus	Values	Default setting	Unit
4-1 Analogue IN 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 Selection: Jumper "A1" has to be set, too! (voltage, potentiometer or current)	potentiometer voltage current	potentiometer	
	4-1-2 Potentiometer (with voltage between 0 and +10V, for setting the reference signal)			
	4-1-2-1 Mode: (in case of values with signs, to be understood relative to the mid-position!)	normal signed value	normal	
	4-1-2-2 Stop band: (with setting "N" there is no stop band)	0.01 - 1.00 N	N	V
	4-1-2-3 Hysteresis:	0.01 - 1.00	0.01	V
	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. When selecting control, the control, reference and modification signals can be entered. Selecting comparator permits control depending on the level of the analogue inputs. The further functions permit the most important parameters to be set during operation.	control comparator T up T down U boost In fmax fmin	control	
	4-1-6 Comparator for setting the signalisation levels at the input			
	4-1-6-1 Mode: What state should take the appliance at the comparation level?	waiting stop error	waiting	
	4-1-6-2 Signalisation value:	0.0 - 100.0	50.0	%
	4-1-6-3 Hysteresis:	0.00 - 10.00	0.1	%
	4-1-6-4 Type: When selecting normal, the **Mode** is active above the signalisation value, when selecting inverse, below the signalisation value**.**	normal inverse	normal	

4-2 Analogue IN 2.	Its settings are similar to that of analogue input IN! (**menu item 4-1**) Along with selecting **4-2-1,** jumper "A2" has to be set, too! (Voltage, potentiometer or current)

- **DIGITAL INPUTS:**

Digital IN 1.: free programmable (default setting: Start switch)
Digital IN 2.: free programmable (default setting: Direction)
Digital IN 3.: free programmable (default setting: Jog)
Digital IN 4.: free programmable (default setting: Acknowledgement)
Digital IN 5.: free programmable (default setting: External error)

Attention:
When start command is to be given by pulse, e.g. one of the digital inputs should be programmed to function stop, roll out or dc brake, since stop command can be given out from these only!
The above can be disregarded if the source of the logic controls is the terminal/terminal blocks since in this case the stop command can be given out from the terminal. If the source of the logic controls is not the terminal/terminal blocks or the input is not set properly, the appliance will stop with parameter error at giving out the start command!
Requirement against the pulses: the pulses will only accepted if they exist in both logic states for at least 50 ms!

Submenu	Explanation, further submenus	Values	Default setting	Unit
4-8 Source of logic control:	This parameter permits the source of the Start/Stop, Direction and Jog inputs to be selected. Attention: the activation of the logic controls can always be made from the place according to the selection. Except for the jog which even with RS485-R can be activated from the terminal blocks, for the adjustment of the machinery!	terminal terminal blocks terminal / t. blocks RS485-R	terminal	

4-9 Logic parameters	Setting further parameters of the digital inputs.			
	4-9-1 Direction change mode:	level pulse	level	A
	4-9-2 Motor potentiometer			
	4-9-2-1 Motor pot. up: acceleration time	0.0 – 999.9	10.0	s
	4-9-2-2 Motor pot. down: deceleration time	0.0 – 999.9	10.0	s
	4-9-2-3 Reference signal=0: Means the zero setting of the motor potentiometer reference signal.	none at switching on to start	none	
	4-9-3 Continuous dc brake current: (If activated from digital input)	0.0 – 999.9	0 type-dependent	A

4-11 Digital IN 1.	For selecting special function commands or to copy the program written to one of the program inputs!			
	4-11-1 Selection:	special functions Pr. IN1 - Pr. IN8		
	4-11-2 Active state: (with closing or breaking contact)	closing breaking	closing	
	4-11-3 Counter 1 direction: Reaching zero at downcounting causes stop! At counting „up-0” the start resets the counter!	down up up -0	up	
	4-11-4 Counter 1 starting value:	0 - 50000	0	

4-12 Digital IN 2.	(The setting is equal to that of item **4-11 Digital IN 1.**)
4-13 Digital IN 3.	(The setting is equal to that of item **4-11 Digital IN 1.**)
4-14 Digital IN 4.	(The setting is equal to that of item **4-11 Digital IN 1.**)
4-15 Digital IN 5.	(The setting is equal to that of item **4-11 Digital IN 1.**))

- **Explanation of the special functions:** (they can be selected at the digital inputs)

Start switch: continuous start command. To activate it, for source of the logic controls terminal blocks or terminal / terminal blocks are to be selected. If multiple digital inputs are programmed as start switch, they are in logic “AND” relation therefore all of them must be activated to achieve start command!

Start button: pulse type start command. To activate it, for source of the logic controls terminal blocks or terminal / terminal blocks are to be selected. 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!

Remark: if there are start switches and start buttons mixed, all start switches must be activated so that the start command can be given out with any of the start buttons!

Direction: direction change command. To activate it for source of the logic controls terminal blocks or terminal / terminal blocks are to be selected. It can be level or pulse activated. If multiple digital inputs are programmed to direction change, then at activating any of them the direction will always be changed. If the source of the logic controls is terminal / terminal blocks, the direction change from the terminal can only be made if pulse type direction change is selected! (The type of the direction change can be set in menu **4-9**.)

Normal jog: generally to be used for adjusting the machinery. It is active from stop state only, in the pre-selected direction.

Inverse jog: generally to be used for adjusting the machinery. It is active from stop state only, in the opposite of the pre-selected direction.

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

Stop: makes the motor stop according to the default setting.

Roll out: makes the motor stop with rolling out.

Dc brake: makes the motor stop with dc braking.

f hold: inhibits the change of the frequency. The frequency cannot change during acceleration and deceleration either!

Motor potentiometer up: if the source of the actual reference signal is the motor potentiometer this input permits the increase of the reference signal.

Motor potentiometer down: if the source of the actual reference signal is the motor potentiometer this input permits the decrease of the reference signal.
(Further parameters of the motor potentiometer can be set in menu item **4-9**)

Control / Regulation: permits the dynamic switch-over of the operating mode.

Program inhibit: inhibits the running of the programs. It is in logic "AND" connection with menu item 4-20-1.

Program stop: halts the running of the program. When restarted, the program starts at the point it was halted.

Program step: the running program steps. Its effect is the same as if the time limitation would have elapsed!

RS485T / R change: even in a configuration with a single serial line there is the possibility to use both. However at switching on the appliance sets the serial line depending on the actual state and this cannot be changed during operation. A new state can only be activated after switching off and on the appliance!

Analogue IN swap: switches over the (by default setting) analogue input (An. IN1. or An. IN2.) to the other one until it is active! (e.g. manual and automatic control. Manual control done e.g. with An. IN1. potentiometer, automatic control e.g. with An. IN2. current input.) (e.g. at pressure regulation if the feedback pressure signal is measured at two places and the active one has to be switched over etc.)

Modification: discrete change of the preset reference signal according to an external condition. (menu item **1-8-5**)

Counter: each input may mean an individual counter (1-5). Even five counters can operate at the same time.
The counters can be programmed individually (direction, zero set). They can be used for stopping and displaying.

IRE position zero set: for declaring the basic position at position regulations and master/slave solutions.

Acknowledgement: acceptance of the error messages.

Program IN1 – IN8: for copying any of the internal programs. The program can be activated from terminal blocks also without equipped program inputs.

Slave parameters:

Submenu	Explanation, further submenus	Values	Default setting	Unit
4-16 Slave data	They complement the signals received through the system serial line, for use by the "slave" units. (Master/slave relation can be established in both control and regulation mode) Setting the frequency ratio and rotation speed ratio is necessary for motors with different pole numbers and gear ratios. The angle position can only be of positive value. (E.g. at slave "lag" of 10°, the value of 10 has to be set while at slave "lead" of 10°, the value of 350.)			
	4-16-1 Frequency ratio: (slave multiplier)	0.10 – 10.00	1.00	
	4-16-2 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.)			
	4-16-2-1 Multiplier:	0 - 1000	1	
	4-16-2-2 Divider:	0 - 1000	1	
	4-16-3 Angle position: (slave lag)	0.0 - 360.0	0	°

IRE parameters:

4-17 IRE data	Parameters necessary for rotation speed and position regulations.			
	4-17-1 Division: Its setting means the number of pulses during one revolution of the IRE.	0 - 10000	1000	
	4-17-2 Rotation speed 100%: (at rotation speed regulations)	0 - 6000	1500	
	4-17-3 Position 100%: (at position regulations)	0 - 50000	1000	
	4-17-4 Position=0: Setting the zero ("HOME") position of the incremental rotation encoder	now to start to prg. cycle start		

- **PROGRAM INPUTS:** (the program inputs which activate from terminal blocks are optional!)

Submenu	Explanation, further submenus	Values	Default setting	Unit
4-20 Program activation	Further parameters necessary for operating the programs.			
	4-20-1 Selection: With setting "Inhibited" the programs can be inhibited at the same time regardless of their selection!	inhibited from terminal block at starting	inhibited	
	4-20-2 character: State of the system to go to after finishing a program or a program group.	return stop cycle	return	
	4-20-3 Time delay: At running programs, in case of regulation, the time period is to be understood after the error signal decreased below the preset value.	0.01-100.00	N	%
	4-20-4 Type: Refers to the input which activates the program!	level pulse	level	
	4-20-5 Cycle counter only active at cyclic program run!			
	4-20-5-1 Type: Its operation is similar to that of the counters.	down up up -0	up	
	4-20-5-2 Starting value:	0-50000	0	
4-21 Program IN 1.	Enabling the program IN 1, setting the program parameters			
	4-21-1 Selection:	inhibited active	inhibited	
	4-21-2 operation mode: Selecting "normal" means leaving the default direction unchanged. Selecting "inverse" means changing direction related to the default one. Selecting 'waiting" means stopping with normal stop, unless N is selected for the decelerat. time.	normal inverse waiting	normal	
	4-21-3 Program parameters Those parameters which can become effective upon the **operation mode**, will be active at activating the program unless their selection is "**N**". The acceleration and deceleration times mean the limitations of the slope of the active reference signal (at both control and regulation).			
	4-21-3-1 Frequency: (control ref. sign.)	0.1-1000.0 N	N	Hz
	4-21-3-2 Regulation reference signal:	0.01 - 100.00 N	N	%
	4-21-3-3 Acceleration time: (Tup)	0.1-3000.0 N	N	s
	4-21-3-4 Deceleration time: (Tdown)	0.1-3000.0 N	N	s
	4-21-3-5 PID selection:	1 - 4 N	N	
	4-21-3-6 Duration limit:	0.1-5000.0 N	N	s

4-22 Program IN 2.	(The setting is equal to that of item **4-21 Program IN 1.**)
4-23 Program IN 3.	(The setting is equal to that of item **4-21 Program IN 1.**)
4-24 Program IN 4.	(The setting is equal to that of item **4-21 Program IN 1.**)
4-25 Program IN 5.	(The setting is equal to that of item **4-21 Program IN 1.**)
4-26 Program IN 6.	(The setting is equal to that of item **4-21 Program IN 1.**)
4-27 Program IN 7.	(The setting is equal to that of item **4-21 Program IN 1.**)
4-28 Program IN 8.	(The setting is equal to that of item **4-21 Program IN 1.**)

- **Using the program inputs:**

Step 1: Finding in the menu and enabling the actual program input.
Step 2: Setting the operation mode of the actual program input.
Setting normal means maintaining the default direction.
Setting inverse, means reversing the default direction unless the change of direction is inhibited!
Setting wait means that in the actual program step the frequency converter suspends operation (for the duration of the time limitation) (practically waits in stop mode) and after the time elapsed it continues operation with the next program step. The waiting state is indicated in the status display and with flashing the RUN LED!
Step 3: Setting the program parameters belonging to the actual program input.

If a parameter value is set to **"N"**, at this parameter the program will use the default setting!

- **Activating program inputs:** (Program IN 1. ÷ IN 8.)

1. When activating **from terminal blocks** - the enabled programs (even more than one), can be activated at any time from the established Program inputs. The condition of the operation is the frequency converter being in start state. (In basic configuration the activation can also be made with Digital IN 1 - Digital IN 5!)
At the end of the program according to its type it returns to the default setting, stops or repeats cyclically.
With cyclic operation selected, at discontinued activation of the input, the appliance returns to the default setting! At repeated activation the cyclic operation continues!
When the inputs are activated, they take over the operation from the default setting. The programs written to the activated inputs run in the sequence of their priorities. If a program conveys the control because its time expired, it can only be restarted by activating after an inactive state (that is after switching the input off and on).
Commands stop, roll out and dc brake can stop the operation at any point!

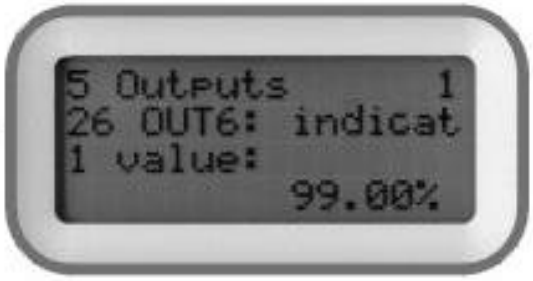
2. When activated with **Start**, the enabled program or program group is started with the start command!
In this case no established Program inputs are necessary for running the programs.
At the and of the program according to its type it returns to the default setting, stops or repeats cyclically.
Return – when selected, the process will be terminated if at the enabled program or program group the duration elapsed or the program is inhibited, then the operation returns to the default setting.
Stop - when selected, the process will be terminated if at the enabled program or program group the duration elapsed or the program is inhibited, causing stop command. Stop is done according to the default setting.
Cyclic - when selected, the process will be terminated if at the enabled program or program group the duration elapsed, then the operation will be restarted at the highest priority point of the program group.
The process can be stopped with the commands stop, roll out and dc brake!

Example for activating from the terminal blocks:

If the setting at input Program IN1 is **N, 32.0%, N, N, 1, 5s,** it means that with activating the programmable digital input IN1:
- the control reference signal is not active (in case of control the default setting is valid),
- at regulation the reference signal is 32.0 % regardless of the value of the selected reference source (potentiometer, terminal).
- acceleration and deceleration of the reference signal occurs according to the default setting of the regulation reference signal,
- in the regulation PID1 is the active setting,
- the duration is limited to 5s.

Since 5s are given for the duration, this state exists for 5s from the beginning of the program run. After 5s the reference signal of the selected reference signal source becomes valid regardless of the state the drive reached to.
However, if input Program IN 2. has also been activated, after the elapse of time 1., the operation continues with the parameters according to the setting of Program IN 2.
According to this, if e.g. a 4 step program has to be performed, the actual 4 inputs from among Program. IN1. ÷ Program. IN 8. have to be jointed and activated jointly during start when the run of the program should start (without start, the run of the programs written to the activated inputs will begin at the appearance of the start command).
At performing multilevel programs, the acceleration and deceleration time parameters will develop with regard to the reference signal existing in the moment of the switch-over and the reference signal programmed to the next input. (This applies to the reference signal at both control and regulation).
Thus, if due to the time limitation, at the actual input the acceleration and deceleration has not yet finished, or even if finished, because of the switch-over, beginning from the actual reference signal either the acceleration parameter or the deceleration parameter become valid depending on the reference signal programmed to the next input being larger or smaller related to the previous one.
If during operation, a higher priority input will be activated again, it takes back operating from the one with lower priority!

5. OUTPUTS MENU



Menu item
(5-26-1)

Unit identifier
(1)

Parameter to be set
(99.00%)

Items of the Outputs menu:

- **Analogue outputs**
- **Relay outputs**
- **Digital outputs** (option)

Remarks:

- The analogue outputs can only be established at frequency converters with power ratings over 2.2 kW!
- At all frequency converters identically, the analogue outputs are the percentual values related to the nominal motor parameters. (**fn, Un, In, Pn, n, n/IRE,** by default 0 to 10V → 0 to 100%)
- Using the built-in relay outputs, the programmable digital outputs can be copied making both establishing the output and external relay connection unnecessary. Moreover, these relay outputs offer further programming options (PID extension, timer).
  The PID extension permits the regulated unit to be supplemented even with further 3 fix switchable units (e g. pressure regulation with multiple compressors).
  With setting "N" for the duration limit at the timing parameters, the operation of the relay is continuous. Delay and duration can be programmed together, too.
- Digital outputs led to the terminal blocks are only needed if the job cannot be solved with the 3 optional relays. For operating a heavy-current actuator unit, the outputs need to be supplemented with a relay unit and power supply!

- **ANALOGUE OUTPUTS:**

Submenu	Explanation, further submenus	Values	Default setting	Unit
5-1 Analogue OUT 1.	For setting the analogue output voltage belonging to the nominal data of the motor. The correct setting of the motor parameters is important because it affects the scaling of the analogue output, that is, changing the motor parameters changes the values of the outputs, too! In case of the error signal the output indicates the measured value related to 100%.			
	5-1-1 Selection: This item permits to select that quantity whose proportional, as voltage, will be given out at output Analogue OUT 1.	frequency voltage current power rotation speed rotation speed IRE error signal	frequency	
	5-1-2 Nominal value: (The voltage belonging to the nominal value)	0.0 - 10.0	5.0	V
5-2 Analogue OUT 2. (option)	Setting the parameters of Analogue OUT2. output. (Its setting is the same as that of item **5-1 Analogue OUT 1.**)			

Remark:
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 **4-17-2**).
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!

- **RELAY OUTPUTS:**

Submenu	Explanation, further submenus	Values	Default setting	Unit
5-11 Relay 1.	In basic state, copying one of the Digital outputs using the built-in relay or implementing timing function or PID extension or back indication of time programs or inactive state ("N").			
	5-11-1 Selection: The timing parameters are in menu item **5-11-3** The PID extension parameters are in menu item **5-11-4** When selecting Time program the relay is active at any time program. When selecting any of Time programs 1, 2, 3 the relay is only active at the selected one.	OUT 1...OUT 8, timer PID extension, time program time program 1 time program 2 time program 3 N	OUT 1.	
	5-11-2 Active state: (operating or breaking contact)	operating breaking	operating	
	5-11-3 Timings			
	5-11-3-1 Delay: (after activating)	0.0- 5000.0	0.0	s
	5-11-3-2 Time: (duration limit)	0.1- 5000.0 N	N	s
	5-11-3-3 Type:	to start to stop halt to value	to start	s
	5-11-4 PID extension parameters			
	5-11-4-1 Serial number: (switch-on)	1...3 N	1	
	5-11-4-2 t in: (delay in)	0.0- 5000.0	10.0	s
	5-10-4-3 t out: (delay out)	0.0- 5000.0	10.0	s
5-12 Relay 2. (option)	Setting the parameters of Relay 2. output. (Its setting is the same as that of item **5-11 Relay 1.**)			
5-13 Relay 3. (option)	Setting the parameters of Relay 3. output. (Its setting is the same as that of item **5-11 Relay 1.**)			

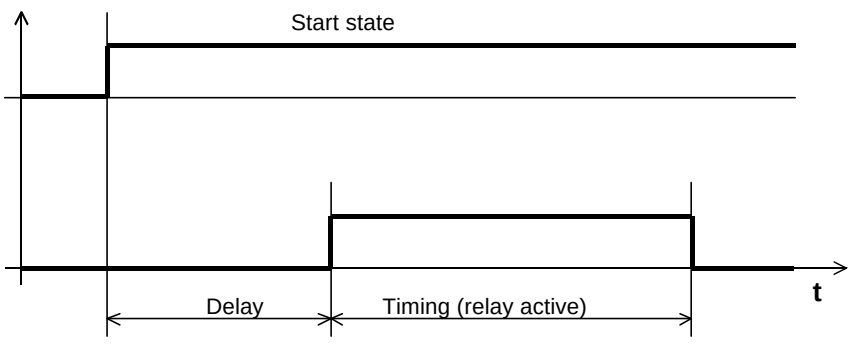
Remark:

Below 2.2 kW in basic configuration relay is not included. Two optional relays can be built in.
For their programming see that of Relay 1 and Relay 2!

At relays, it is practical to choose the closing contact for the active state, so that the back indication of the two most important operation modes is logically right without supply voltage, too!

Good - Error back indication: In case of error open contact (e g. for switching off other units)
Run - Halt back indication: In case of halt open contact (e g. for controlling the brake of motors equipped with brake)

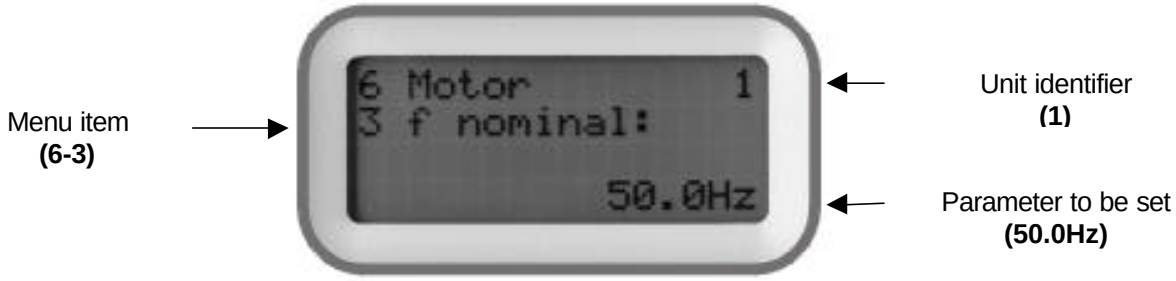
- **Example for programming the relay:** (timing and delay for start)



- **DIGITAL OUTPUTS:** (Optionally, digital outputs can be led to the terminal blocks!)

Submenu	Explanation, further submenus	Values	Default setting	Unit
5-21 Digital OUT 1.	**OUT 1: Good - error** indication It can be chosen whether operating or breaking contact means the "Good" (ready to operate) state	operating breaking	operating	
5-22 Digital OUT 2.	**OUT 2: Run - halt** indication It can be chosen whether operating or breaking contact means the "Run" (operates) state.	operating breaking	operating	
5-23 Digital OUT 3.	**OUT 3: Forward - backward** indication It can be chosen whether operating or breaking contact means the "Forward" (direction of rotation) state. The default direction is decided with wiring the output of the frequency converter	operating breaking	operating	
5-24 Digital OUT 4.	**OUT 4: Tsink** back indication of the heatsink temperature. (Active state is when the heat sink temperature exceeds the preset indication value)			
	5-24-1 Indication value: (temperature)	0 - 90	75	°C
	5-24-2 Active state: (operating / breaking contact)	operating breaking	operating	
5-25 Digital OUT 5.	**OUT 5: Load** Percentual value related to the nominal motor current (In), when reached indication will be given after the delay time.			
	5-25-1 Limit current (related to In)	10 - 150	100	%
	5-25-2 Delay (to activating the indication)	0 - 60	0	s
	5-25-3 Active state: (operating / breaking contact)	operating breaking	operating	
5-26 Digital OUT 6.	**OUT 6: Indication** At control, becomes active if the output frequency approached the reference signal by the % value given in the indication value. (1% is to understood as fmax/100!) At regulation, becomes active if the feedback signal approached the reference signal by the % value given in the indication value. The inactive state is to be understood at the indication value - hysteresis.			
	5-26-1 Indication value:	0.01 – 100.0	99.00	%
	5-26-2 Hysteresis:	0.01 - 10.00	1.00	%
	5-26-3 Active state: (operating / breaking contact)	operating breaking	operating	
5-27 Digital OUT 7.	**OUT 7: f >** Active above the programmed frequency. Through selecting the active state, it can be decided whether below or beyond the preset frequency value the output should become an "operating contact" (e.g. in which case the connected unit should operate). A Δf hysteresis value can be given. The indication at the output will only ceased if the frequency decreases below f-Δf. If f-Δf is less than 0 Hz, the output becomes inactive at zero 0 Hz.			
	5-27-1 Frequency:	0.0 - 999.9	10	Hz
	5-27-2 Hysteresis: (Δf)	0.1 - 10.0	1	Hz
	5-27-3 Active state: (operating / breaking contact)	operating breaking	operating	
5-28 Digital OUT 8.	**OUT 8: f < >** This item is active in the interval between two preset frequency values. With selecting the active state it can be decided whether within the interval between both frequency values or outside the output should become an "operating contact" (e.g. in which case the connected unit should operate). A Δf hysteresis value can be given. At increasing the frequency the output becomes active at f1 and remains active up to f2+Δf. At decreasing the frequency the output becomes active at f2 and remains active up to f1-Δf. If f1-Δf is less than 0 Hz, the output becomes inactive at 0 Hz.			
	5-28-1 f1 frequency:	0.0 - 999.9	40	Hz
	5-28-2 f2 frequency:	0.0 - 999.9	45	Hz
	5-28-3 Hysteresis: (Δf)	0.1 - 10.0	1	Hz
	5-28-4 Active state: (operating / breaking contact)	operating breaking	operating	

- **6. MOTOR MENU**



Submenu	Explanation, further submenus	Values	Default setting	Unit
6-1 Nominal power Pn:	For calculating the temperature rise of the motor. The thermal time constant is different at motors of different power ratings.	0.25 - 200	type-dependent	kW
6-2 Nominal voltage Un:	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.	110 - 440V	400	V
6-3 Nominal frequency fn:	The frequency belonging to the nominal voltage. This item sets the upper frequency corner point of the U/f curve.	25 - 1000	50	Hz
6-4 Nominal current In:	The motor current permissible for permanent operation. This is the current the 100 % thermal model belongs to. This current value corrected with the torque limit can only develop, if it is less than **I inverter limit!**	1.0 - 500.0	type-dependent	A
6-5 Nominal rotation speed nn:	The rotation speed at nominal load. At the displays it can be used as orientation data in function of the load.	100 - 60000	1450	f/min
6-6 Cooling type:	This data is necessary for the thermal modelling of the motor. In case of forced cooling, the motor can be loaded up to the nominal torque also at low frequency (below 10 Hz).	own forced	own	
6-7 Torque limit:	The largest torque permitted by the frequency converter. It modifies the frequency to decrease the load or stops with error signal if the load does not decrease or the modification of the frequency is inhibited. The value 200% cannot be exploited in any case, because it depends on the motor data and the max. power rating of the frequency converter, too.	10 - 200	120	%
6-8 Heat limit:	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	100	%
6-9 Frequency modification?	It can be decided whether in case of motor overloading the frequency converter is allowed to decrease the frequency or in case of generator overloading the frequency converter is allowed to increase the frequency or the frequency converter should stop with error sign.	yes no	yes	
6-10 Motor test	Automatic recording of the motor parameters with the motor in **standstill**.	test		

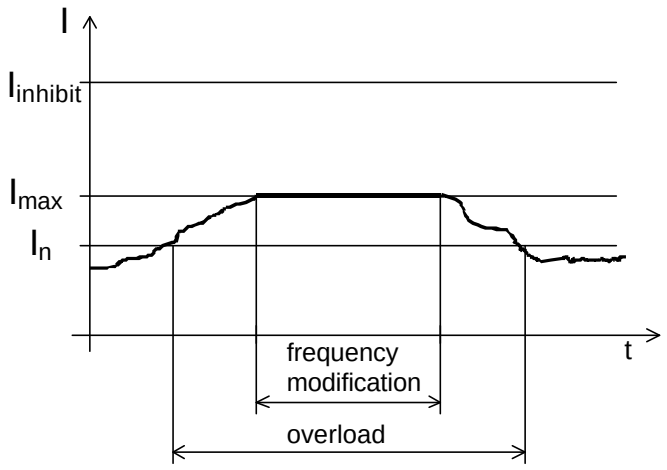
Remarks:

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**).

- **The motor current vs. time:**



$I_{inhibit} = 2 \times I_{max.}$

if $I_{inv.max.} \leq I_{inhibit}$

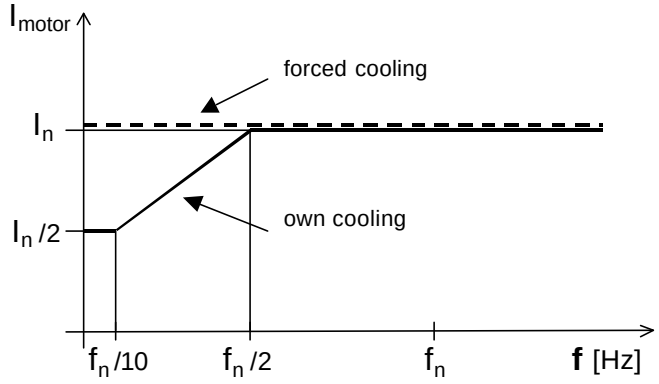
then $I_{inhibit} = I_{inv.max.}$

$I_{max.} = I_{n.} \times$ **Torque limit**

$I_{max.} \leq I_{inv.\ limit}$

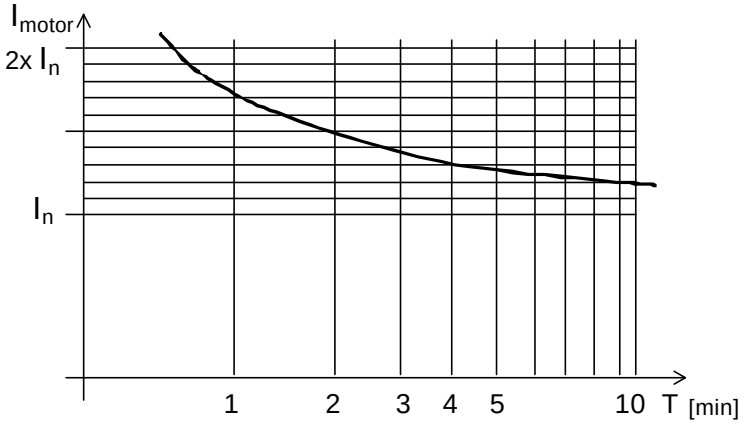
E.g.: In = 4A
Torque limit = 120%
I inv. max. = 9A
I max. = 3A x 1.2 = 4.8A
I max. x 2 = 9.6A
I inhibit = 9A because I inhibit **£** I inv. max.

- **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 if 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:**



If the motor has its own cooling only, without overheating it can be loaded with a current exceeding the nominal value for the period given in the graph!
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%.

- **7. U/f RATIO MENU**

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 linear characteristic is desired, while for compressor - air blower a quadratic charact. (In the torque vs. frequency characteristic this means a curve with constant torque, and a curve with linear increasing torque, respectively)	linear 1 linear 2 quadratic 1 quadratic 2 arbitrary	linear 1	
7-2 U / f modifiers	This item permits the setting of the frequency threshold for the modification of the voltage value and the characteristic, which is necessary for providing the initial flux (drawing supplement: **U/f** curves). U boost: The starting voltage to be given to the motor at start from standstill. f boost: In cases Linear 1 and Quadratic 1 the returning point from the initial U boost voltage to the actual U/f characteristic. The effect of Uboost on the theoretical terminal voltage decreases linear up to fboost and expires above fboost. In cases Linear 2 and Quadratic 2 the nominal voltage will develop by this value prior to the preset nominal frequency.			
	7-2-1 U boost (starting voltage)	0 - 50	type-dependent	V
	7-2-2 f boost: (to the theoretic characteristic)	0.0 - 25.0	type-dependent	Hz
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.) Remark: (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 data			
	7-3-1-1 Frequency:	0.0 – 1000.0	1	Hz
	7-3-1-2 Voltage:	0 - 440	0	V
	7-3-2 Second point data (the setting is the same as that of **7-3-1 First point**)			
	7-3-3 Third point data (the setting is the same as that of **7-3-1 First point**)			
	7-3-4 Fourth point data (the setting is the same as that of **7-3-1 First point**)			
	7-3-5 Fifth point data (the setting is the same as that of **7-3-1 First point**)			
	7-3-6 Sixth point data (the setting is the same as that of **7-3-1 First point**)			
7-4 Load characteristic type	In order to ease creating an arbitrary frequency vs. voltage characteristics, one of the standard characteristics can be downloaded. Then the corresponding points (voltage - frequency) can be modified according to demand.	linear 1 linear 2 quadratic 1 quadratic 2	linear 1	

Remark:

Prior to download a standard characteristic type, the frequency points desired to be used have to be set (in increasing order). The program will enter the actual voltage values by these set points. Frequencies being set not in increasing order will be disregarded!

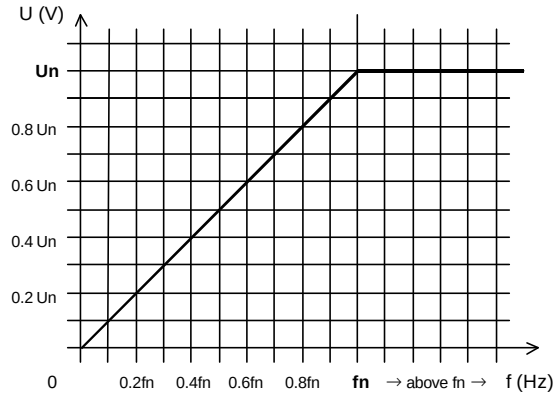
It is practical to choose a small value for f1. (This can substitute for setting Uboost.)

It is practical to choose f nominal for f6. (This can substitute for setting Un.)

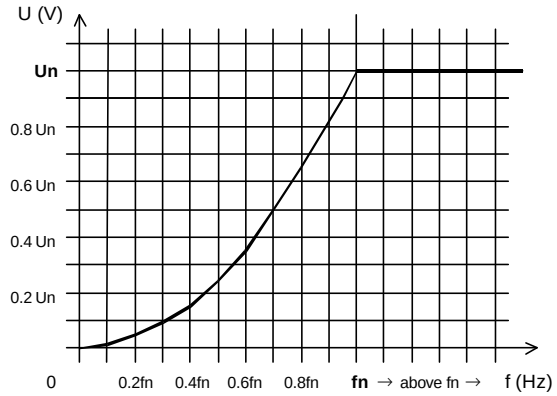
At lower frequencies, it is practical to state the points closer to each other (see default values) so that the mapping of the characteristics will be as accurate as possible.

During downloading a standard characteristic in the third row of the display '**In progress"** is displayed. After having finished the downloading the unit restarts.

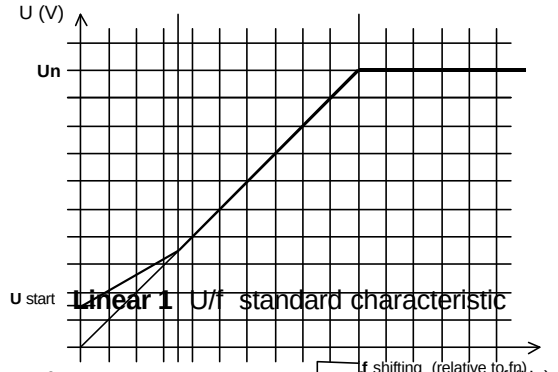
- **APPLICABLE U/f CHARACTERISTICS:**



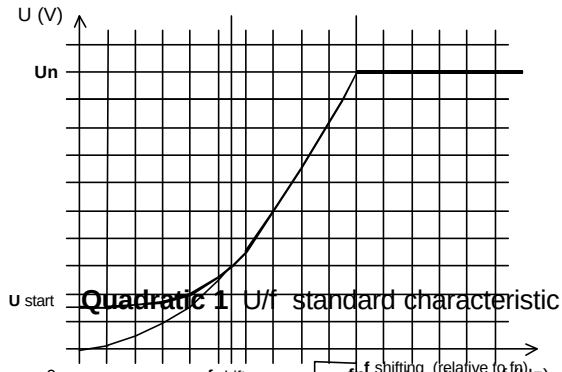
Linear U/f basic characteristic



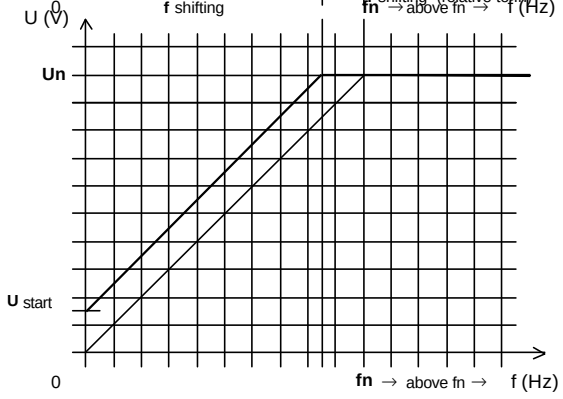
Quadratic U/f basic characteristic



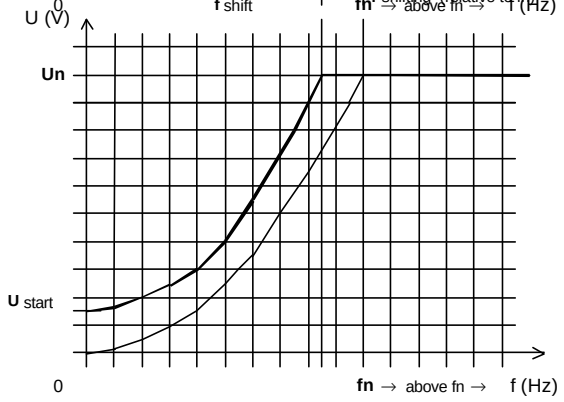
Linear 1 U/f standard characteristic



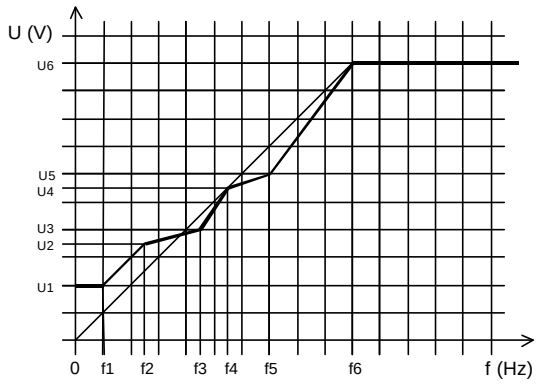
Quadratic 1 U/f standard characteristic



Linear 2 U/f standard characteristic



Quadratic 2 U/f standard characteristic



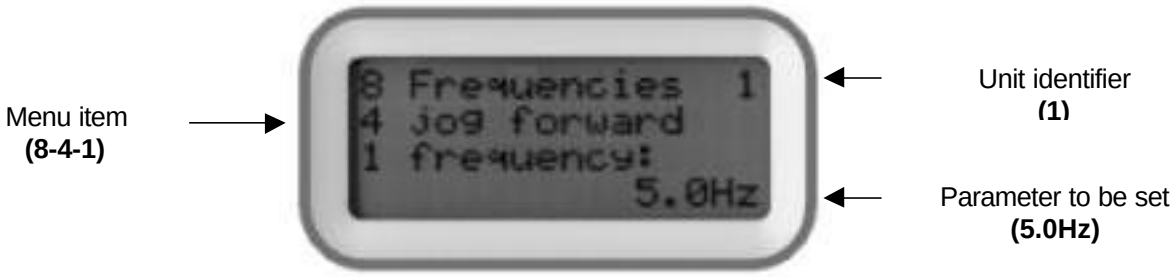
Arbitrary U/f characteristic

At an arbitrary U/f characteristics, 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"!

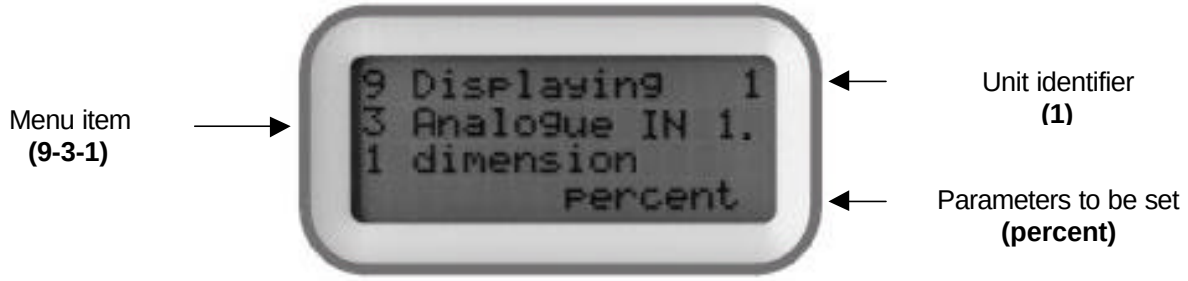
The frequency value which does not fulfil the condition of monotone increase will not be taken into consideration by the program!

- **8. FREQUENCIES MENU**



Submenu	Explanation, further submenus	Values	Default setting	Unit
8-1 f maximum:	This is the highest value of the usable frequency reference signal. It has priority over the minimum frequency! Even if the frequency reference signal is set to a higher value, fmax will be effective!	0.0 – 1000.0	50	Hz
8-2 f minimum:	This is the lowest value of the usable frequency reference signal. Even if the frequency reference signal is set to a lower value, fmin will be effective!	0.0 – 1000.0	1	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 – 1050.0	105	Hz
8-4 Jog forward	Low frequency intermittent mode, generally used to adjusting the machinery. It can be operated from stop state only. With the actual input set to jog, independently of the selected mode (control or regulation), the activation can be made from the point selected for the source of the logic controls (e.g.: terminal), or using the digital input from the terminal blocks! Set-in time means the time of accelerating to jog frequency in forward direction. The mode of stopping and the deceleration time corresponds to the default setting!			
	8-4-1 Frequency:	0.0 - 30.0	5.0	Hz
	8-4-2 Set-in time:	0.1 - 9.9	0.5	s
8-5 Jog reverse	The operation is similar to the forward jog! (Its setting is the same as that of item **8-4 Jog forward**)			
8-6 Inhibited bands	Generally, these provide protection for the driven unit against mechanical resonance. They will be skipped by the frequency converter at both accelerating and decelerating. Also the width of the inhibited frequency bands can be set, because generally the inhibition refers not to a single frequency value but to a narrow band. The inhibited band means that between the set frequency and the value of the set frequency + inhibited band, no frequency value can be set for steady operation. If the frequency converter receives such value as reference signal, below the half value of the inhibited band the lower value, above the half value of the inhibited band the upper value will become effective.			
	8-6-1 f 1 position (Inhibited frequency 1)			
	8-6-1-1 Frequency:	0.1 - 1000.0	0	Hz
	8-6-1-2 Band: (Δf bandwidth)	0.0 - 10.0	0	Hz
	8-6-2 f 2 position (Inhibited frequency 2) (Its setting is the same as that of item **8-6-1 f1 position**)			
	8-6-3 f 3 position (Inhibited frequency 3) (Its setting is the same as that of item **8-6-1 f1 position**)			

- **9. DISPLAYS MENU**



Submenu	Explanation	Parameter	Description	Default setting	Unit
9-1 Parameter 1:	Here, the parameter to be displayed in row 3 in DISPLAY mode can be selected.	f	frequency (actual)	f	Hz
		f. r. sign.	frequency reference signal		Hz
		reg. ref. sign.	regulation reference signal		%
		mod. ref. sign.	modified regulation ref. signal		%
		fb. sign.	regulation feedback signal		%
		An. IN1	analogue IN1 input		-individual-
		An. IN2	analogue IN2 input		-individual-
		Counter 1	counter 1 actual state		-
		Counter 2	counter 2 actual state		-
		Counter 3	counter 3 actual state		-
		Counter 4	counter 4 actual state		-
		Counter 5	counter 5 actual state		-
		Cycle count.	state of the cycle counter		-
		n	motor rotation speed (estimated)		f/min
		n IRE	rotation speed (measured)		revolution
		Imotor	motor current		A
		Pcons.	power consumption		kW
		Uline	power line voltage		V
		Umotor	motor terminal voltage		V
		Udc	Intermediate circuit dc voltage		V
		Prod.	productivity		-individual-
		Tsink	heat sink temperature		°C
		Serv. h1	total service hour counter		hour
		Serv. h2	"Run" service hour counter		hour
		Dig. IN	state of digital inputs		-
		Prg. IN	state of program inputs		-
		Relay	state of relay outputs		-
		Dig. OUT	state of digital outputs		-
		Date	year, month, day, hour, minute		-

9-2 Parameter 2:	Here, the parameter to be displayed in row 4 in DISPLAY mode can be selected (default setting: Imotor) (Its setting is the same as that of item **9-1 Parameter 1**)

- **Dynamic state back indications:**

They appear in the middle of the display's first row. The display occurs in the moment of the occurrence and lasts at least for the minimum perception time (approx. 0.4 s) or steady until the dynamic operation mode exists.
At more than one states to be displayed the appliance displays all of them but in sequence and at the end the state of highest priority stays in the display until this state exists!

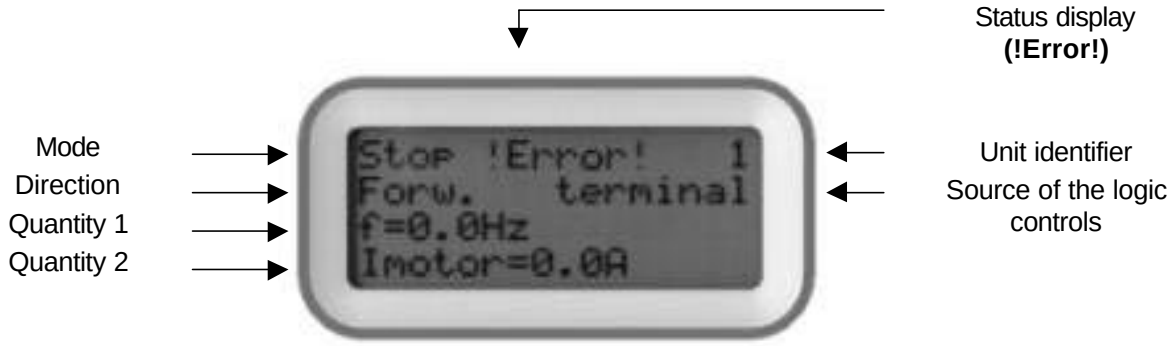
<u>The possible dynamic operation states (in the order of priorities)</u>:

(! Error !, U dc<, Stop, Dc brake, Free run, Stop, f hold, Cnt.stp, Potm.stp, Comp.stp, Waiting, R. brake, Program1... Program8, Time prg., U dc lim, I.limit, Gen.mode, Mot.pot., Jog,)

Submenu	Explanation, further submenus	Values	Default setting	Unit
9-3 Analogue IN 1.	Depending on the setting of the input, the dimension can be of several different kinds.			
	9-3-1 Dimension:	percent voltage current frequency	percent	% V mA Hz
9-4 Analogue IN 2.	Depending on the setting of the input, the dimension can be of several different kinds.			
	9-4-1 Dimension:	percent voltage current frequency	percent	% V mA Hz
9-5 Feedback signal	Permits entering the numeric value corresponding to the 100% of the feedback signal and the dimension.			
	9-5-1 Correspondence:	0.00 – 600.00	100.00	
	9-5-2 Dimension: (extendable according to demand!)	- percent piece pc mass kg mass t length mm length m speed m/s speed km/h volume l volume m^3 revolution pressure bar temperature °C	-	 % pc kg t mm m m/s km/h l m^3 rpm bar °C
9-6 Productivity	This parameter permits displaying a deliberate technological quantity, which is proportional with the frequency or the consumed power. This correspondence can be made at a deliberate frequency or power value! To the display an individual dimension can be assigned.			
	9-6-1 Selection:	frequency power	frequency	
	9-6-2 Frequency:	0.1 - 1000.0	50	Hz
	9-6-3 Power:	0.1 - 200.0	type-depending	kW
	9-6-4 Correspondence:	0.1 - 6000.0	100.0	
	9-6-5 Dimension: (extendable according to demand!)	- percent piece pc mass kg mass t length mm length m speed m/s speed km/h volume l volume m^3 revolution pressure bar temperature °C	-	 % pc kg t mm m m/s km/h l m^3 rpm bar °C

- **10. ERRORS MENU**

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



Pushing the Escape button, menu item **10 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. The third and fourth rows show the time of the occurrence of the error. The figure in the end of the fourth row shows the order of the errors. The last error is of **"0"** the previous one of **"-1"**.
Up to 512 errors can be read in the display.
The frequency converter can only be started after the acknowledgement of the error.

- **Error acknowledgement:**

  - Switching the frequency converter off and on
  - Giving a rising and falling edge to the Digital IN1...IN5 input programmed for acknowledgement
  - From the terminal, pushing the “ENTER” button in the Errors submenu, at the last error!

After acknowledgement the display returns to the Main menu.

Remark: The error message **"Deleted"** means the empty storing places along with the deletion date of the error log the last time.

With low operating voltage both reading and writing of the error log is inhibited.
In this case the appliance cannot receive start command either!
The appliance indicates the reason of the error with **U DC<** status display also in the Errors menu!

- **List of errors:**

Displayed text	Short description of the error
Deleted	Indicates the deletion date of the error log.
External error 1-5	Error indication generated by activating Digital IN1. - IN5. (e.g. warning by the thermal switch on the motor, field inhibit etc.).
Motor overheated	The motor temperature is too high according to the thermal model.
Motor overcurrent	The motor current exceeded the maximum value. (its value: In motor x torque limit x 2 , but maximum I converter max.)
No motor	There is no motor connected to the motor terminals or its power rating is too low. (monitoring: from 10Hz to 40 Hz, if I motor < 5% of In)
U phase error	U phase conductor of the motor broken (not connected) or the current asymmetry across the motor is abnormally high.
V phase error	V phase conductor of the motor broken (not connected) or the current asymmetry across the motor is abnormally high.
W phase error	W phase conductor of the motor broken (not connected) or the current asymmetry across the motor is abnormally high.
Brake overload	According to the preset data of the brake resistor the brake is overloaded.
Line phase error	E g. any of the input phase voltages broken or abnormally low relative to the others.
Heatsink too cold	The measured heatsink temperature is too low (possibly broken sensor).
Heatsink too hot	The measured heatsink temperature is too high (possibly shorted sensor).
U phase overcurrent	The U phase output of the freq. conv. is overloaded, that is I motor Uphase > I conv. max.
V phase overcurrent	The V phase output of the freq. conv. is overloaded, that is I motor Vphase > I conv. max.
W phase overcurrent	The W phase output of the freq. conv. is overloaded, that is I motor Wphase > I conv. max.
IGBT HW protection	The converter gave out an error indication and the IGBT module received hardware inhibition.
IGBT protection	Error indication from the IGBT module.
HW voltage protection	The DC voltage in the intermediate circuit reached the limit of inhibit by hardware. (At IHD frequency converters can also be phase error or release of the charging relay!)
Low line voltage	The input line voltage does not reach the permissible lowest value.
DC overvoltage	The DC voltage in the intermediate circuit exceeded the permitted limit.
Overfrequency	Due to drive from the load side, the frequency exceeded the permitted (preset overfrequency) value.
Power supply error	Any of the internal supply voltages of the frequency converter got defective (e g. shorted).
Iu measuring error	Measuring of U phase current defective (e g. broken or shorted signal wire).
Iv measuring error	Measuring of V phase current defective (e g. broken or shorted signal wire).
Iw measuring error	Measuring of W phase current defective (e g. broken or shorted signal wire).
EEPROM error	Error in the stored data (e g. parameter chart).
Software error 1	Program error 1
Software error 2	Program error 2
Terminal error	False parameters have been entered from the terminal.
PC comm. error	False parameters have been entered from the computer.
RS485 error	Error in the communication through the RS485-R. (e.g. at master/slave connection)
IIC error	Error in the internal data transmission (I^2C) (clock, EEPROM).
Terminal emerg. stop	The source of the control/regulation is not the terminal but Stop command is given from there.
AN1 input error	Input Analogue1 is selected but the signal is outside the preset limits.
AN2 input error	Input Analogue2 is selected but the signal is outside the preset limits.
Parameter error 1	Selecting a not proper parameter to An. IN1.
Parameter error 2	Selecting a not proper parameter to An. IN2.
Parameter error 3	Selecting a not proper parameter to RS485-R.
AN1 comparator error	At input Analogue1 the signal exceeded the preset limit and is programmed to inhibit
AN2 comparator error	At input Analogue2 the signal exceeded the preset limit and is programmed to inhibit
Dc voltage ripple	The dc voltage is overloaded or the power line voltage is too low.
Dc measuring error	The measured dc voltage does not fulfil the criteria of the credibility test.
Unknown error	Not defined error.

If the error cannot be removed by troubleshooting with use of the list of errors and acknowledgement, contact the manufacturer!

- **11. SYSTEM PARAMETERS MENU**

- **VARIABLE SYSTEM PARAMETERS:**

Submenu	Explanation, further submenus	Values	Default setting	Unit
11-1 Parameter modification:	Is changing the parameters permitted? The user can inhibit this item so that the parameters cannot be modified accidentally	yes no	yes	
11-2 Load parameters:	Memory: user parameter charts Terminal: user parameter charts stored in the terminal Default: factory set parameter chart	memory 1 - 3 terminal 1 - 4 default copy	copy	
11-3 Save parameters:	Memory: user parameter charts Terminal: user parameter charts stored in the terminal	memory 1 - 3 terminal 1 - 4	user 1	
11-4 Save log:	This item permits saving the event log in external terminal. The content can be evaluated later with the connected computer!	save		
11-5 Unit identifier:	In the case of operating multiple frequency converters in parallel, different unit identifiers must be set for each of the converters.	1 - 32	1	
11-6 Carrier frequency:	This menu item sets the switching frequency of the frequency converter end stage. Attention! Above 5 kHz, the current of the frequency converter decreases proportionally (at 16 kHz -20 % already).	2 - 16 (ISD) 2 - 16 (ILD) 1 - 5 (IHD) (optional) 2 - 16	5 5 2	kHz
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 Enable:	no normal feedback (IRE)	no	
	11-7-2 Degree:	0 - 200	50	%
11-8 Output	Item for setting the special output parameters of the frequency converter.			
	11-8-1 Motor error signalisation (Option for setting error signalisation in case of not connected motor terminal block or underload.)	error no error	error	
	11-8-2 Umotor sinusoidal? The frequency converter - depending on the dc voltage - can only compensate the motor voltage until the motor voltage remains sinusoidal. (When this item is set to no, the frequency converter attempts to hold the motor voltage until it is possible.)	yes no	no	
11-9 Language:	The language used to programming and messages. (On demand it can include two optional languages beside Hungarian).	Hungarian English German	Hungarian	

11-10 RS485 - R system serial line: (option)	A serial line can receive one master only! The remote control feature provides simple operating from some kind of control unit (e.g. from computer).	slave master remote control	master	

11-11 Theta external compensation:	This item permits the compensation of the swingings which can occur due to the inertia of the driven unit.	0 - 100	20	%
11-12 Terminal function:	This item permits selecting the functions of buttons **"-"** and **"¯"** of the push button terminal. (It is active in display mode only).	none change display motor pot.meter prog. stepping	change display	
11-13 Automatic error acknowl-edgement	In case of error coming from voltage error, overcurrent or overloading, the unit attempts to restart, if it was in start state. When in stop state, it only deletes the error if possible. At other errors (e.g. parameter error, RS485 error, at too cold heatsink etc.) the error cannot be deleted, its reason must be removed.			
	11-13-1 Number of trials:	0-5 N	N	
	11-13-2 Delay time:	1-60	3	s
11-14 Save event	Possibility is provided for logging such events which do not cause error but their recording is necessary for inspecting the technology or other reasons. Enabling this function is practicable at demand only not to occupy the place in the log superfluously.			
	11-14-1 Supply on / off:	yes no	no	
	11-14-2 Start / stop:	yes no	no	

- **Explanations to the system serial line:**

When selecting a "master", the system serial line (RS485-R), functions as output and sends data to the connected "slave" unit, or units!

When selecting a "slave", the system serial line (RS485-R), functions as input and receives data from the connected "master" unit!

In "remote control" mode the appliance can receive commands from the control unit (e.g. computer) and send back the requested data. The communication is continuous.

The identifiers of the units connected to the serial line must be different! (1-32)

If units are connected also through the terminal serial line (RS485-T), even more independent master/slave connections can be established (single terminal operation or computer supervision). However all units must have different identifiers in this case, too!

- **Features and capabilities of the master/slave connection:**

- Control:
  The slave unit(s) use(s) the frequency reference signal received from the master unit.
  At the slave units the frequency can be divided (e.g. for the different number of pair of poles).
  (Slave settings: control, reference signal source RS485-R, system serial line slave, slave frequency ratio)

- Regulation to rotation speed:
  (Slave settings: regulation, reference signal source RS485-R, system serial line slave, feedback signal IRE revolution, 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, reference signal source RS485-R, system serial line 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!

11-18 Manufacturing data	**Read only parameters!**	
	11-18-1 Year, month:	(e.g.: 99 11)
	11-18-2 Type (kW):	(e.g.: 7.5)
	11-18-3 Serial number:	(e.g.: 135)
	11-18-4 Option:	(e.g.: DC 700V)
11-19 Software version:	**Read only parameter!** Refers to the actual program	(e g.: 6.00)

- **PASSWORDED SYSTEM PARAMETERS:** (To be set by the manufacturer only!)

Submenu	Explanation, further submenus	Values	Default setting	Unit
11-20 Date	This item permits the internal calendar and clock to be set. Its correct setting is very important for the authenticity of the logging and the time programs! (For calibration purposes, the settings of hours, minutes and seconds are allowed to be corrected by the user!)			
	11-20-1 Year:	1990 -	1990	year
	11-20-2 Month:	1 - 12	1	month
	11-20-3 Day:	1 - 31	1	day
	11-20-4 Days:	Monday ... Sunday		
	11-20-5 Hour:	0 - 23	0	hour
	11-20-6 Minute:	0 - 59	0	minute
	11-20-7 Second:	0 - 59	0	second
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	A
	11-21-2 I converter limit t=40 °C:		type-dependent	A
	11-21-3 I converter limit t=80 °C:		type-dependent	A
	11-21-4 I converter maximum:		type-dependent	A
11-22 Voltages	Internal voltages of the frequency converter			
	11-22-1 Umin:	200 - 500	400	V
	11-22-2 Ustart:	200 - 500	450	V
	11-22-3 Udecel:	200 - 500	450	V
	11-22-4 Uaccel:	200 - 700	640	V
	11-22-5 Umax:	600 - 850	750	V
11-23 Special data	Internal parameters of the frequency converter.			
	11-23-1 cooling fan switch on:	0 - 90	45	°C
	11-23-2 Udc compensation:	0 - 1000	200	ms
11-24 Delete log:	Provides deletion of the log, hours run 1 and hours run 2!	delete		
11-25 Passwording:	**TO BE USED EXCLUSIVELY BY THE MANUFACTURER!**			

- **Remarks to the system parameters:**

  Changing the switching frequency is activated by a switch-off and switch-on only!

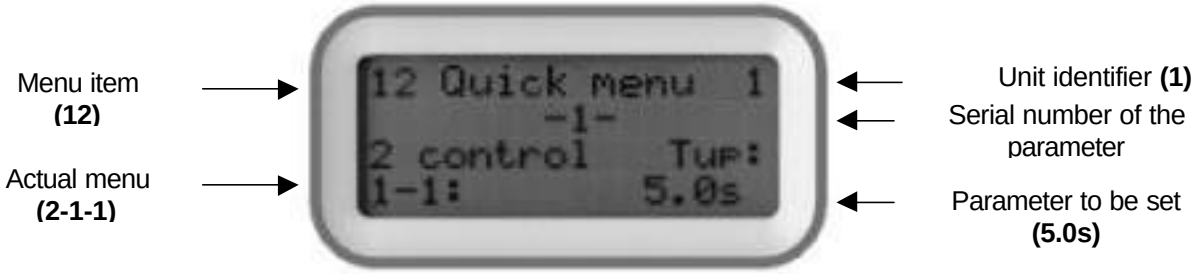
  After parameter downloading (default, memory1-3, terminal1-4) the unit restarts automatically.

  Exchange of the parameter chart is time consuming!

  (The procedure is shown in row 3 of the display with "**In progress!**", or at loading from the terminal with "**%**" !).

  At changing the parameter chart, all parameters will be written into the actual table, except for the **read only** parameters (e.g. manufacturing data and software version).

- **12. QUICK SET MENU**



This menu permits the parameters frequently modified by the user to be set at the same place. Of course, these parameters can be set in their own menus, too!
The number of parameters can be maximum 7!

This has two reasons:

- Limitation of the number of parameters in the quick menu to avoid retaining the really quick setting.
- The quick programmer (2 x 16 character display + 4 direction buttons) cannot replace the push button terminal (4 x 16 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:** that is: **2** Starts
1 Acceleration time
1 Control Tup: 5.0 s

Adopting parameters in the quick menu:

In programming mode, each parameter with value setting option can be adopted in the quick menu with button **"⊗"**, in a deliberate order (except for item **11** System menu, from which saving and loading of the parameters can only be selected). The adopted state is indicated with **"+"** following the main menu item number. 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.

Removing parameters from the main 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. After removing a parameter the quick menu will be renumbered automatically. A newly adopted parameter will get the next order number!

Factory setting of the quick menu:

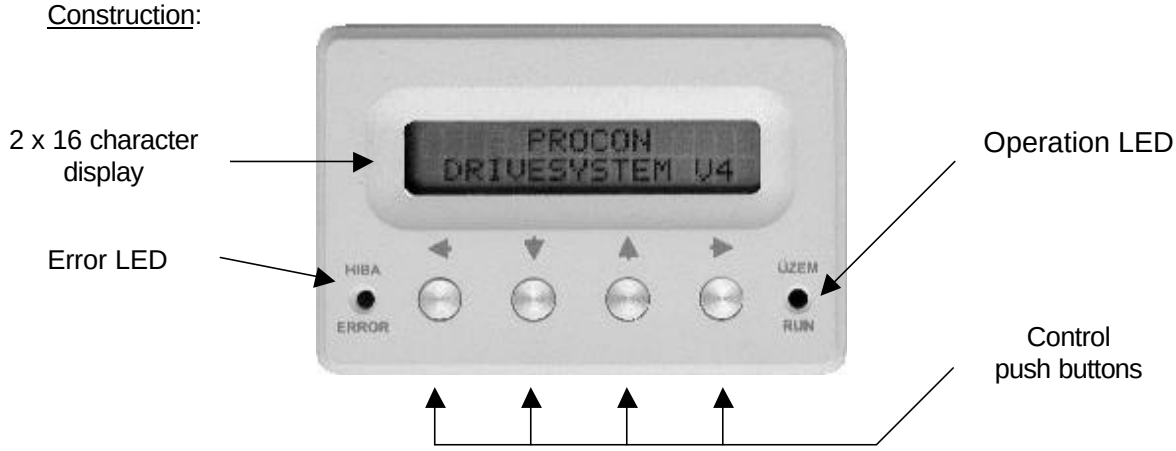
Submenu	Explanation, further submenus	Values	Default setting	Unit
Parameter -1-2-1-1 Control Tup:	The time of linear acceleration without breakpoints, in control mode. (The time to achieve fmax starting from 0)	0.1- 5000.0	5	s
Parameter -2-3-1-1 Control Tdown:	The time of linear deceleration without breakpoints, in control mode. (The time to achieve f=0 starting from fmax)	0.1- 5000.0	5	s
Parameter -3-7-2-1 U boost:	The starting voltage to be given on the motor in standstill after start, for providing the initial flux.	0 - 50	type-dependent	V
Parameter -4-6-4 Motor In:	The motor current permissible for prolonged operation. This current corrected with the torque limit is the highest current value, which can develop.	1.0 - 500.0	type-dependent	A
Parameter -5-8-1 f maximum:	fmax, the highest frequency. Even if the frequency reference signal is set to a higher value, the fmax value is effective!	0.1-1000.0	50.0	Hz
Parameter -6-8-2 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 -7-1-1 Control reference signal:	If the source of the reference signal is the terminal, it means the prescribed value of the output frequency in control mode.	0.1 - 1000.0	1.0	Hz

- **QUICK PROGRAMMER:**

Design: - built in version, built in the front panel of the appliance

- remote located, according to customer demand

Construction:

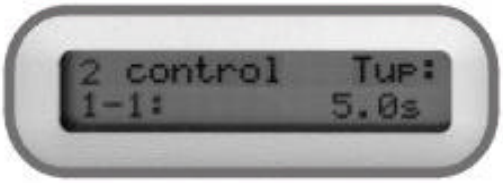


The four operating buttons (LEFT, DOWN, UP and RIGHT) perform two functions:

- in case of error (the red Error LED flashes) the error can be acknowledged by pushing the RIGHT (Enter) button,
- leaving the display and entering the quick menu by pushing the LEFT (Escape) button.

In basic state the display shows the basic display: in its upper row it displays the top row of the 4 x 16 character display, in its bottom row the lowest row of the 4 x 16 character display.

The buttons DOWN and UP permit selecting items from the quick menu. Change is started with pushing the RIGHT (Enter) button then the cursor flashes at the character to be changed.
Saving the parameter is made by pushing the RIGHT button again, during the time the cursor flashes.
Exit without save is made by pushing the LEFT button, during the time the cursor flashes.
Return to the basic display from the quick menu is made by pushing the LEFT button, or if the cursor does not flash the display returns in 5 seconds automatically to the basic display.



In case of error, if to the appliance is connected the quick programmer or the display only, in the second row also the name of the error appears!

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PROGRAMMING GUIDE

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

Control from terminal between 5 and 60 Hz:

Source of the frequency reference	terminal	(menu item	1-5-1)
Source of the logic controls	terminal	(menu item	4-8)
Setting of the frequencies	fmax.=60Hz	(menu item	8-1)
	fmin.= 5Hz	(menu item	8-2)
	finhibit=70Hz	(menu item	8-3)
Frequency change	5-60Hz	(menu item	1-1)

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)

Source of the frequency reference	analogue IN 1	(menu item	1-5-1)
Setting of analogue IN 1	potentiometer	(menu item	4-1-1)
Setting of the potentiometer	normal	(menu item	4-1-2-1)
	stop band	(menu item	4-1-2-2)
	hysteresis	(menu item	4-1-2-3)
Source of the logic controls	terminal blocks	(menu item	4-8)
Setting of the frequencies	fmax.=50Hz	(menu item	8-1)
	fmin.=10Hz	(menu item	8-2)
	finhibit=55Hz	(menu item	8-3)

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 digital IN2 inputs or from the terminal!)

Source of the frequency reference	motor potentiometer	(menu item 1-5-1)
Source of the logic controls	terminal	(menu item 4-8)
Setting of the frequencies	fmax.=100Hz	(menu item 8-1)
	fmin.= 1Hz	(menu item 8-2)
	finhibit=110Hz	(menu item 8-3)
Selection of digital IN4.	motor potentiometer up	(menu item 4-14-1)
Selection of digital IN5.	motor potentiometer down	(menu item 4-15-1)
Motor potentiometer parameters	acceleration time	(menu item 4-9-2-1)
	deceleration time	(menu item 4-9-2-2)
	reference signal zero set	(menu item 4-9-2-3)
Selection of the terminal function	motor potentiometer	(menu item 11-12)

Commands start, stop and directions can be given from the terminal. Changing the frequency can be effected with digital IN 4. and digital 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 0 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 %.)

Source of the regulation ref. signal	terminal	(menu item 1-6-1)
Type of the control	normal	(menu item 1-6-2u)
Regulation reference signal maximum	80%	(menu item 1-6-3-1)
Regulation reference signal minimum	40%	(menu item 1-6-3-2)
Regulation ref. signal acceleration time	30,0 s	(menu item 1-6-4-1)
Regulation stop time limit	60 s	(menu item 1-6-5-1)
Regulation start error signal	5%	(menu item 1-6-5-2)
Source of the feedback signal	analogue IN 1.	(menu item 1-7-1)
Setting of analogue IN 1	current	(menu item 4-1-1)
Setting of the current limits	upper=20mA	(menu item 4-1-4-1)
	lower= 4mA	(menu item 4-1-4-2)
Source of the logic controls	terminal	(menu item 4-8)
Setting of the frequencies	fmax.=50Hz	(menu item 8-1)
	fmin.=10Hz	(menu item 8-2)
	finhibit=55Hz	(menu item 8-3)
PID characteristics	PID 1 active	(menu item 1-10-1)
PID1 parameters	Ap= 0.5	(menu item 1-11-1)
	Ti= 1000 ms	(menu item 1-11-2)
	Ad= 0	(menu item 1-11-4)

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!
Commands start, stop and directions as well as changing the reg. ref. signal can be effected 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.)
(Remark: upon the maximum rotation speed, 5000 corresponds to 100 %!)

Source of the regulation ref. signal	terminal	(menu item 1-6-1)
Type of the regulation	normal	(menu item 1-6-2)
Regulation reference signal maximum	60%	(menu item 1-6-3-1)
Regulation reference signal minimum	1%	(menu item 1-6-3-2)
Source of the feedback signal	IRE	(menu item 1-7-1)
Setting of the IRE	division=1000	(menu item 4-17-1)
	rotation speed =5000	(menu item 4-17-2)
Source of the logic controls	terminal	(menu item 4-8)
Setting of the frequencies	fmax.=100Hz	(menu item 8-1)
	fmin.=1Hz	(menu item 8-2)
	finhibit=105Hz	(menu item 8-3)
PID characteristics	PID 1 active	(menu item 1-10-1)
PID1 parameters	Ap = 0.5	(menu item 1-11-1)
	Ti = 100 ms	(menu item 1-11-2)
	Td = 100ms	(menu item 1-11-3)
	Ad = 0.5	(menu item 1-11-4)

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.
Important:
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).