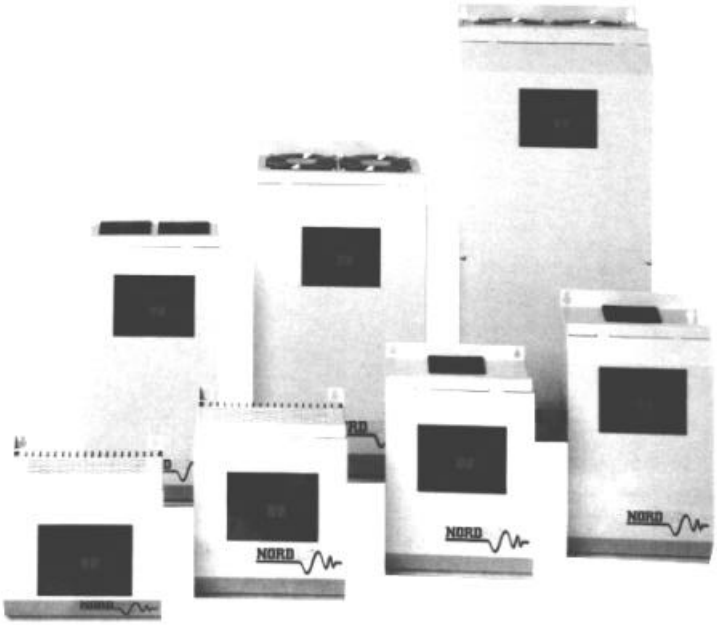
OPERATING INSTRUCTIONS

NORDAC Frequency Inverters

Type series SK 1.300/1 to SK 2.400/1

And

Type series SK 1.300/3 to SK 38.000/3



BU 3000/93E

GETRIEBEBAU NORD

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1.0 General

NORDAC frequency Inverters are sine-related pulse-width modulated inverters with a constant DC link voltage.
The inverters can be used for infinitely variable adjustment of the speeds of 3-phase motors with low loss.

Use:	- For single-motor and multiple-motor drives
Output currents and DC link voltages are detected very quickly and precisely.	- NORDAC frequency inverters are short-circuit proof, ground-fault resistant and stable at no load.
The inverters permit 1.5 times the rated current for seconds.	- There is no immediate switch-off in the event of overload of brief short-circuit

The settings on the NORDAC Frequency Inverter are made with keys and displays in plain language (in dialogue with operater).

Advantages:	- Operating data in digital values - Precisely reproducible at any time and with any unit of the same series - Analogue adjustment facilities no longer present
Separate braking chopper:	- To be used for recovery of high regenerative braking energy to the DC link - To be connected to the + and - terminals (even afterwards)

1.1 Delivery

Examine the device **immediately** after delivery for transport damage such as distortions or loose parts.

If damage has occured:	- Contact the transport company without delay. - Make a careful note of damage.

Important! this applies even if the packaging is undamaged.

1.2 Scope of delivery

Standard version :	- IP 20 panel mounting unit with built-in line choke and output filter for compensating for line capacitances (see point 10.3) - Operating instructions - Output filters (see point 10.4)
Accessoires available:	- Braking chopper with integrated braking resistor (see point 7) - Additional choke for higher line capacitances (see point 10.3) - Special versions, e.g. for frequencies above 120 Hz

1.3 Installation and operation

Installation :	- Installation by qualified personnel only - Observe local regulations applicable to installation of electrical systems - Adhere to accident prevention regulations - Take the usual safety measures
Before switching on the unit:	- Re-attach all covers and guards - Reconnect all plugs (---> push-locked terminal strips) - Also reconnect all plugs not being used

CAUTION ! DANGER !
==========

The power section can still be live up to 2 minutes after being disconnected from the mains.

Inverter terminals, motor supply cables, and motor terminals can still be live.

Touching exposed or unconnected terminals, cables, or parts of the device can lead to serious injuries or even death!

Important Note ! Caution !
==========

Motor stop owing to: - Electronic disable - Terminal short-circuit - Drive jammed	* Inverter terminals, motor leadwire, and motor terminals are still live ! * The motor may start up on its own if the inverter is not disconnected from the mains.

The electronic disable facility is not a device as defined by German Accident Prevention Regulations (UVV).

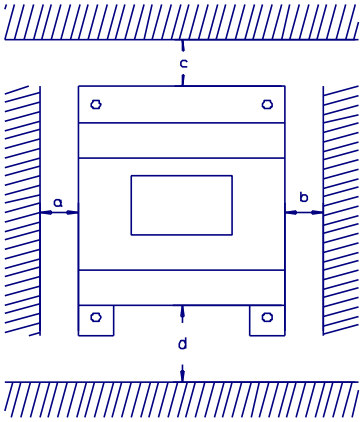
The terminals on the control board are not at mains potential.

2.0 Installation

The units require adequate ventilation. Minimum clearances between the individual units must be observed for this purpose.

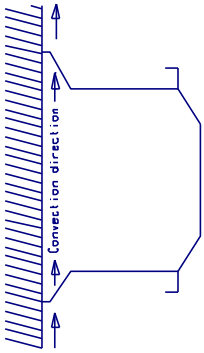
The heated air is to be carried off above the devices!

Front view



Side view

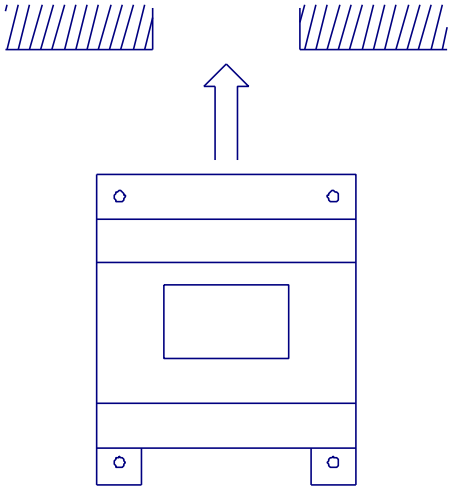
If the mountig surface does not form a rear surface --> fit a baseplate

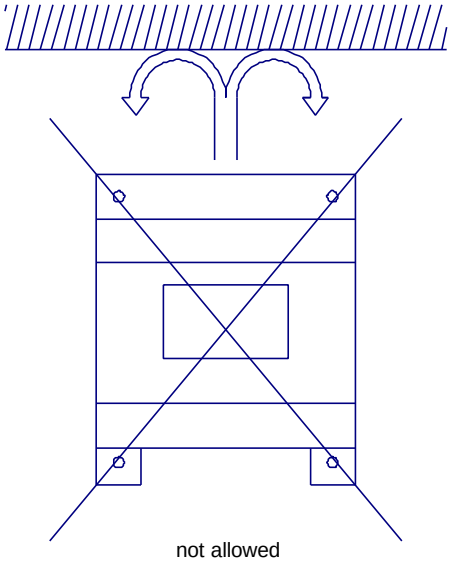


Type	a	b	c	d
SK 1.300/.; SK 1.900/.	10	10	100	50
SK 2.400/1 ; SK 3.600/3; SK 5.900/3	10	10	100	50
SK 7.500/3; SK 10.000/3; SK 15.000/3	10	10	100	50
SK 20.000/3	10	10	150	80
SK 30.000/3; SK 38.000/3	10	10	200	100

All dimensions in mm

Several devices one above another --> Take precautions against heat build-up (e.g. air baffles)



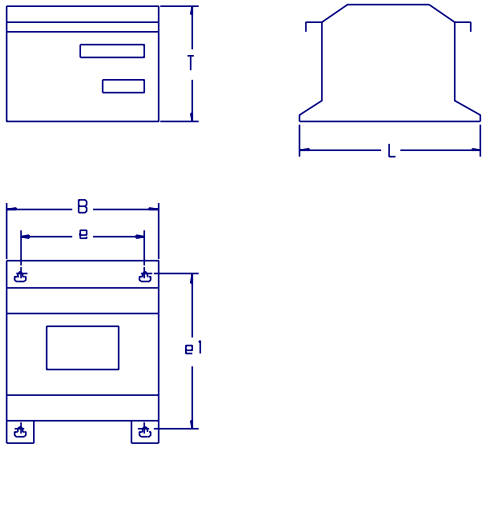


not allowed

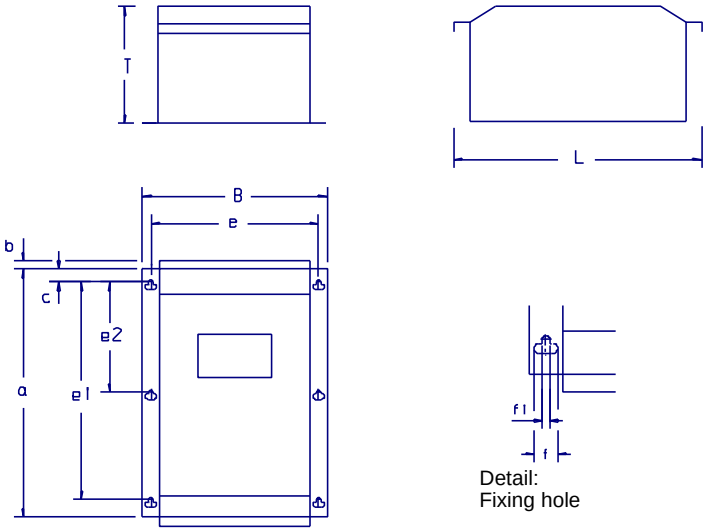
3.0 Frequency inverter dimensions

Version shown: IP 20

SK 1.300 ... SK 15.000/3



SK 20.000/3 ... 38.000/3

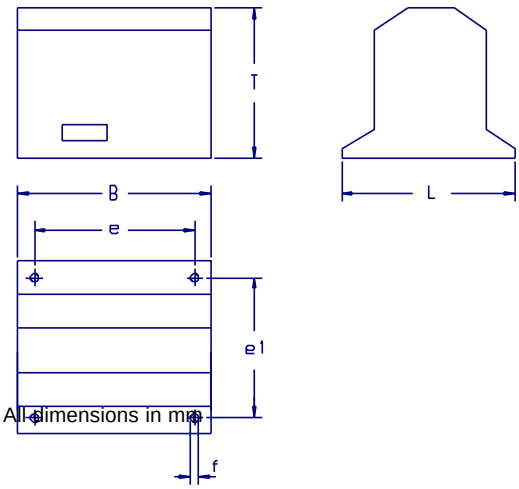


Detail:
Fixing hole

Type	T	B	L	a	b	c	e	e1	e2	f	f1
SK 1.300/1	185	203	205				180	182		10	5,2
SK 1.900/1	185	203	250				180	227		10	5,2
SK 2.400/1	185	203	290				180	265		10	5,2
SK 1.300/3	185	203	205				180	182		10	5,2
SK 1.900/3	185	203	250				180	227		10	5,2
SK 3.600/3	185	203	290				180	265		10	5,2
SK 5.900/3	185	203	355				180	326		12	6,2
SK 7.500/3 + SK 10.000/3	185	203	430				180	401		12	6,2
SK 15.000/3	250	268	520				235	484		14	6,2
SK 20.000/3	250	319	642	600	20	22	299	540	280	12	6,2
SK 30.000/3	292	353	728	680	25	20	333	620	320	12	6,2
SK 38.000/3	252	440	647	595	25	73	420	472	236	12	6,2

All dimensions in mm

3.1 Braking chopper dimensions



Type	T	B	L	e	e_1	f
SK 3/350/32	175	100	85	90	64	5,5
SK 6/350/64	175	100	85	90	64	5,5
SK 3/600/64	175	100	85	90	64	5,5
SK 6/600/180	185	222	110	200	100	5,5
SK 12/600/360	185	222	110	200	100	5,5
SK 24/600/720	185	222	170	200	160	5,5
SK 40/600	150	150	195	128	175	6,5
SK 80/600	150	150	195	128	175	6,5
SK 130/600	150	150	195	128	175	6,5

All dimensions in mm

4.0 Connection

4.1 Power section

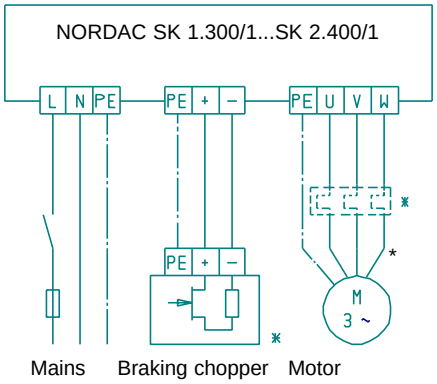
4.1.1 Typ SK 1.300/1 - SK 2.400/1

Connection for mains, braking chopper and motor board
Maximum line cross-sectional area
Keep earth connection (PE) at very low ohms.

- via screw-type push-lock terminal strips on the lower output stage
- 2,5 mm^2

- Please mind the line lengths!

- Cf. point 10.3



if required

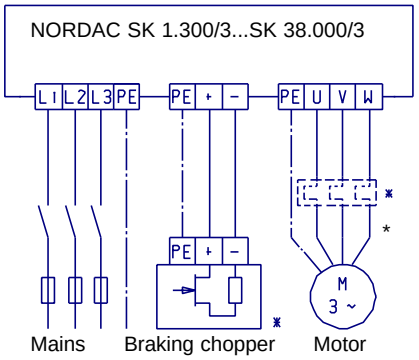
SK 3/350/22 +
SK 6/350/64

4.1.2 Typ SK 1.300/3 - SK 38.000/3

Connection for mains, braking chopper and motor
Maximum line cross-sectional area
Keep earth connection (PE) at very low ohms

SK 1300/3 to SK 5900/3
- 2,5 mm^2 via screw-type push-lock terminal strip on the lower output stage board

SK 7.500/3 and 10.000/3



- 4,0 mm^2 via screw-type terminal strip on the line and output choke

SK 15.000/3 to SK 30.000/3
- 10 mm^2 via screw-type terminal strip on the line and output choke

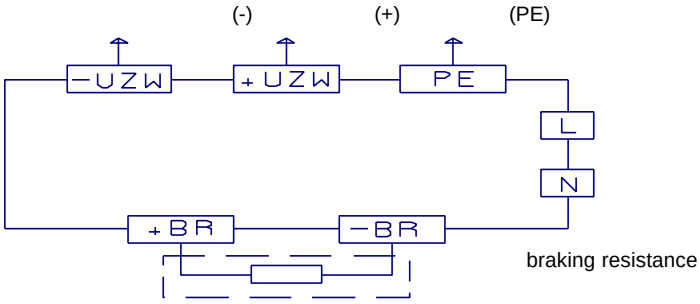
SK 38.000/3
- 16 mm^2 via screw-type terminal strip on the line and output choke

if required

- Please mind the line lengths!
- Cf. point 10.3

Also for braking chopper connection (recommended < 10m)

SK 3/600/64...
SK 24/600/720



230 / 240 V
50 / 60 Hz

auxiliary voltage

braking resistance

SK 40/600 ... SK 130/600

4.1.3 Additional measures (compare point 10.2, 10.3 and 10.4)

Types SK 1.300/1 to SK 2.400/1 and SK 1.300/3 to SK 38.000/3

4.2 Control section

Connection for the control lines

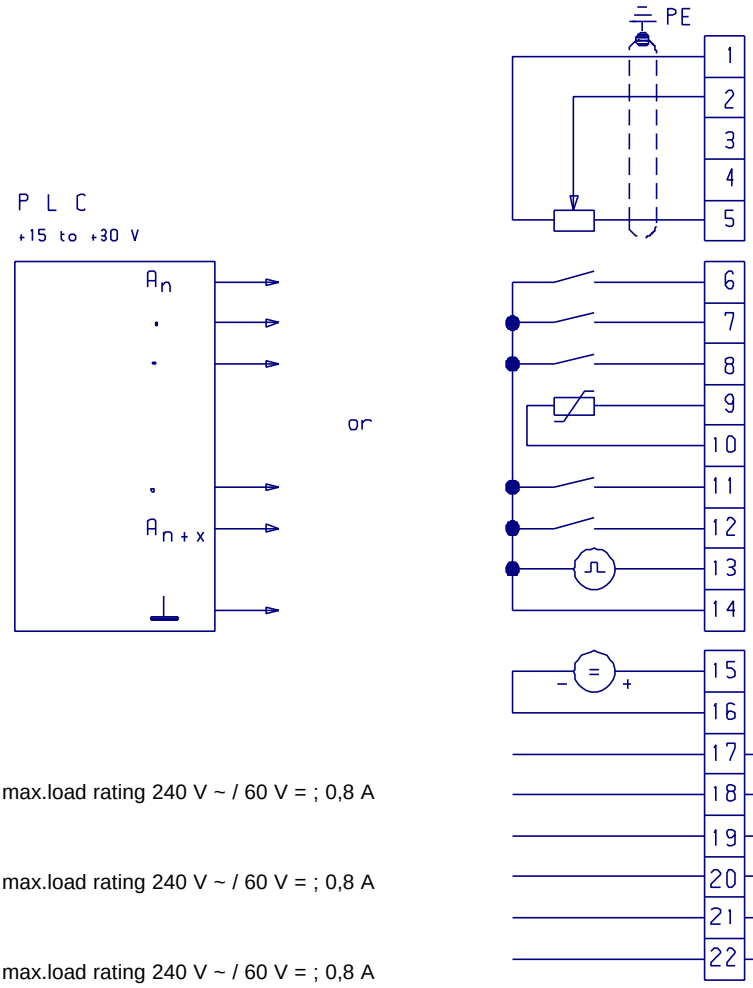
- 22-pole control terminal strip on the mains power supply board, subdivided into three blocks

Maximum connection cross sectional area

- 1,5 mm^2

4.2.1 Control terminal strip

Setpoint - shield lines.
(short lines twisted at least)



Reference potential for the setpoints (GND)

Setpoint - 10 V / 0 / + 10 V DC

Setpoint - 10 V / 0 / + 10 V DC

Setpoint 0 (4) ... 20 mA

+ 10 V reference voltage

Reversing

Electronic release

Fault acknowledgement

PTC thermistor/tempearture sensor

PTC thermistor/temperature sensor

Parameter switchover input 1

Parameter switchover input 2

Digital frequency output
Reference potential for the control inputs (GND)

Tachogenerator + *)

Tachogenerator - *)

max.load rating 240 V ~ / 60 V = ; 0,8 A — Multifunction relay

max.load rating 240 V ~ / 60 V = ; 0,8 A — Frequency signalling relay

max.load rating 240 V ~ / 60 V = ; 0,8 A — Fault signalling relay

*) Option

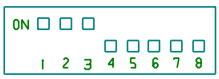
4.2.2 Control inputs

Terminal	Function / Notes	Data	Suggested circuit

General

The push-lock terminal strip for the control inputs is located at the power supply board.
If you remove the front cover, you will find switches S1 and S3 on this board, by means of which the inverter can be adjusted to various control signals.

S 3 **S 1**



8-pole DIP switch slider switch, two positions

S 1 : Switchcover of signal level at terminals 6, 7, 8, 11, 12

S 1 to the left

----> works setting

Control commands
a) potential free contacts
b) Transistor (npn) open collector

S 1 to the right

Control commands as external signal tension e.g. as PLC-control

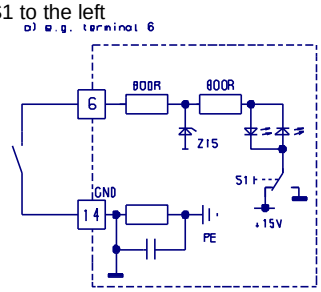
from +15 VDC to +30 VDC

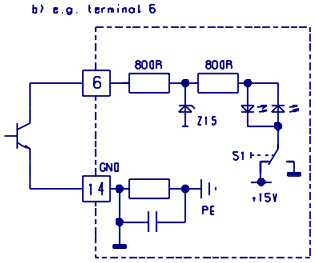
S 3 : Switchover setpoint actual point

OFF	ON
Terminal 1 high-ohms against GND	Terminal 1 low-ohms against GND
rpm-regulation *)	Frequency control
4 ... 20 mA	0 ... 20 mA
0 ... 20 mA	4 ... 20 mA
Negative set-point switched off	+/- Setpoint active
frequency control	rpm-regulation *)
Actual point area 30V to 100V *)	Actual point area 10V to 40V *)
not connected (N.C.)	

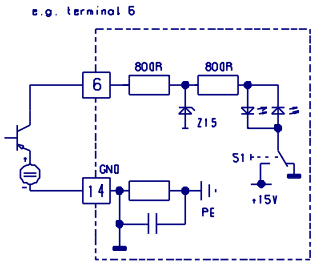
*) PI controller option (see point 9.0)

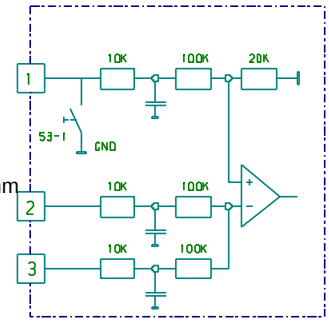
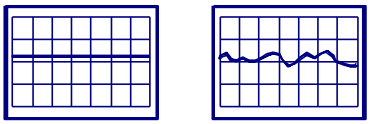
S1 to the left

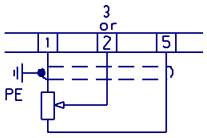
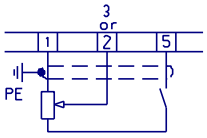
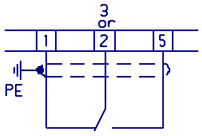
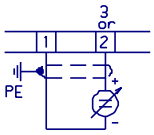
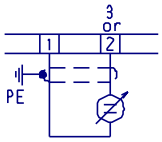
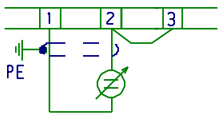
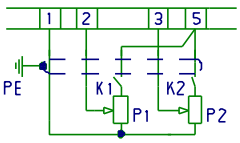
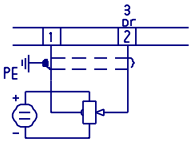
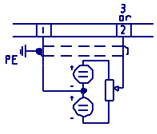
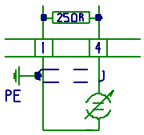
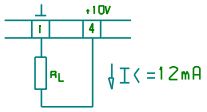


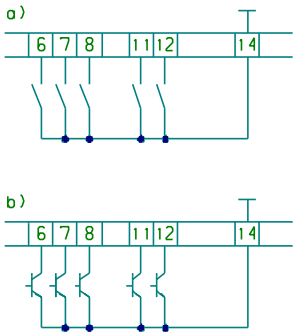
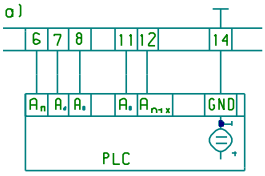
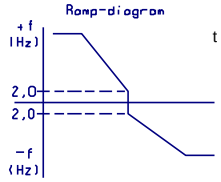
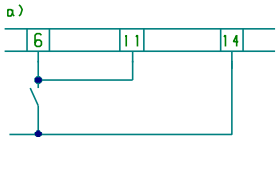


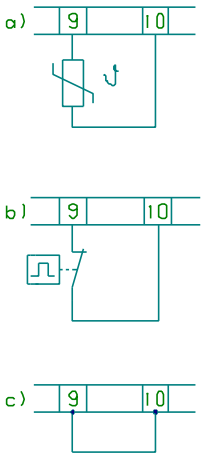
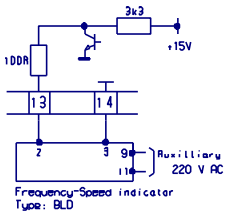
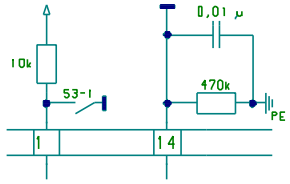
S1 to the right

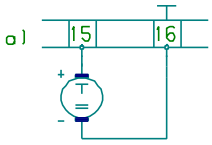
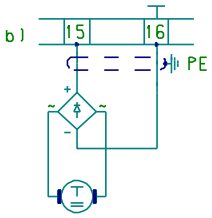
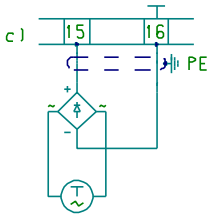
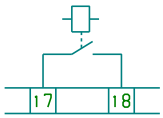
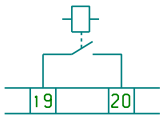
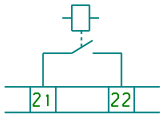


Terminal	Function / Notes	Data	Suggested circuit
1	S 3 - 1 : ON - Terminal 1 is linked to Terminal 14 (GND): Setpoints at Terminal 2 and Terminal 3 are added together S 3 - 1 : OFF - Terminal 1 is at high ohms against GND - Inputs Terminal 1 and Terminal 2 or Terminal 1 and Terminal 3 are working as differential inputs. The differential inputs cannot both be used at the same time as linear addition of their setpoints would then not be possible. The differential amplifier is ineffective if Terminal 14 and Terminal 1 are both given the same potential by the external control unit, e.g. protection lead (PE) or ext. GND	approx.130 kOhm	
2 or 3	Setpoints must be free of interference. Check with oscilloscope if necessary acceptable: not acceptable:  If necessary, lay the setpoint-lines as shielded wiring. The shield must be connected on one side to GND or PE. The setpoint-lines should be twisted if they are short and not shielded.	Input resistance approx 130 kOhm	
	S 3 - 5 : ON with direction recognition from the polarity of the setpoint. The direction of rotation at Terminal 6 then must not be approached.	-10V ... 0 ...+10V	
	Setpoint / Terminal 6 / Direction 0 ... + 10V / 0 / clockwise 0 ... + 10V / I / counter-clockwise 0 ... - 10V / 0 / counter-clockwise 0 ... - 10V / I / counter-clockwise 0 = not approached I = approached		
	S 3 - 5 : OFF Direction change only possible by signal to Terminal 6	0 ... + 10V	
	Setpoint / Terminal 6 / Direction 0 ... + 10 / 0 / clockwise 0 ... + 10 / I / counter-clockwise 0 ... - 10 / 0 / counter-clockwise, with the minimum frequency set 0 ... - 10 / I / counter-clockwise, with the minimum frequency set Aim: No unitentional reversal will occur at setpoints with negative upper waves, alternatively selection of direction at Terminal 6 will not be obstructed.		

Terminal	Function / Notes	Data	Suggested circuit
2 or 3	a) Setpoint setting with potentiometer without direction recognition S 3 - 1 : ON or OFF S 3 - 5 : OFF	Poti min. 1 kOhm max. 20 kOhm	
	b) as for a), but with start/stop by contact-setting Contact open: Setpoint = 0 = $f_{min.}$ Contact closed: Set setpoint equal to/less than $f_{max.}$		
	c) Setpoint with fixed internal setting without direction recognition S 3 - 1 : ON or OFF S 3 - 5 : OFF Contact from 2(3) to 1: Setpoint = 0 = $f_{min.}$ Contact from 2(3) to 5: Setpoint = 10V = $f_{max.}$ Note: further setpoints $f_{min.}$ and $f_{max.}$ can also be programmed into the parameter sets 1 to 4 (Point 11/12)		
	d) Setpoint setting by an external voltage source without direction recognition S 3 - 1: ON or OFF S 3 - 5: OFF	0 ... +10V	
	e) as for d), but with direction recognition S 3 - 1 : ON or OFF S 3 - 5 : ON	-10V...0...+10V	
	f) as for d) or e) but unity control-factor setting at 5 V S 3 - 1 : ON S 3 - 5 : OFF or ON	0 ... +5V -5 ... 0 ... +5V	
	g) Several setpoints via potentiometers without direction recognition S 3 - 1 : ON S 3 - 5 : OFF	Poti: min. 2 kOhm max. 20 kOhm	
	K 1 / K 2 / Setpoint open / open / 0 = $f_{min.}$ closed / open / Setpoint 1 open / closed / Setpoint 2 closed / closed / Sum of Setpoint 1 and Setpoint 2	internal limit: approx 11 V	
	h) Setpoint setting via potentiometers with direction recognition (external voltage source needed) S 3 - 1 : ON or OFF S 3 - 5 : ON		
4	Setpoint from marked current S 3 - 1 : ON 0 ... 20 mA : S 3 - 3 ON S 3 - 4 OFF 4 ... 20 mA : S 3 - 3 OFF S 3 - 4 ON	0(4) ... 20 mA Load: 250 Ohm	 
5	Reference voltage for setpoint supply	+10V, +/- 1% max. 12 mA (short-circuit proof)	
8			

Terminal	Function / Notes	Data	Suggested circuit
	<u>Terminals 6-14 generally</u> The control signals at Terminals 6, 7, 8, 11 and 12 relate to the reference potential GND at Terminal 14. Switch S1 to the left a) Contacts potential free or b) Transistors with open collector If switch S1 is set to the right a) outside voltage	+15 ... + 30V	
	Note: Control commands can be switched to several inputs at the same time, e.g. direction and parameter switchover, with one command or output a) Contact potential free b) Voltage signal from PLC if the loading is permissible (see general points on control terminal strip)		
6	Reversing via control command S 3 - 5 : OFF or ON The inverter brakes with the braking ramp, changes the field rotation direction, and accelerates to the high-speed ramp (see ramp diagramm) 	Setpoint: 0 ... + 10V or 0(4) ... 20 mA	
7	Electronic Release Parameter "rampdown" (menue point 20) is programmed at "on" and electronic is disabled: - the motor is run down to braking ramp - all other functions will be finished as set (e.g. setpoint delay and DC braking) - finally electronic release will lock output automatically Aim: A completely closed working cycle can only be controlled with the following switches set: - setpoint (Terminal 2 or 3, function c) - direction recognition (Terminal 6) - electronic release (Terminal 7) If an electromecanical brake is existing: - control of external brake relay with help of frequency signalling relay (terminal 19/20) f_{set}=2,0 Hz and setpoint delay t = 0,02 - 0,3 s acc. to reaction time of the brake. **<u>Caution ! Danger !</u>** Even though ELECTRONIC RELEASE is locked and motor is de-energized, the motor is **not** electrically insulated from the mains. Working on the inverter power terminals, motor leadwire, or motor terminals is **very dangerous !** Take care!		

Terminal	Function / Notes	Data	Suggested circuit
8	Fault acknowledgement A fault disables the inverter Display: - Fault Released by: - acknowledgement of fault or switching main OFF\ON Presupposing: - the fault is no longer present or has been cleared Display flashes: - Acknowledgement possible Caution ! If the cause of the fault has been put right, or if it is no longer present,and is then acknowledged, the drive starts to run again as soon as control is released and setpoint reset. Acknowlegdment input should not be used during operation. Undesirable drive movements could result.		
9/10	Connection for temperature sensor a) PTC thermistor temperature sensor b) Floating temperature switch c) Bridge terminals 9 and 10 if no temperature sensors are existing	Response threshold approx. 5 kOhm	
11/12	Options: Parameter set 1 - 4 parameter set Term. 11 Term.12 1 0 0 2 I 0 3 0 I 4 I I 0 = open input I = input approached If the parameter sets are switched over during operation, the new parameters selected come into effect at once. The transition to a new frequency is made with the acceleration and braking ramps of the parameter set selected.		
13	Digital frequency output Pulse duty factor 1 : 1 and Frequency duty factor 1 : 1	L = GND H = + 15 V	
14	Reference potential GND for control signals Terminals 6 to 13 S 3 - 1 : ON ---> Terminal 1 is linked with Terminal 14		

Terminal	Function / Notes	Data	Suggested circuit
15/16	Terminals for tachogenerator (speed controller option)		a) 
15	Connection of the positive voltage of the tachogenrator The polarity at the terminals must remain the same in the case of reversing the motor DIP switch at the power supply board:		b) 
	c) 
17/18	Multifunction relay Closing of the floating contact with a) programmed at "Current" $I > I_{Set}$ b) programmed at "Frequency" $f > f_{Set}$		
19/20	Frequency-signalling relay Closing of the floating contact with $f > f_{Set}$		
21/22	Fault-signalling relay Floating contact open: - Fault has occured - The inverter is disconnected from the mains		 Contact is shown in no-voltage condition. When the inverter is ready for operation, the contact is closed.

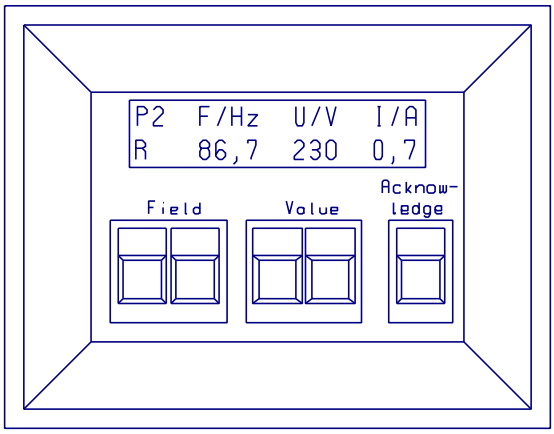
	frequency-controlled	Speed-controlled
S 3 - 1	ON (OFF)	ON
S 3 - 2	ON	OFF
S 3 - 6	OFF	ON

	highest control point	
	10-40V	30-100V
S 3 - 7	ON	OFF

5.0 Operation and displays

General
On the control board you will find:

- the two-line alpanumerical liquid-cystral display with 16 digits each
- 5 keys for entering all operating data (parameters)



Example:
Display during operation
- Parameter 2 selected (P2)
- Rotation clockwise (R)
- Frequency (F) 86,7 Hz
- Voltage (U) 230 V
- Current (I) 0,7 A

PARAMETER-keys	VALUE-keys	ENTER-keys
Paging for-wards/back-wards in program	Change values lower / higher off / on	Enter changed values

PARAMETER keys

Paging through the program (menu)
- Possible in enable and disable status
- Repeated use of one key
- Simultaneous use of both keys

- continuous paging in program
- program jumps back to start

Program start and
disabled state

- device type is displayed

e.g.

```
NORDAC
SK 5.900/3
```

Program start and
enabled state

- The operating data (status displays) are displayed

e.g.

```
P1 F/Hz U/V I/A
 R  0.0  0  0.0
```

VALUE keys

- changing the parameters
- selecting the languages
- switching the functions "ON/OFF"

Keeping the keys pressed makes the values change faster, thus speeding up setting work.
A change is only possible:

- in disabled condition
- if the frequency lies below the absolute minimum frequency

ENTER key

Press the ENTER key in order to accept a newly set value.
If the unit flashes or shows *, this indicates an altered value which has not yet been accepted/acknowledged.
If you do not acknowledge after the change, the set value is deleted immediately if you press a program key or the electronic-disable. The previously stored value is retained.

LCD-Display

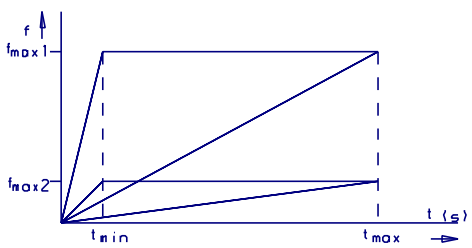
Display of the operating data (parameters)

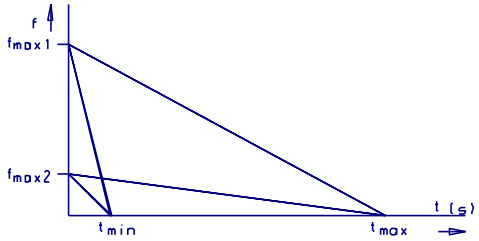
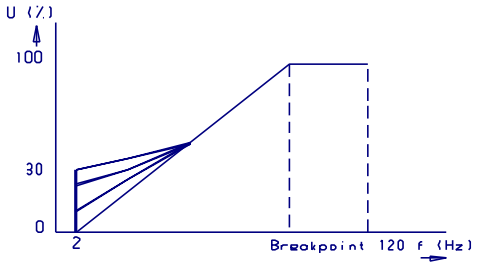
- in plain text
- with the current value
- with the unit

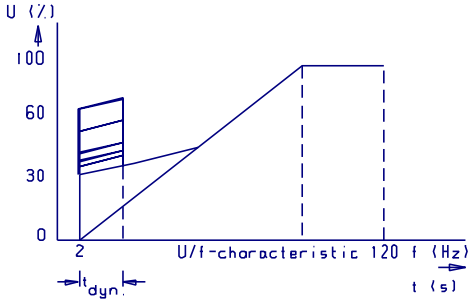
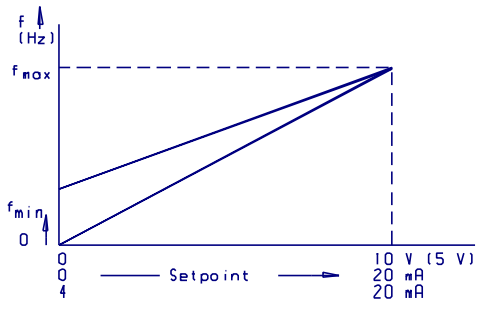
5.1 Settings and displays possible

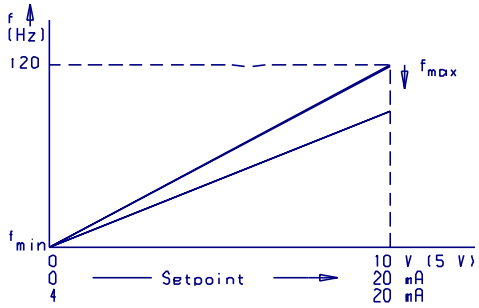
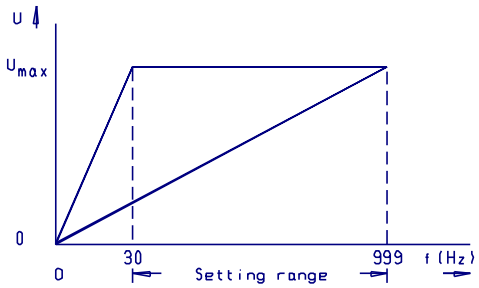
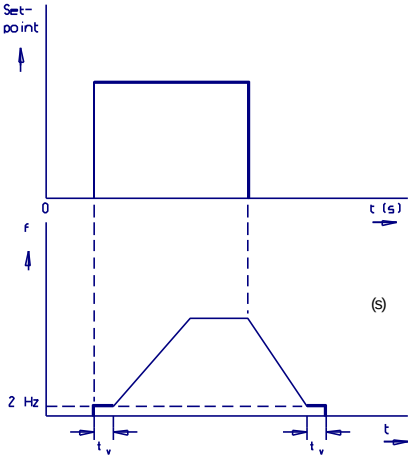
Menu option	**displayed** text/ works setting	Range min /max value	Increment
1	NORDAC SK...../.	SK 1.300/1 to SK 38.000/3	Corresponding to the actual type
2	Language: German	German / English	
3	Parameter set 1	1 / 4	1
4	Copy parameter from 2 *	1 / 4	1
5	Accelerat. time 5.00 sec P1	0,05 / 120 sec	0,05 s in the range from 0,05 to 5 seconds 0,1 s in the range from 5 to 10 seconds 0,5 s in the range from 10 to 120 seconds
6	Decelerat. time 5.00 sec P1	0,05 / 120 sec	0,05 s in the range from 0,05 to 5 seconds 0,1 s in the range from 5 to 10 seconds 0,5 s in the range from 10 to 120 seconds
7	Static boost 8 % P1	0 / 30 %	1 %
7.1	Start val. U contr. 8 % P1	0 / 30 %	1 %
8	Dynamic boost 0 % P1	0 / 30 %	1 %
8.1	Limit U control 0 % P1	0 / 30 %	1 %
9	Time dynam. boost 0.0 sec P1	0 / 10 sec.	0,1 s
10	Min. frequency 0,0 Hz P1	$f_{min} < f_{max}$ 0 / 120 Hz	0,1 Hz
11	Max. frequency 100,0 Hz P1	$f_{max} > f_{min}$ 0 / 120 Hz >120 Hz if required	0,1 Hz
12	U/f-character. 50 Hz P1	30 / 999 Hz	1 Hz
13	Setpoint delay 0.00 sec P1	0 / 10 sec.	0,01 s
14	Frequency relay 50.5 Hz P1	0 / 120 Hz	0,1 Hz
15	Multifunct. relay Current P1	Current/Frequency	
16	Funct. frequency 2.0 Hz P1	0 / 120 Hz	0,1 Hz
17	Function current ... A P1	0 / 100 A	0,1 A
18	Sensitivity 15 % P1	5 / 50 %	1 %
19	Ramp respon. time On P1	On / Off	
20	Ramp down Off P1	On / Off	
21	DC braking Off P1	On / Off	
22	Volt. DC braking 0 % P1	0 / 30 %	1 %
23	Time DC braking 0.0 sec P1	0 / 10 sec.	0,1 s
24	Contr. reac. curr. Off	On / Off	
25	Refer. reac. curr. 1,0 A P1	0 / 99,9 A	0,1 A
26	Fault history 1 Excess temp.motor 2	last 5 error messages	
27	Actual fault No fault 0	up to 20 different errors	
28	cosphi Iw/A Ib/A 1,0 0,0 0,0	displayed operating value (status indicator)	
29	F/Hz P/kW cos 0,0 0,0 1,0	displayed operating value (status indicator)	

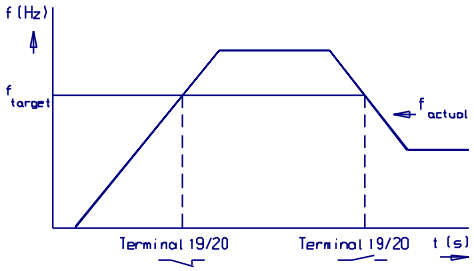
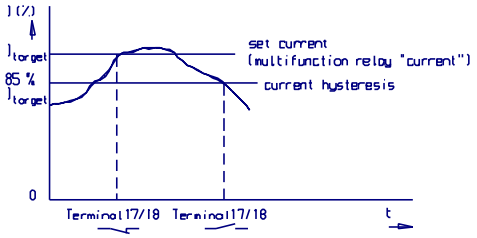
5.2 Description of settings and displays

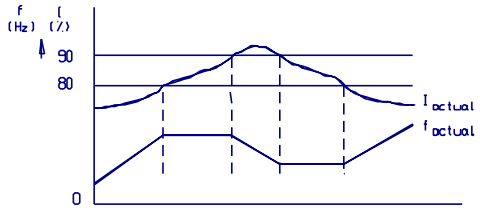
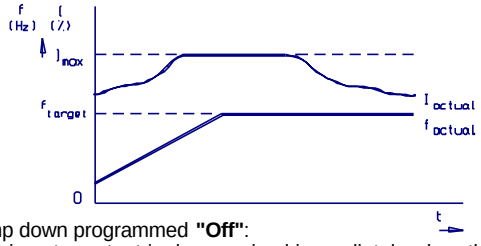
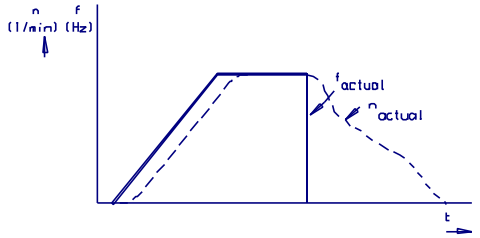
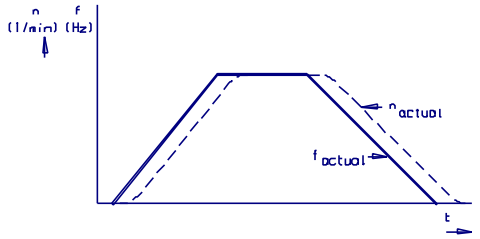
Menu option	**displayed** text	Description
1	N O R D A C S K . . . . . / .	Circuitry disabled - Paging in program possible - Changing values possible
	P 1 F / H z U / V I / A R 0.0 0.0 0.0	Circuitry enabled - Paging in program possible
2	L a n g u a g e : G e r m a n	Selecting the language ---> VALUE keys Acknowledging ---> ENTER keys
3	P a r a m e t e r s e t 1	Up to four different complete parameter sets can be programmed. The parameters of the parameter set selected are shown in the display regardless of the settings at Terminals 11 and 12. The exception is the operation/status indicator (option 1). This shows the operating values of the parameter set at Terminals 11 and 12. VALUE keys - select the parameter sets 1 to 4 be programmed ENTER keys - acknowledge
4	C o p y p a r a m e t e r f r o m 2 *	Copying the parameter sets: PROGRAM keys ---> back to option 3 VALUE keys ---> setting the number of the parameter set to which the required parameter set is to be copied ENTER keys ---> acknowledge PROGRAM keys ---> select option 4 VALUE keys ---> select number of parameter set to be copied ENTER key ---> display shows "Wait" Copying is completed in a few seconds. Display "Wait" is cleared. The parameters of the parameter set selected with option 4 are now also in the parameter set which was selected with option 3. Only deviating values now need to be set in it.
5 keys	A c c e l e r a t . t i m e 5 . 0 0 s e c P 1	Setting range: from 0.05 to 120 Sekunden --->VALUE The time refers to the **set** max. frequency. Changing the max. frequency with the same acceleration time affects: ---> acceleration ---> required power **Caution**: Too short an acceleration time will cause instability of the motor (see option 19) Precautions: ---> lengthen the acceleration time example: fmax 1 or fmax 2 

Menu option	**displayed** text	description
6	D e c e l e r a t . t i m e 5 . 0 0 s e c	Setting range: from 0.05 to 120 seconds ---> VALUE keys P 1 The time refers to the **set** max. frequency. Changing the max. frequency with the same braking time affects: ---> deceleration ---> required power ---> energy fed back **Caution**: Too short a deceleration time will cause instability of the motor (see option 19) Energy fed back results in: ---> a rise in the DC link voltage ---> inverter switching off (message: overvoltage) Precautions: ---> use a braking chopper ---> lengthen the acceleration time 
7	S t a t i c b o o s t 8 %	Setting the initial voltage from 0-30 % of the rated voltage --> VALUE keys P 1 Aim: - starting the motor against maximum load ---> select a low frequency (2 - 5 Hz) ---> check the starting current with the help of display (option 1) ---> if the current is low (motor will not start) - intensify boost ---> if the current is too high (motor is jerking) decrease boost 
7.1	S t a r t v a l . U c o n t r . 8 %	Initial voltage at "Contr.reac.curr." "On" (option 24) P 1 From 0 to 30 % of nominal voltage ---> VALUE keys The regulator adds a variable voltage depending on load to this initial voltage. Aim: - Without a regulated time delay an adjustable minimum start-up torque is immediately avialable. Setting: ---> regulation of "Contr.reac.curr." to pos. "Off" (option 24) ---> setting "Static boost" as described in option 7 but for minimum torque needed only ---> regulation of "Contr.reac.curr." to pos. "On" (option 24)

Menu option	**displayed** text	Description
8	D y n a m i c b o o s t 0 % P1	Adding a time-limited "dynamic" starting torque with Contr. reac. curr. regulator set at "Off" (option 24): 0 - 30 % of the rated voltage ---> VALUE keys Aim: - reducing the thermal load on the motor - lifting brake of sliding-rotor motors ---> set time (option 9) ---> boost drops to value set under option 7 (static boost) within time set under option 9 ---> check the starting current - see option 7 (the time can be prolonged for this purpose --> simplified read-off) 
8.1	L i m i t U c o n t r o l 0 % P 1	With "Contr. reac. curr." "On" (option 24), setting of the maximum voltage which the controller is able to add to the voltage resulting from U/f characteristic curve. From 0 to 30% of the rated voltage ---> VALUE keys Aim: - preventing over-saturation on the motor through excessively high correction values Setting: ---> "Contr. reac. curr." "Off" (option 24) ---> "Static boost" setting as described under option 7 until required start-up current/torque is reached ---> "Contr. reac. curr." "On" (option 24) ---> enter value obtained at option 8.1 "Limit U control" ---> correct "Start val. U contr." option 7.1 and enter value previously obtained
9	T i m e d y n a m . b o o s t 0 . 0 s e c P 1	Used to limit duration of dynamic boost Aim: - avoiding additional heating of the motor at low frequencies
10	M i n . f r e q u e n c y 0 H z P 1	Setting range from 0 to < f_{max} 

Menu option	**displayed** text	descritption
11	M a x . f r e q u e n c y 6 0 H z P 1	Setting range from 0 to 120 Hz, but > f_{min} 
12	U/f - c h a r a c t e r . 5 0 H z P 1	Transition of the U/f characteristic curve (voltage/frequency characteristic curve) from - **proportional** adjustment of voltage and frequency (constant torque) to - constant voltage and **rising** frequency (field attenuation with falling torque) 
13	S e t p o i n t d e l a y 0 . 0 0 s e c P 1	In the case of a setpoint step-change starting **from** "0": - the absolute minimum frequency (2 Hz) is applied immediately to the inverter output - a further increase in the frequency is delayed by the the set time In the case of a setpoint step-change **to** "0": - braking on the braking ramp to absolute minimum frequency (2 Hz) - the absolute minimum frequency (2 Hz) is retained for the set period - the controller is then disabled automatically Used for: - control of an electro-magnetic brake by the inverter in conjunction with option 14 or 15/16 - heavy duty starting 

Menu option	**displayed** text	description
14	F r e q u e n c y r e l a y 5 0 . 5 H z P 1	Floating contact at Terminals 19/20 - closes ---> output frequency **exceeds** the set value - opens ---> output frequency **drops below** the set value VALUE keys ---> set frequency required 
15	M u l t i f u n c t . r e l a y c u r r e n t P 1	VALUE keys ---> function frequency - signals a further frequency, chosen ---> function current - signals a variable current, set
16	F u n c t . f r e q u e n c y 2 . 0 H z P 1	With function selected ---> frequency - as described under option 14 - but signalling at Terminals 17/18 - contact closes if the set frequency is exceeded
17	F u n c t i o n c u r r e n t . . . A P 1	With function selected ---> current Floating contact at terminals 17/18 - closes ---> output current **exceeds** the set value - opens ---> output current **drops below** the set value minus the value set with the sensitivity (option 18)
18	S e n s i t i v i t y 1 5 % P 1	Function: setting a switch-off threshold Aim: avoids persistent switching of the multifunction relay in the "current" function on slight current fluctuations 

Menu option	**displayed** text	Description
19	R a m p r e s p o n . t i m e O n P 1	Ramp response time programmed **"On"**: - interruption in further frequency rise in the case of excess current of approx 80% of the maximum current - reduction of the frequency at approx 90% of the maximum current
		
	R a m p r e s p o n . t i m e O f f P 1	Ramp response time programmed **"Off"**: - **No** interruption in further frequency rise at maximum excess current - reducing the current by reducing the voltage - motor may become unstable under certain circumstances owing to falling torque - you will briefly receive greater torque owing to full utilization of the current limit
		
20 21 only	R a m p d o w n 22 O f f P 1	Ramp down programmed **"Off"**: - the inverter output is de-energized immediately when the release control is locked - the motor supplies no torque and decelerates to stop by mechanical friction
		
	R a m p d o w n O n P 1	Ramp down programmed **"On"**: - the inverter output is **not** immediately de-energized when the release control is locked - frequency decreases to 0 Hz following the set braking ramp - motor is braked to 2 Hz - any programmed function (e.g. setpoint delay, DC-braking) are performed as set - **after this** the output is de-energized
		

Menu option	**displayed** text	Description
26	F a u l t h i s t o r y 1 m o t o r t e m p. 2	The unit stores the last 5 fault messages (in order in which they occur) Scanning---> VALUE keys The last fault message is number 1, the first is number 5 In case of further faults: ---> message no. 5 is deleted ---> the preceding messages move up one position
27	A c t u a l f a u l t N o f a u l t 0	Current fault message - shown in display immediately when fault occurs - steady display ---> fault is still present - flashing display ---> fault is no longer present, can be acknowledged. For further information see section on "Disruptions and faults" (Point 8.0)
28	c o s p h i I w / A I b / A 1 , 0 0 , 0 0 , 0	Operating values/status indicator
29	F / H z P / k W c o s 0 , 0 0 , 0 1,0	Operating values/status indicator

6.0 Commissioning

Before switching on:
- follow the accident prevention regulations
- note to the safety regulations
- take locally applicable safety measures
- note the information in the operating instructions
- check the power and control connections
- install a disconnection facility (in case a malfunction occurs)
- connect the motor in either a star or a delta circuit (depending on application)
- disable the electronic circuit
- set the setpoint at 0 V or alternatively 0(4) mA

Caution !

Ensure that persons, machines, and other valuable items are not endangered when the drive starts.
This even applies in the event of a malfunction of the drive.

Switching on:
- switch on the inverter
- set the voltage/frequency characteristic line (U/f characteristic) to correspond with the motor data - you will find some standard values below (option 12)
- other voltage/frequency characteristic curves can be set between 30 and 999 Hz, in increments of 1 Hz

Mains (V)	Rated voltage/frequency of motor (V;Hz)	(Hz)	U/f-character. of frequency inverter (V)	max.output voltage	Circuit configuration	Factor of power/speed increase
1x230 V	230/400 V;50 Hz		50 Hz	220 V		1
3x400 V	230/400 V;50 Hz		50 Hz	380 V		1
3x400 V	230/400 V;50 Hz		87 Hz	380 V		1,73
3x400 V	400/660 V;50 Hz		50 Hz	380 V		1
3x400 V	400/380 V;50 Hz		50 Hz	380 V		1
1x230 V	230/400 V;60 Hz		60 Hz	230 V		1
3x400 V	230/400 V;60 Hz		60 Hz	400 V		1
3x400 V	230/400 V;60 Hz		104 Hz	400 V		1,73
1x240 V	240/415 V;50 Hz		50 Hz	240 V		1
3x415 V	240/415 V;50 Hz		50 Hz	415 V		1
3x415 V	240/415 V;50 Hz		87 Hz	415 V		1,73
3x400 V	290/500 V;50 Hz		38 Hz	380 V		0,76
3x400 V	290/500 V;50 Hz		66 Hz	380 V		1,31
3x400 V	254/440 V;60 Hz		52 Hz	380 V		0,83

Other combinations are possible in the same way.
The relationship of stator voltage to frequency must remain constant:

$$\text{U/f characteristic} = \frac{\text{Inverter output voltage x rated frequency}}{\text{Motor rated voltage}}$$

Example: Motor 230/400 V; Δ /' ; 50 Hz
Circuit configuration 230 V Δ

$$\text{U/f characteristic} = \frac{400\text{ V} \times 50\text{ Hz}}{230\text{ V}} = 87\text{ Hz}$$

- set f_{min} and f_{max} to low frequencies (e.g. 2 and 5 Hz)
- go to start of program (at the same time, press first two buttons)
- enable control release
- check the starting current against the operating display (status display)
- if current is too low / motor does not start ---> increase static boost
- if current is too high / motor overloaded / inverter at current limit--> reduce static boost
- if necessary, divide static boost into part dynamic / part static boost (options 7 and 8)
- check the control functions, e.g.:
  * direction of rotation of the motor
  * change of direction
  * signalling the frequency
  * switching the setpoint
  * disabling the circuitry
  * function of the electromagnetic brake
  * anything else
- set the remaining parameters
- increase the operating parameters **step by step** to the required final values
- the values obtained for the static and , if necessary, the dynamic boost should not be changed again.

6.1 Parameter record

Setting of parameter sets after commissioning

Menu option	**displayed** text/ works setting	P 1	P 2	P 3	P 4
2	Language: German				
3	Parameter set 1				
4	Copy parameter from 2 *				
5	Accelerat. time 5.00 sec P1				
6	Decelerat. time 5.00 sec P1				
7	Static boost 8 % P1				
7.1	Start val. U contr. 8 % P1				
8	Dynamic boost 0 % P1				
8.1	Limit U control 0 % P1				
9	Time dynam. boost 0.0 sec P1				
10	Min. frequency 0 Hz P1				
11	Max. frequency 60 Hz P1				
12	U/f character. 50 Hz P1				
13	Setpoint delay 0.00 sec P1				
14	Frequency relay 50.5 Hz P1				
15	Multifunct. relay current P1				
16	Function frequency 2.0 Hz P1				
17	Function current ... A P1				
18	Sensitivity 15 % P1				
19	Ramp respon. time On P1				
20	Ramp down Off P1				
21	DC braking Off P1				
22	Volt. DC braking 0 % P1				
23	Time DC braking 0.0 sec P1				
24	Contr. reac. curr. Off P1				
25	Refer. reac. curr. 1,0 A P1				

7.0 Braking chopper

Used for generative operation of the motor if:

- reduction of the energy arising in the power circuit and
- storage of the energy in the DC link is not possible

7.1 Technical data

Type	Connection voltage U_Z (V =, V_{DC})	Pulse current I_{max} (A)	Continuous output P_d (W)	Braking resistance R (Ohm)
SK 3/350/32	350	3,0	32	120
SK 6/350/64	350	6,0	64	60
SK 3/600/64	600	3,0	64	240
SK 6/600/180	600	6,0	180	120
SK 12/600/360	600	12,0	360	60
SK 24/600/720	600	24,0	720	30
SK 40/600	600	40,0		
SK 80/600	600	80,0	external resistance	
SK 130/600	600	130,0	on request	

7.2 Installation instructions

- Provide the required clearances
- Ensure adequate ventilation ---> Heating of the braking resistors which occurs occasionally should not be allowed to impair other units!

7.3 Settings

Set the DIP switches of the braking chopper to ON up to 400 V mains voltages	not applicable
Set the DIP switches of the braking chopper to OFF over 400 V mains voltages	to SK 40 ... 130/600

7.4 Selection criteria

- Braking torque
- maximum braking current
- mean braking power

General example for approximately determining the braking chopper
(without calculating individual data)

* Calculate the individual torque: - On the basis of the known formula from drive engineering
  - take into consideration for + und - signs and efficiencies

* Assistance in calculation: - can be obtained if required from our Planning Department

* Determine the operating points at which the sum of the braking torques is highest

* Calculate the maximum braking current (I_{max}): based on the example of the following diagram:

$$I_{max} = \frac{M_6 \times n}{9{,}55 \times U_Z} \quad (A)$$

Condition : $I_{max} < I_{chopper} < I_{max\ converter}$

* Determine the mean braking power P_d (only the braking torques cause heating of the braking resistors) based on the example of the following diagram:

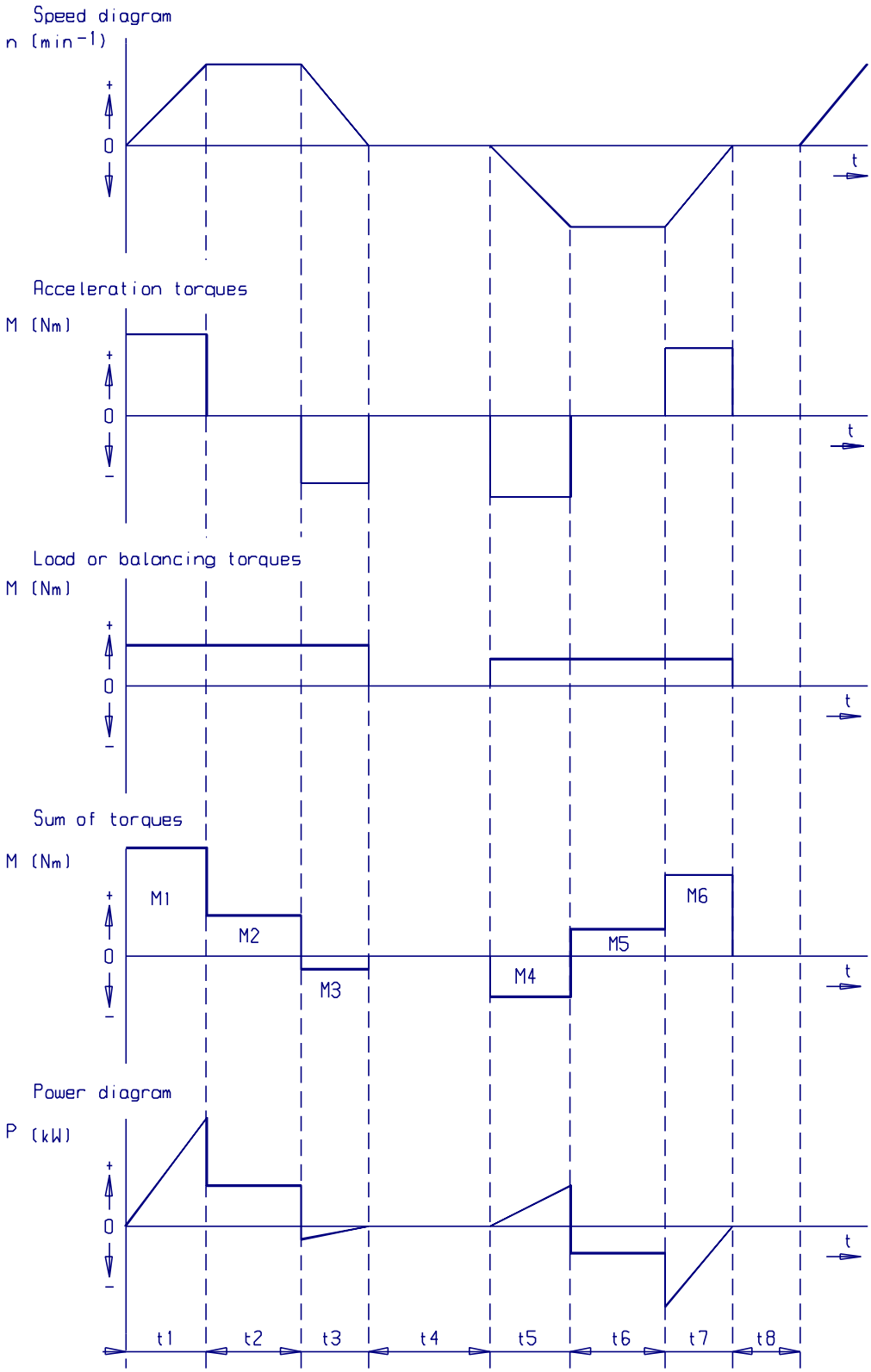
$$P_d = \frac{\left(\frac{M_3 \times t_3}{2} + M_5 \times t_6 + \frac{M_6 \times t_7}{2} \right) \times n}{9{,}55\ (t_1 + t_2 + ... + t_8)} \quad (W)$$

Condition: $P_d < P_{chopper}$

I_{max} : Braking current (A)
M_1 - M_6 : Torque related to the motor shaft (Nm)
n : Speed of the motor (rpm)
U_Z : DC link voltage of the inverter (V)
P_d : Mean braking power (W)
t_1 - t_8 : Times (s)

Note:
- Experience has shown that an electrical braking torque of approx 10 to 20 % of the rated motor torque is applied even without a braking chopper
- Other load diagrams must be evaluated analogously
- Connect or disconnect to the inverter only in the de-energized status, i.e., wait approximately 5 minutes after disconnecting the mains

General example of a load diagram:



8.0 Disruptions and faults

Urgent error messages: - displayed immediately
e.g.

Actual fault motor temp. inv. 1

Old error messages: - Up to 5 preceding fault messages are stored and cannot be deleted
e.g. - Displayed in option 24 ("Old fault")

Fault history Motor temp. inv. 1

- Call up with Value keys
- 1 to 5, order in which the errors occurred
- Type of fault with identification digit 1 to 20

Displayed text		Message	Possible cause
No fault	0	No fault has occurred	
Overtemp. inv. 1		Thermostatic switch in inverter has tripped	Ventilator failure, overload Coolant temperature too high or defective components length of line (compare point 10.3)
Overtemp. motor	2	Temperature sensor in motor has tripped	PTC thermistor or thermal cutout has high resistance or is open or instrument leads affected by interference potentials If **no** temperature sensors are connected --> bridge Terminals 9 and 10
Overvoltage	3	DC link voltage monitor has tripped	Braking too fast Operating without brake chopper GND shortage Mains voltage too high Defective braking chopper
Overcurrent	4	Excess current longer than 30 sec.	Overload Output short circuit Wrong motor/inverter selection Acceleration or braking time too short Boost/magnetic saturation too high **Important:** motor operation different from generator operation! --> it may be necessary to use a different parameter set
Parameter loss data	5	Internal computer check signals	Switch-off while computer was storing
		an error	The EEPROM or EPROM ist defective The EPROM version has been changed --> switch on the inverter again or recharge it
Zerop. curr. 1	6	Internal monitoring Phase 1	Defective components
Zerop. curr. 2	7	Internal monitoring Phase 2	Defective components
Zerop. curr. 3	8	Internal monitoring Phase 3	Defective components
+ 15 V error	9	+ 15 V controller voltage error	Power supply unit defective
- 15 V error	10	- 15 V controller voltage error	Power supply unit defective
EEPROM error	11	Internal monitoring of the EEPROM	Defective component
No NMER	12	Internal monitoring	Defective component
NMER multiple	13	Internal monitoring	Defective component
UZER multiple	14	Internal monitoring	Defective component
Watchdog	15	Internal monitoring	Program run error --> switch inverter on again
GND shortage	16	Earth fault at the output terminals	Motor or motor supply line defective
EPROM error	17	Internal monitoring	Defective components
Charging err.	18	Monitoring of the charging facility	Defective component Defective brake-chopper
Interrupt err.	19	Internal monitoring	Defective component
Watchdog err.	20	Internal monitoring	Defective component

Note regarding "defective components":
If the inverter can be acknowledged or switched on again, the fault is due to high interference potentials rather than to a component defect.

9.0 Speed controller

- Option
- Available at extra charge
- Modification only possible by exchanging the entire power supply board
- A connection of terminals 15/16 to the circuitry exists only if the PI controller and Trimm potentiometer TP1 to TP3 are fitted
- Arrangement of the potentiometers for the proportional amplification V_P, the integral-action time V_F, and setpoint/actual reconciliation on the mains power supply board
- Maximum input voltage at Terminals 15/16 is 100 V (S 3 - 7 : OFF).

TP 1 TP 2 TP 3

TP 1: Setpoint-/actual reconciliation

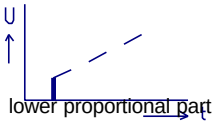
If the setpoint remains unchanged, actual speed will decrease.

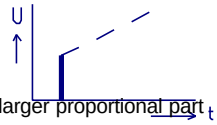
If the setpoint remains unchanged, actual speed will increase.

TP 2: Proportional part of the controller

lower proportional part with faults

larger proportional part with faults

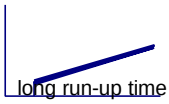




TP 3: Integral part of the controller

short run-up time

long run-up time



9.1 Commissioning

Commissioning should start with the PI controller switched off, i.e. frequency-controlled as in Section 6.0
DIP switch S3 should be set as follows:

S 3/1 : ON
S 3/2 : ON
S 3/3 : irrelevant for the PI controller
S 3/4 : irrelevant for the PI controller
S 3/5 : ON
S 3/6 : OFF
S 3/7 : OFF

- Set acceleration and braking time short enough for the drive to be able to keep up with sudden setpoint changes without excess current or voltage.
- Measure setpoint at Terminal 2-1(⊥)
- Measure actual value at Terminal 15-16(⊥) at highest speed
- If direction of rotation is correct, setpoint and actual value must have the same polarity.

- Switch off inverter

- Activate PI-controller with DIP-switch S3:

S 3/1 : ON
S 3/2 : OFF
S 3/3 : irrelevant for the PI controller
S 3/4 : irrelevant for the PI controller
S 3/5 : OFF - direction is reversed by means of a command to Terminal 6
S 3/6 : ON
S 3/7 : OFF ---> if the actual value at the highest speed is greater than 35 V but still less than 100 V
S 3/7 : ON ---> if the actual value at the highest speed is less than 40 V

Note:
If the maximum value is greater than 100 V ---> fit an external voltage distributor
If the maximum value is less than 10 V ---> limit the setpoint to a value equal to or less than the maximum actual value

Reconciliation und optimization
---> set setpoint at 0
---> switch inverter on, limit the frequency if necessary to protect the machine
---> set a low setpoint (approx. 10%)

If the drive immediately accelerates to the frequency limit set, the following should be checked:

---> actual value present	no	---> check circuit
---> polarity actual value = setpoint	no	---> correct polartiy
---> actual value less than setpoint	yes	---> frequency limit is too low
		---> S 3 - 6 : should be set at OFF
		---> setpoint is too high

If the motor follows the actual value, make a temporary setpoint/actual value reconciliation with TP1.

---> program the maximum frequency into the operating value
---> enable circuitry
---> raise setpoint to approx. 50%
---> set TP1 so the approx. 50% the speed is attained.

Speed/frequency falls

TP 1

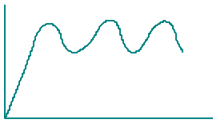
speed/frequency rises

TP 1

Optimizing the control ciruit:

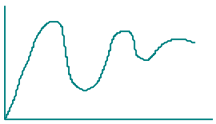
---> connect oscilloscope to the actual value
---> raise setpoint in one jump by approx. 10%
---> the new speed must be attained without any excessive swing or any lengthy swing period

Rapid swing of long duration



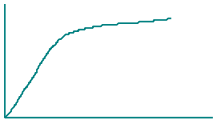
Reduce proportional part: TP 2
Raise integral part: TP 3

Large, slow excessive swing



Raise proportional part: TP 2
Reduce integral part: TP 3

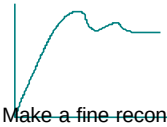
Slow swing



Raise proportional part: TP 2
Reduce integral part: TP 3

Optimum transition

No adjustment
necessary



Make a fine reconciliation of actual value and setpoint

---> set highest setpoint
---> reconcile actual speed with Trimm potentiometer TP 1 into the required value. The maximum frequency must be set slightly higher than the level corresponding to the actual speed.

10.0 Mains filter

Normal version contains:

- Line choke | to protect the inverter
- Capacitors |---> against normal mains
- Varistors | voltage peaks

Special cases:

- Installation of a standard mains filter (data on request) ---> protects against high-frequency voltage peaks (e.g. in the case of power-factor correction systems, welding equipment etc.)

10.1 Radio interference suppression

RFI suppression is possible if required.
Reducing the emitted interference to the value of limit value class B in accordance with VDE 0871:

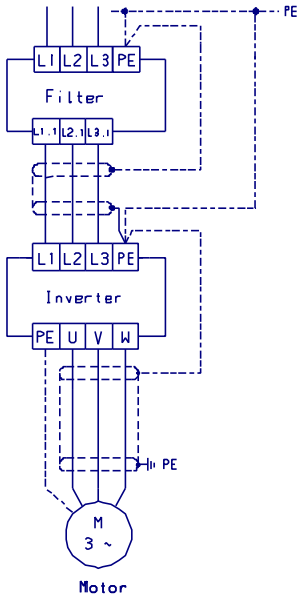
- with mains-circuit coupling ---> by use of standard RFI suppression filters
- with emitted interference of the motor supply line ---> by use of a screened cable or lay in earthed heavy-gauge steel conduit

a) Arrange earth connection (PE)
- ensure very low resistance
- arrange connection/transition with large cross-section

Screening
- bring as close as possible to the inverter and the motor (< 0,2 m)
- do not interrupt
- connect on both sides to earth (PE)

If (a) is not sufficient to suppress interference --> try b)

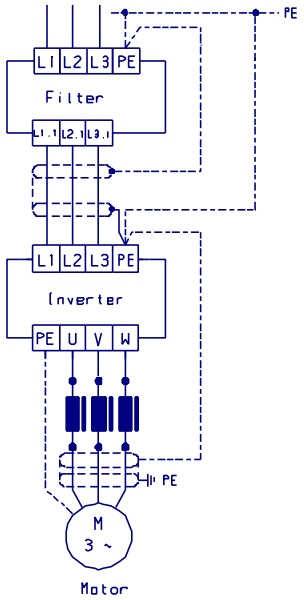
a)



b) As a), but in more advanced form, with line compensation choke or standard output filter with higher damping

(chokes and filters available on request at extra charge)

b)



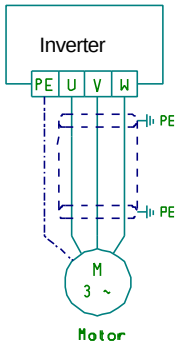
10.2 Effect on other consumers

Main cause: Capacitive coupling to earth potential ---> Lay PE wires and motor cable separately
---> Provide a good center PE wire connection

To improve electromagnetic compatibility of sensitive equipment (e.g. PLC-control units or capacitive transmitters), the following steps can be taken:

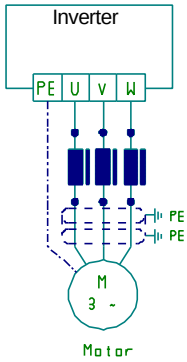
a) Arrange earth connection (PE):
- ensure very low resistance
- arrange connection/transition with large cross-section

Screening
- bring as close as possible to the inverter and the motor (< 0,2 m)
- do not interrupt
- connect on both sides to earth (PE)



b) As a), but in more advanced form, and with additional line compensation

(Chokes available on request at extra charge)



10.3 Line capacitances (motor cable)

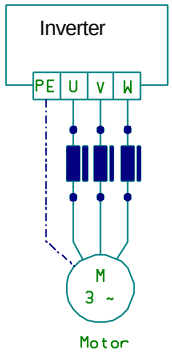
- Incorporated output chokes compensate for the line capacitances at:

8 kHz clock frequency up to 2000 pF

Along with reducing the motor voltage at the terminals, line capacitances will result in a reduction of motor power.

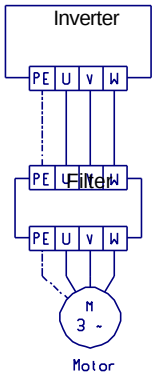
- Additional output chokes available on request at extra charge (e.g. in case of long line lengths)

As a general guide:
Line compensation chokes are to be recommended for
SK 1300/3
Lines 3 x 1,5 mm^2 or 4 x 1,5 mm^2 upwards of approx. 20 meters
SK 1300/1
Lines 3 x 1,5 mm^2 or 4 x 1,5 mm^2 upwards of approx. 30 meters
SK 1900/1, SK 2400/1, SK 1900/3 and SK 3600/3
Lines 3 x 1,5 mm^2 or 4 x 1,5 mm^2 upwards of approx. 40 meters
SK 5900/3
Lines 3 x 2,5 mm^2 or 4 x 2,5 mm^2 upwards of approx. 40 meters
SK 7500/3 and SK 10.000/3
Lines 3 x 4,0 mm^2 or 4 x 4,0 mm^2 upwards of approx. 100 meters
SK 15.000/3 and SK 20.000/3
Lines 3 x 6.0 mm^2 or 4 x 6,0 mm^2 upwards of approx. 300 meters
SK 30.000/3
Lines 3 x 10 mm^2 or 4 x 10 mm^2 upwards of approx. 300 meters
SK 38.000/3
Lines 3 x 16 mm^2 or 4 x 16 mm^2 upwards of approx. 300 meters



10.4 Output filters

Special filters for sinusoidal output voltage or du/dt limitation are available on request.



10.5 Regulations

- Note the local safety regulations
- Observe the accident prevention regulations
- Follow the regulations applicable to installation of electrical switchgear and control systems, including those relating to electronic components, e.g. (in Germany) VDE 0110, VDE 0160, VDE 660, VDE 0113, or any others applicable.

Caution !!

The discharge time of the DC link capacitors after disconnecting from the power supply can in some circumstances **be more than 2 minutes!**

Dangerous !! High voltage !!

11.0 Technical data

Typ SK... 38.000/3	1.300/1	1.900/1	2.400/1	1.300/3	1.900/3	3.600/3	5.900/3	7.500/3	10.000/3	15.000/3	20.000/3	30.000/3
Output power **kVA**	1,3	1,9	2,4	1,3	1,9	3 ,6	5,9	7,5	10,0	15,0	20,0	30,0 38,0
max.motor output **kW**	0,75	1,1	1,5	0,75	1,1	2,2	4,0	5,5	7,5	11,0	15,0	22,0 30,0
Rated current **A**	3,5	5,0	6,5	2,0	3,0	5,5	9,0	12,0	16,0	23,0	31,0	43,0 60,0
Overload current for 30 sec. **A**	5,5	7,5	10,0	3,0	4,5	8,5	14,0	18,0	24,0	35,0	46,0	65,0 90,0
Mains voltage **50 - 60 Hz**	1 x 220/240 V +/- 10%			3 x 380/415 V +/- 10%								
Output voltage	3 x 220/240 V +/- 10%			3 x 380/415 V +/- 10%								
Typical power loss **W**	55	115	120	60	115	150	220	300	440	480	685	975 1340
Recommended mains fusing **A (slow-blow)**	10	10	16	10	10	16	16	20	25	35	50	63 100
Convection cooling	X	X		X	X							
Cooling by built-in fan with sperarate drive			X			X	X	X	X	X	X	X X
Weight approx. 46,0 **kg**	6,0	7,5	8,5	6,0	7,5	8,5	10,0	12,5	13,0	24,0	26,0	46,0
Modul clock IGBT	MOS-FET	MOS-FET	IGBT	IGBT	IGBT	IGBT	IGBT	IGBT	IGBT	IGBT	IGBT	IGBT
frequency **kHz**	8*	8*	8	8	8	8	8	8	8	8	8	8 8

* Clock frequency can be set to 16 kHz if required.

Data applicable to all models

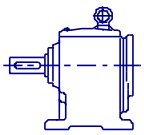
Output frequency	2 - 120 Hz
Linearity error	+/- 0,5 Hz
Power factor ot the mains fundamental wave	approx. 1
Coolant temperature	0°C up to +40°C no moisture or aggressive gases
Storage temperature	-20°C up to +70°C no moisture or aggressive gases
Relative humidity	20 up to 90 % rel., no condensation
Installation altitude	up to 1000 meters above sea level with no loss of perfomance
Enclosure	IP 20 and VGB 4 accordance with IEC 529
Electrical protection	Earth-fault resistant, short-circuit proof, and open circuit stable
Manufactured in accordance with regulations	IEC 536 / VDE 106 part 1

Subject to technical modification

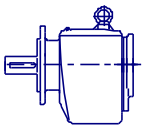
MODULAR SYSTEM

TRANSMISSION TYPE

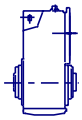
HELICAL FOOT MOUNT



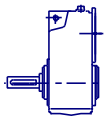
HELICAL FLANGE MOUNT



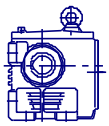
SHAFT MOUNT REDUCER



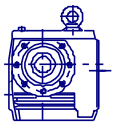
SHAFT MOUNT REDUCER
WITH SOLID SHAFT



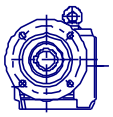
WORM GEAR UNIT
(FOOT MOUNT BASE)



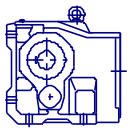
SHAFT MOUNT WORM GEAR UNIT



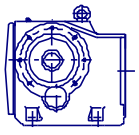
FLANGE MOUNT WORM GEAR UNIT



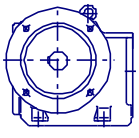
HELICAL-BEVEL-GEAR UNIT
(FOOT MOUNT)



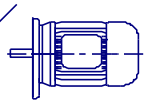
HELICAL-BEVEL-GEAR UNIT
SHAFT MOUNT



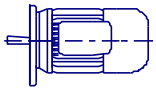
HELICAL-BEVEL-GEAR UNIT
FLANGE MOUNT



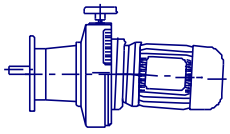
ATTACHMENT ELEMENTS



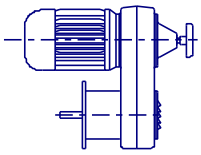
ELEKTIC MOTOR



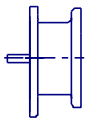
BRAKING MOTOR



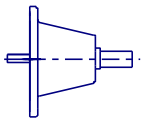
FRICTION-WHEEL VARIABLE-
SPEED GEAR MOTOR



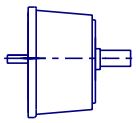
VARIABLE-SPEED GEAR
MOTOR



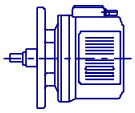
IEC ATTACHMENT CYLINDER



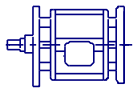
FREE INPUT SHAFT HOUSING



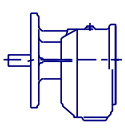
DRIVE-END FLANGE



CENTRIFUGAL CLUTCH/
COUPLING WITH OR
WITHOUT BRAKE



COMBINED COUPLING/
CLUTCH AND BRAKE



HELICAL SPEED REDUCER
EXTREMLY LOW SPEEDS