

NORDAC SK 500E / SK 520E

Condensed Instructions



SK 500E-250-323-A ... SK 500E-751-340-A
SK 520E-250-323-A ... SK 520E-751-340-A

1 General

Owing to sensorless vectorial current control which involves evaluation of a simulator programme based on the three-phase asynchronous motor connected, the above devices will constantly optimise the relation between voltage and frequency.

The present Condensed Instructions are based on the V1.5 R0 (P707) SK 500E / 520E equipment software. If the frequency inverter used does not ensure the same performance level, different instructions may be required. The present Instructions do call your attention to those features which are not identical in the SK 500E and SK 520E inverter types however.

PLS NOTE: To be on the safe side, why don't you download the latest detailed version of the BU0500 manual from the internet (<http://www.nord.com/>).



1.1 Safety and installation instructions

NORDAC SK 500E / 520E frequency inverters are operational equipment for use in industrial power plant. That is why touching them may cause, due to the voltages at which they are operated, serious injuries or even death.



- Only skilled personnel qualified in electrotechnical professions is allowed to perform installation or any other work on the devices provided that these have previously been disconnected from supply. The personnel involved must have access to the Operating Instructions any time and observe them conscientiously without exception.
- Even when the motor has stopped, the supply terminals, the motor terminals, and the terminals for the braking resistor can be dangerously live. Even if the motor is not running it can by no means be assumed that it is also electrically isolated from the mains.
- **Caution**, parts of the control board and especially the female connector for the detachable equipment boxes are dangerously live, too, whereas the control terminals are not at mains potential.
- **Attention**, certain setting configurations may cause the frequency inverter to start up automatically when it is connected to the mains.
- The frequency inverter is intended for permanent connection only and must not be operated without having been effectively earthed as stipulated by the local regulations for high leakage currents (> 3.5mA). German VDE 0160 demands that either a second earth conductor be laid or that the earth conductor cross-section be 10mm² minimum.
- **For the frequency inverter to provide maximum performance, effective earthing must by all means be ensured!**

CAUTION! DANGER!

**The power section may still be live for up to 5 minutes after disconnection from the mains.
Inverter terminals, motor supply cables, and motor terminals may be live, too!**

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

1.2 European EMC directive

Provided that installation is carried out as recommended in the present manual, the NORDAC SK 500E / 520E inverters will meet all of the EMC requirements stipulated in the said directive, conforming at the same time to the EN 61800-3 product standard regarding the EMC of products involved in motor-driven systems.



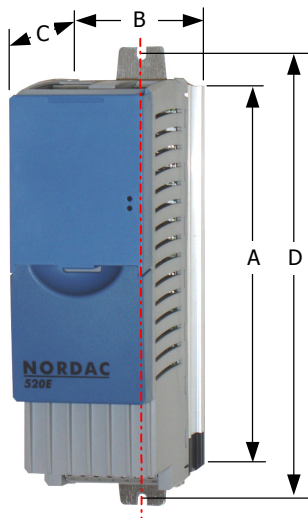
1.3 UL approvals

- **File No. E171342** - The inverters are suitable for connection to a mains supplying a 200...240-volt power or a 380...480-volt power (three-phase units), provided that the (symmetrical) short-circuit current does not exceed 5000 A, and that it is protected by "J class fuses" as specified in the BU0500 manual.



2 Mounting and installation

2.1 Dimensions

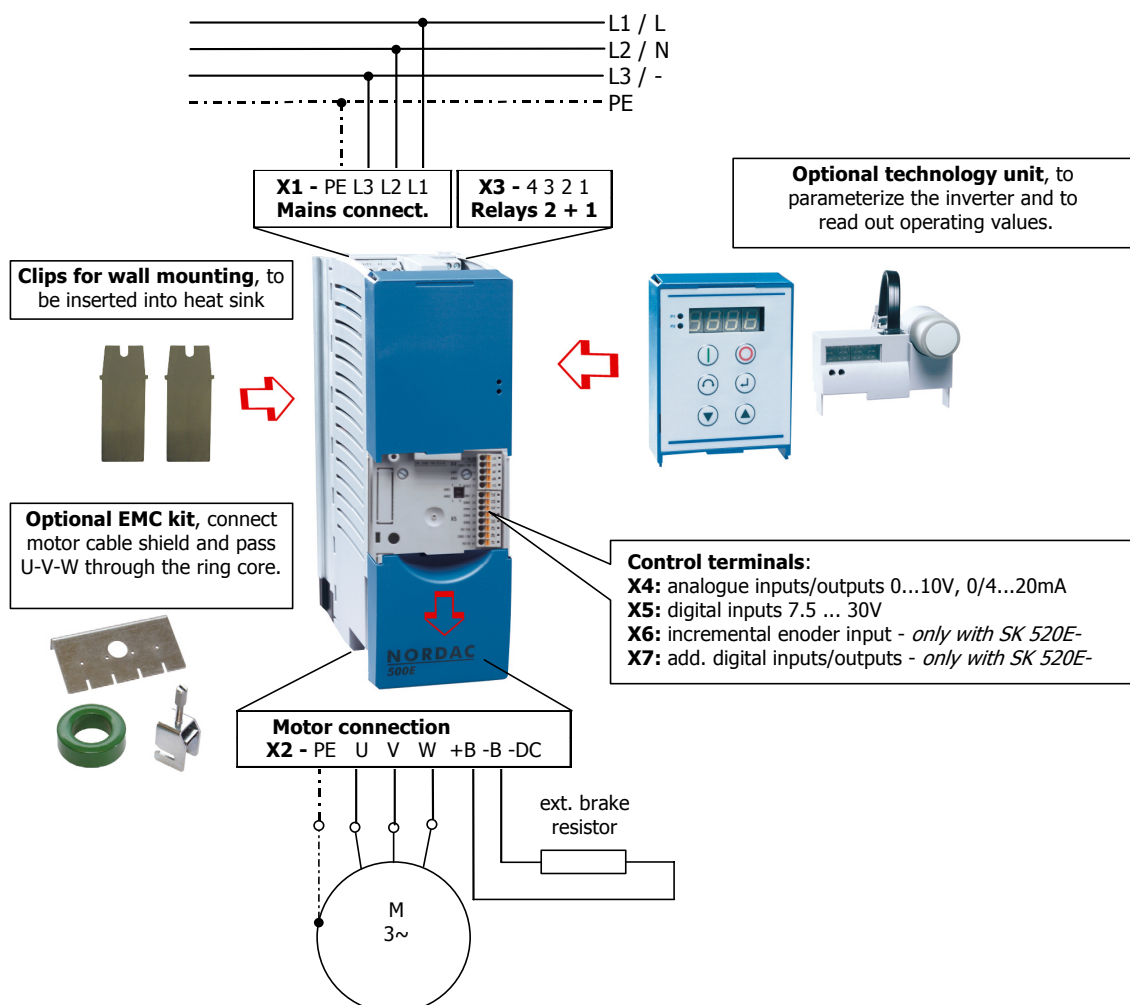


Device type	Frame size	Housing dimensions			Wall mounting		Weight approx. [kg]
		A	B	C	D, ca.	Ø	
SK 5xxE-250- ... SK 5xxE-750- ...	BG1	186	74	153	220	5.5	1.4
SK 5xxE-111- ... SK 5xxE-221- ...	BG2	226	74	153	260	5.5	1.8
SK 5xxE-301- ... SK 5xxE-401- ...	BG3	241	98	178	275	5.5	2.7
SK 5xxE-551- ... SK 5xxE-751- ...	BG4	286	98	178	320	5.5	3.1
All dimensions in [mm]							

2.2 Electrical connection

The mains connection and relay terminals are located on top of the frequency inverter while the motor connection and brake resistor terminals are located on the bottom side.

The control terminals are accessible from the frequency inverter front. They are protected with a cover however (below the slot intended for technology units) which must be pushed downwards or even detached. After that the spring-loaded connection terminals are exposed and can be used as required.



- NOTE:** With an IP20 type of protection this frequency inverter series is designed to be mounted into a suitable switch cabinet. For sufficient ventilation a distance of 100 mm minimum should be ensured between the top and bottom sides of the frequency inverters and the components installed above and below.
- NOTE:** When a shielded motor cable is used it should not be more than 30 m long. A length of 100 m max. is allowed for unshielded motor cables though.
- NOTE:** To ensure that the device will correspond to degree A1 of radio interference suppression the motor cable used should be shielded with a length not exceeding 20 m.
- NOTE:** Refer to chapter 7 for more information regarding mains fuses, line cross-sections and starting torques.

2.2.1 How to connect the power section

DO NOT CONNECT THE DEVICE BEFORE MAKING SURE THAT:

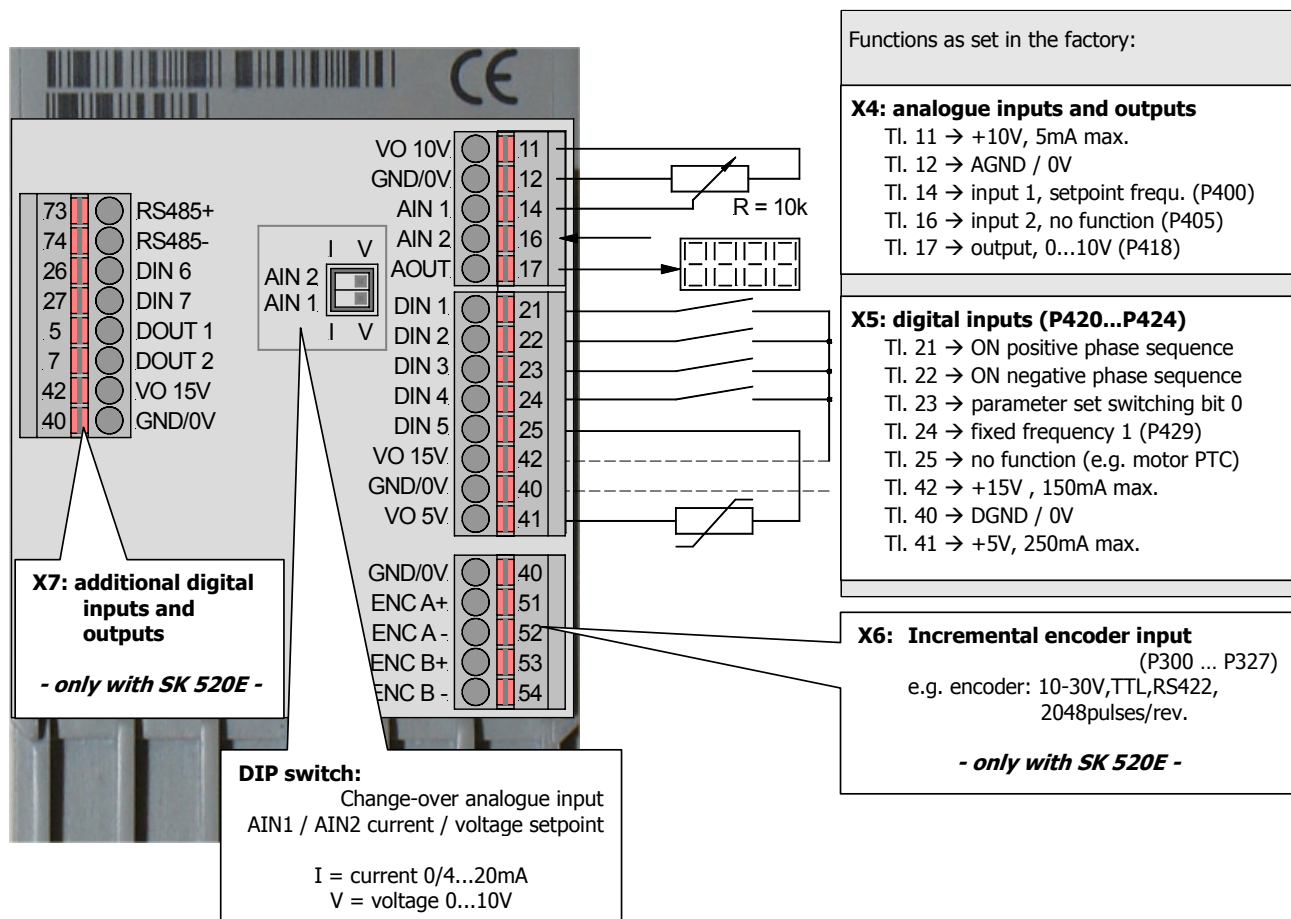
1. the voltage source will be supplying the right amount of voltage and is rated for the required current intensity,
2. and that suitable power switches covering the specified nominal current range are connected between voltage source and frequency inverter.
3. Connect the mains supply directly to the mains terminals **L₁-L₂/N-L₃-PE** (according to the type of device).
4. Use a four-wire cable to connect the motor. Connect the motor cable to the **PE-U-V-W** motor terminals.
5. If shielded motor cables are used (as indeed we recommend), a large part of the cable shield should additionally and preferably be connected to the metal shield supporting angle of the EMC kit, at least however to the highly conductive assembly surface of the switch cabinet.

IMPORTANT: Performance of the device regarding the specified degree of radio interference suppression absolutely depends on shielded cable types being used.

2.2.2 How to connect the control section

Different components are integrated depending on the inverter type (SK 500E or SK 520E).

AGND and DGND are common reference potentials for analogue or digital inputs. Where appropriate a 5V/15V voltage can be picked from several terminals. The total amount of the currents collected must not exceed 250mA/150mA.



3 Operation and display

In their basic version the SK 500E and SK 520E inverter types have got 2 LED's (green – red) each visible from the outside. These LED's will signal the state the device is in at any moment of its operation.

When the **green LED** is illuminated this means that mains voltage is being applied. While operation is in progress, if the **green LED** is flashing at a growing pace it is signalling an increasing overload at the frequency inverter output.

When the system has detected a fault, the **red LED** will call your attention to this fact by flashing at a frequency corresponding to the number code assigned to the type of error that has occurred.

3.1 Modular subassemblies

A variety of modules for display, control, and parameterization is available which can be fitted to the SK 500E / SK520E inverters individually or in combination to conveniently adapt the devices to whichever control requirements are to be met.

For straightforward control configurations alphanumeric display and operating modules will do. For more complex tasks a number of different options is available with which to link up the inverters to a PC or an automation system.

Snapped onto the inverter externally, the **technology units (SK TU3-...)** e.g. are easily accessible for either manipulation or replacement all the time.

3.1.1 ControlBox, SK TU3-CTR

This optional subassembly is a tool allowing for convenient parameterization, value display, and control of the SK 500E / 520E inverter types.

When the ControlBox has been clipped on and the inverter has been connected to supply voltage, horizontal dashes will appear in the 4-digit, 7-segment display signalling that the frequency inverter is ready for operation.

If a start-off frequency value has been preset in parameter P113, the display will toggle between 0.0Hz and the value set in P113.

As soon as the frequency inverter is enabled, the display will automatically change to indicating the operating value (default setting = actual frequency) selected in the P001 parameter.

The parameter set currently effective is indicated in binary form by the 2 LED's located to the left of the display.



IMPORTANT

The digital frequency setpoint is preset at 0Hz in the factory. To check whether the drive will be working, feed a frequency setpoint to the system either by operating the  button or by defining a start-off frequency in parameter P113.

Only skilled personnel qualified for the task must be allowed to do the settings while strictly adhering to all of the safety and warning instructions mentioned in this document.

WARNING: Depending on the settings the drive may start up immediately as soon as the  START button is operated!

Best disable the frequency inverter (use the  STOP button to be sure) before you begin to **set the parameters**.

Having transferred the inverter into the "disabled" state of operation, you can proceed to accessing the parameterization mode using either of the VALUE keys  or .

→  ... . When you have reached the desired parameter group you open it using the  ENTER key → e.g. at  = ramp-up time.

All parameters of the various parameter groups are arranged in numerical order and in an annular structure at the same time. This will enable you to page forward or backward all through the provided range just as required.

Now you can select any individual parameter operating the  ENTER key and vary the setting with the  or  VALUE keys. As a result the display will start flashing until you have stored the change by pressing the  ENTER key once again. Afterwards the display will return to showing the parameter number.

Should you change your mind and not want to store the change, quit the parameter by pressing the button  with which the phase sequence is selected.

Use the  STOP button to return to control mode (the initial display).

3.1.2 SimpleBox, SK CSX-0

This optional subassembly is proposed to enable convenient parameterization, value display, and control of the SK 500E / 520E inverter types.

After the SimpleBox has been fitted and power supply been switched on, horizontal dashes will appear in the 4-digit, seven-segment display signalling that the frequency inverter is ready for operation.

When the frequency inverter is enabled the display will change automatically to showing the operating value selected in parameter P001 (default value = actual frequency).

The two LED's located below the display window will show the parameter set currently being used in a binary-coded form.

Installation

The SimpleBox can be clipped on to any technology unit (SK TU3-...) or the blind cover from above. To remove it again simply pull it off after you have interrupted the RJ12 contact (use the unlocking lever on the RJ12 connector).

Electrical connection

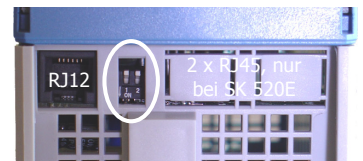
The SimpleBox is connected directly to the socket at the upper edge of the frequency inverter with the RJ12 plug/cable.

If a bus terminating resistor is involved the DIP switch 1 (on the left) can be used to activate it. This may be the case e.g. when the frequency inverter is addressed by a (remotely installed) master control unit.

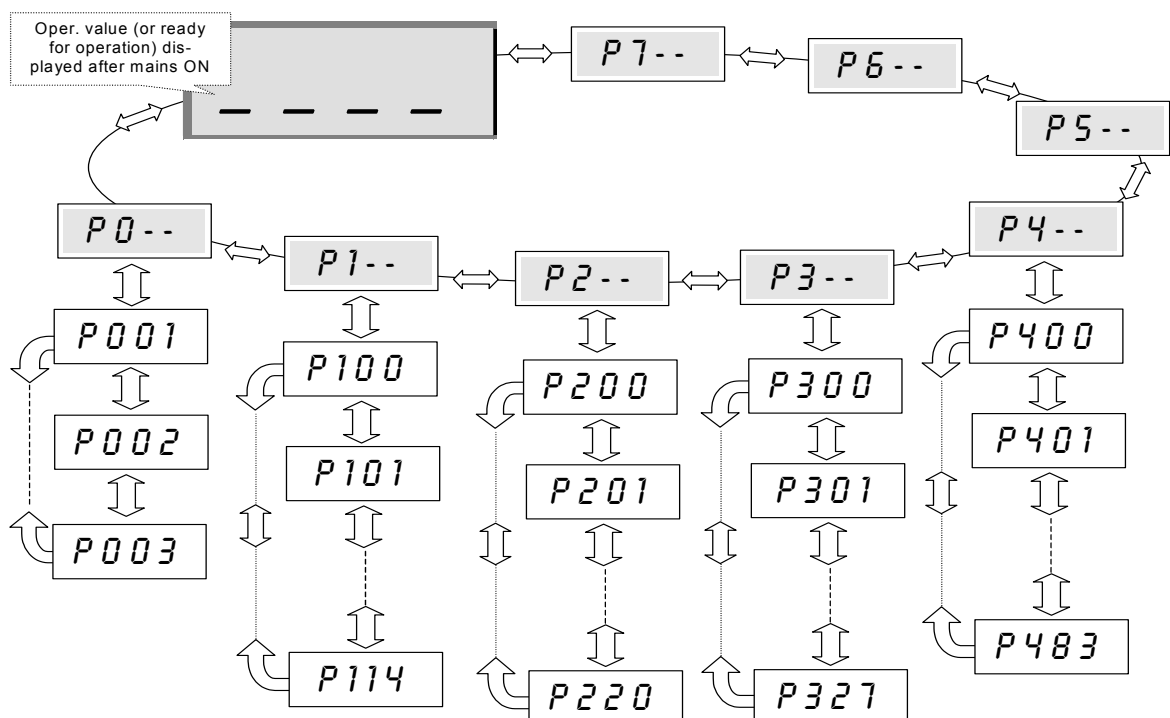
How the SimpleBox is operated

Turn knob right	Turn the knob right to increase the parameter number or parameter value respectively.
Turn knob left	Turn the knob left to reduce the parameter number or the parameter value respectively.
Press knob briefly	Pushing the knob down briefly means = ENTER, to store changed parameter values or to switch from parameter number to parameter value.
Keep knob pressed for a few moments	When the knob is held down for a few moments, control will go up one level displaying relevant information, even without storing a change if no appropriate action has been taken.

Top surface of device



Menu structure with the SimpleBox or ControlBox



PLEASE NOTE: A survey of parameters is provided in section 5.

4 System start-up

When power is fed to the frequency inverter it will be ready for operation within a few moments. In this condition the inverter can be adjusted to the requirements of the application, i.e. the parameters of the control process can be defined. A list containing all of the parameters is provided in section 5.

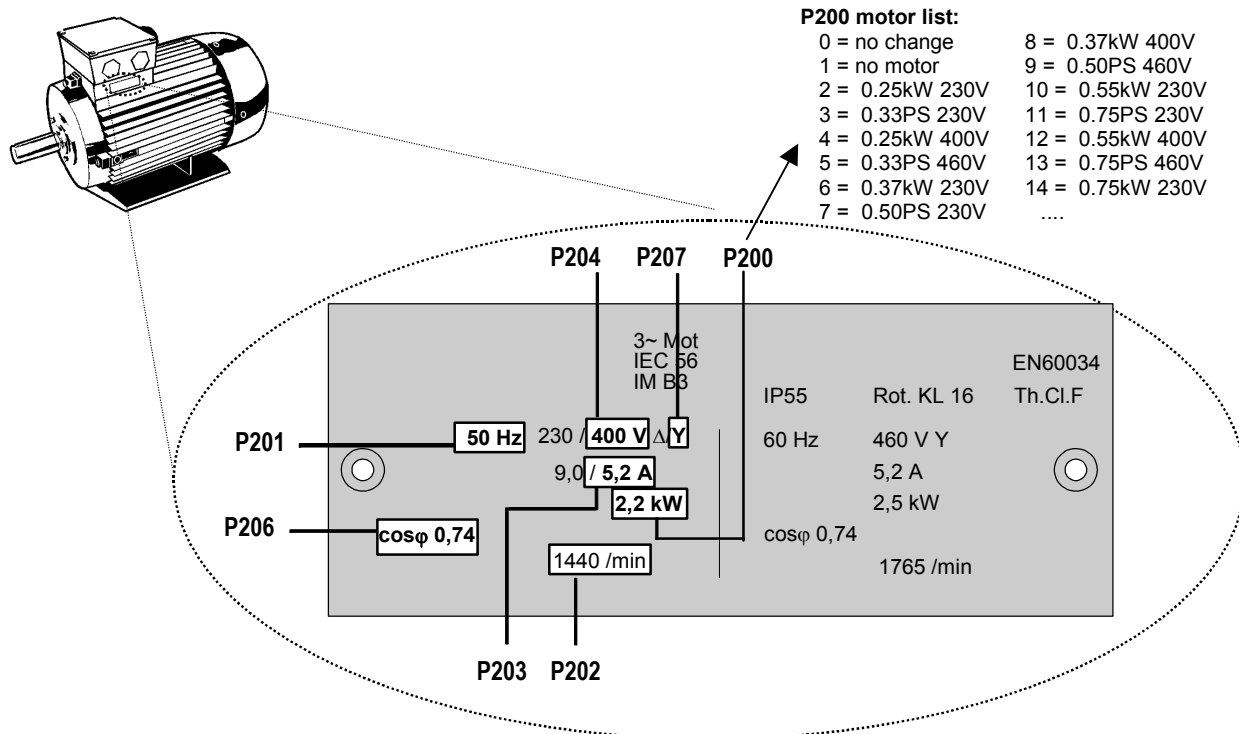
Before the motor is allowed to be started by means of an enable signal the necessary parameters must have been appropriately set by personnel adequately qualified for the task.

WARNING: As the frequency inverter is not equipped with a master power switch it will be live for as long as it remains connected to line voltage. It is possible therefore that voltage is being applied to the motor connected to it as well.

4.1 Default settings

All frequency inverters supplied by NORD are programmed in advance in the factory for standard uses involving 4-pole three-phase standard motors with the ratings and supply voltages indicated below. If motors with different outputs or pole numbers are used, the data mentioned on the type plate of the respective motor must be entered into the parameters P201...P207 of the >motor data< menu group.

PLS NOTE: If your motor is among those in the list proposed in parameter P200, all of the motor data will be preset automatically when you select the corresponding number. Don't worry – it's normal procedure that having executed this function the system will reset parameter P200 to 0 = no change! The data are loaded into parameters P201...P209 automatically where they can be viewed to be compared once again with the actual data on the motor's rating plate.



RECOMMEND.: Smooth operation of the drive depends on the motor data having been set as exactly as possible in accordance with the type plate. In particular we urgently recommend to have an automatic stator resistance measurement carried out using parameter P220.

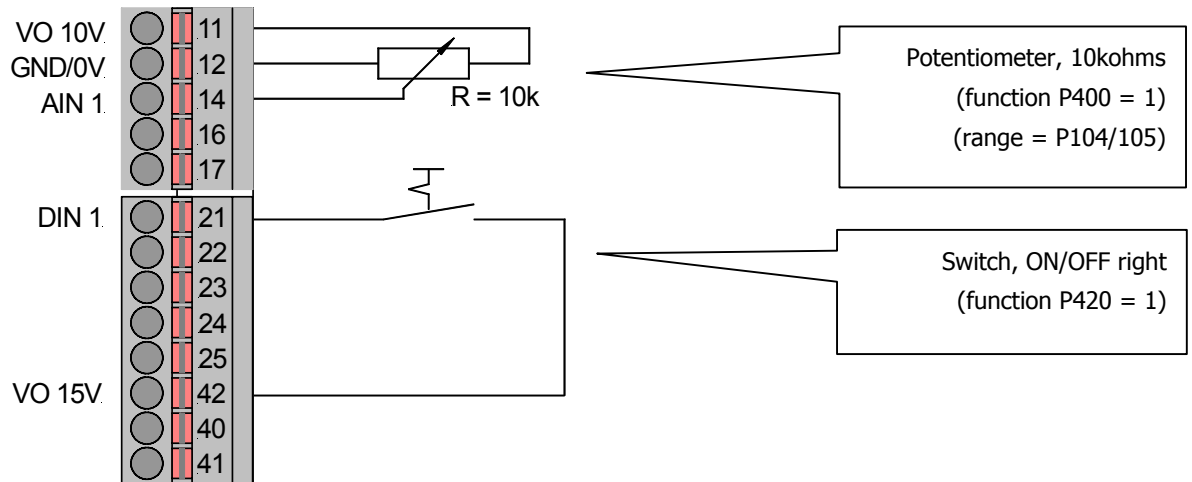
In fact the stator resistance will be measured automatically when P220 is set = 1 followed by operation of the "ENTER" key. The system will store the value obtained in parameter P208 after having converted it to the phase resistance (which depends on the type of connection selected in P207).

In order to ensure that all data required for motor operation will be determined automatically, P220 needs to be set = 2 and this input to be confirmed with "ENTER". Before you do, make sure that parameters P201, P202, P204, P205 and P207 have been set correctly.

4.2 Minimal configuration of the control terminals

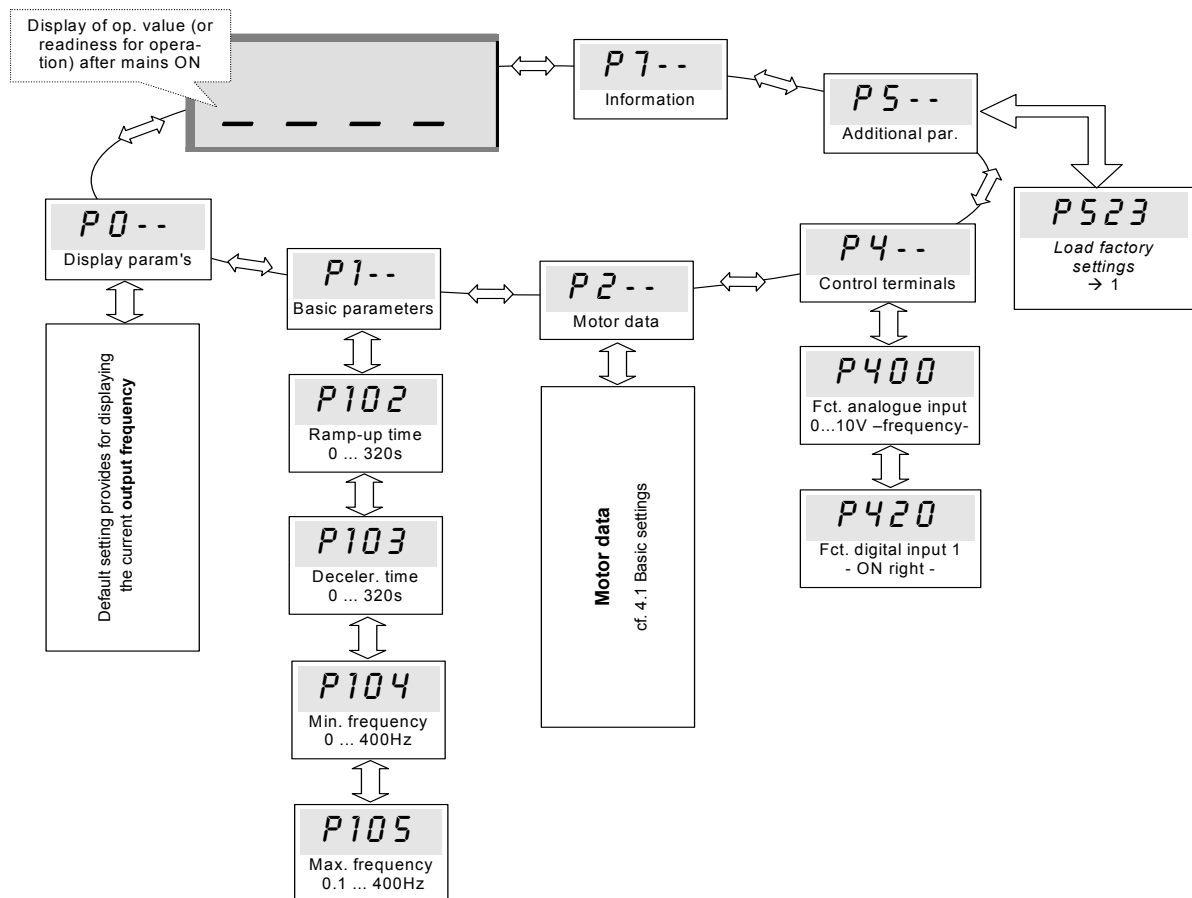
If you want the frequency inverter to be controlled via the digital and analogue inputs, this is possible right away on the basis of the factory configuration without performing any further settings for the time being.

Minimum connection effort



Basic parameters

If you don't know the current configuration of the frequency inverter you should load the factory settings → P523 = 1. The factory configuration ensures that the frequency inverter is pre-programmed for standard applications. In addition you might use the optional SimpleBox SK CSX-0 or ControlBox SK TU3-CTR with which the following parameters can be adjusted:



5 Parameter setting

Four parameter sets are provided which can be switched while operation continues. Factory configuration provides for all of the parameters to be visualized any time, allowing for on-line variation of the settings. Still parameter P003 can be used to conceal certain parameter types if desired.

NOTE: As some of the parameters are interdependent, varying one or another may lead to conflicting commands with illegal internal data and hence to temporary operating trouble. While operation is in progress, editing should therefore be limited to the inactive parameter sets or at least to settings which may be assumed not to affect the rest of the configuration.

The various parameters are arranged in groups according to their major purpose. The first digit of a parameter number denotes the **parameter group** to which the parameter belongs:

Parameter group	No.	Major function
Operational values	(P0--):	Selection of the physical unit of the value to be displayed
Basic parameters	(P1--):	Refer to basic frequency inverter settings such as behaviour at power-on and power-off. Along with the data of the respective motor they are sufficient to deal with standard applications.
Motor / characteristic curve parameters	(P2--):	For setting the specific data of a motor which will affect ISD current control as will the setting of the dynamic and static boost which determines the characteristic curve selected by the program.
Control parameters (only with SK 520E)	(P3--):	This is for setting the controller parameters (current controller, speed controller ...) in the SK 520E to be effective in the speed feedback mode (encoder).
Control terminals	(P4--):	Scaling the analogue inputs and outputs, assigning functions to the digital inputs and relay outputs, defining the PID controller parameters.
Additional parameters	(P5--):	Involve functions dealing e.g. with interfaces, pulse frequency, or fault acknowledgement.
Information	(P7--):	Parameters reading out e.g. current operating values, historic fault messages, device status messages, or the software version.
Array parameters	-01 ... -xx	Some of the parameters are organized in several levels (arrays) each of which is available for programming or reading out. When such a parameter is selected the applicable array level must be selected as well.

PLS NOTE: With the parameter P523 the default setting of any parameter can be restored any time. This may be the most convenient way of configuring a frequency inverter whose parameters have apparently been varied as compared with the original settings done in the factory.

WARNING: All of the parameter settings effective at any particular time will be cancelled if P523 is set = 1 followed by operation of the "ENTER" key.



Any current settings you want to save can be transferred into the ControlBox memory.

5.1 List of parameters, user settings

(P1, P2, P3, P4) ⇒ input will affect one parameter set only, these parameters can be set differently in 4 parameter sets.
S ⇒ Supervisor parameter, visualization depends on the setting selected in P003.

Parameter No.	Description	Default setting	Super-visor	Setting after intervention by the user			
				P 1	P 2	P 3	P 4
DISPLAY OF OPERATING PARAMETERS							
P000	Operating parameter display						
P001	Selection of op. value to be displayed	0					
P002	Display factor	1.00	S				
P003	Supervisor code	1		0= S-parameters are hidden 1= all parameters are visually represented			
BASIC PARAMETERS							
P100	Parameter set	0	S				
P101	Copy parameter set	0	S				
P102	(P) Acceleration time [s]	2.0					
P103	(P) Deceleration time [s]	2.0					
P104	(P) Minimum frequency [Hz]	0.0					
P105	(P) Maximum frequency [Hz]	50.0					
P106	(P) Ramp smoothing [%]	0	S				
P107	(P) Brake reaction time [s]	0.00					
P108	(P) Disconnection mode	1	S				
P109	(P) DC braking current [%]	100	S				
P110	(P) Time DC braking [s]	2.0	S				
P111	(P) P-factor torque limit [%]	100	S				
P112	(P) Torque current limit [%]	401 =off	S				
P113	(P) Start-off frequency [Hz]	0.0	S				
P114	(P) Brake release time [s]	0.00	S				
MOTOR DATA / CHARACTERISTIC CURVE PARAMETERS							
P200	(P) Motor list	0					
P201	(P) Nominal motor frequency [Hz]	50.0 *	S				
P202	(P) Nominal motor speed [rpm]	1385 *	S				
P203	(P) Nominal motor current [A]	4.8 *	S				
P204	(P) Nominal motor voltage [V]	230 *	S				
P205	(P) Motor rating [kW]	1.10 *					
P206	(P) Motor cos phi	0.78 *	S				
P207	(P) Motor connection [star=0/delta=1]	1 *	S				
P208	(P) Stator resistance [Ω]	6.28*	S				
P209	(P) No-load current [A]	3.0 *	S				
P210	(P) Static boost [%]	100	S				
P211	(P) Dynamic boost [%]	100	S				
P212	(P) Slip compensation [%]	100	S				
P213	(P) ISD control gain [%]	100	S				
P214	(P) Torque derivative action [%]	0	S				

Parameter No.	Description	Default setting	Super-visor	Setting after intervention by the user			
				P 1	P 2	P 3	P 4
P215	(P) Boost derivative action [%]	0	S				
P216	(P) Time boost derivative action [s]	0.0	S				
P220	Parameter identification	0		1= initiates a stator resistance measurement 2= initiates measurement of all motor parameters required			

*) dependent on FI rating or P200 / P220 respectively

CONTROL PARAMETERS, encoder input, only SK 520E							
P300	(P) Servo mode [OFF / ON]	0					
P301	Rotary encoder resol.	6					
P310	(P) Speed controller P [%]	100					
P311	(P) Speed controller I [%/ms]	20					
P312	(P) Torque current controller P [%]	200	S				
P313	(P) Torque current controller I [%/ms]	125	S				
P314	(P) Torque current controller limit [V]	400	S				
P315	(P) Field current controller P [%]	200	S				
P316	(P) Field current controller I [%/ms]	125	S				
P317	(P) Field current controller limit [V]	400	S				
P318	(P) Field weakening controller P [%]	150	S				
P319	(P) Field weakening controller I [%/ms]	20	S				
P320	(P) Field weakening contr. limit [%]	100	S				
P321	(P) Speed controller I release time	0	S				
P325	Shaft encoder function	0					
P326	Encoder ratio	1.00					
P327	Speed contouring error [rpm]	0 (OFF)					
CONTROL TERMINALS							
P400	Function analogue input 1	1					
P401	Mode analogue input 1	0	S				
P402	Alignment 1: 0% [V]	0.0	S				
P403	Alignment 1: 100% [V]	10.0	S				
P404	Filter analogue input 1 [ms]	100	S				
P405	Function analogue input 2	1					
P406	Mode analogue input 2	0	S				
P407	Alignment 2: 0% [V]	0.0	S				
P408	Alignment 2: 100% [V]	10.0	S				
P409	Filter analogue input 2 [ms]	100	S				
P410	(P) Sec. setpoint min. frequ. [Hz]	0.0					
P411	(P) Sec. setpoint max. frequ. [Hz]	50.0					
P412	(P) Process controller setpoint [V]	5.0	S				
P413	(P) PID controller P component [%]	10.0	S				
P414	(P) PID controller I component [%/ms]	1.0	S				
P415	(P) PID controller D component [%ms]	1.0	S				

Parameter No.	Description	Default setting	Super-visor	Setting after intervention by the user			
				P 1	P 2	P 3	P 4
P416	(P) PI setpoint ramp time [s]	2.0	S				
P417	(P) Offset analogue output [V]	0.0	S				
P418	(P) Function analogue output	0					
P419	(P) Analogue output scaling [%]	100					
P420	Digital input 1	1					
P421	Digital input 2	2					
P422	Digital input 3	8					
P423	Digital input 4	4					
P424	Digital input 5	0					
P425	Digital input 6	0					
P426	(P) Quick stopping time [s]	0.10					
P427	Quick stopping at fault	0	S				
P428	(P) Automatic starting [OFF / ON]	0	S				
P429	(P) Fixed frequency 1 [Hz]	0.0					
P430	(P) Fixed frequency 2 [Hz]	0.0					
P431	(P) Fixed frequency 3 [Hz]	0.0					
P432	(P) Fixed frequency 4 [Hz]	0.0					
P433	(P) Fixed frequency 5 [Hz]	0.0					
P434	(P) Function output 1 (K1)	1					
P435	(P) Scaling output 1 [%]	100					
P436	(P) Hysteresis output 1 [%]	10	S				
P441	(P) Function output 2 (K2)	7					
P442	(P) Scaling output 2 [%]	100					
P443	(P) Hysteresis output 2 [%]	10	S				
P450	(P) Function output 3 (DOUT1)	0					
P451	(P) Scaling output 3 [%]	100					
P452	(P) Hysteresis output 3 [%]	10	S				
P455	(P) Function output 4 (DOUT2)	0					
P456	(P) Scaling output 4 [%]	100					
P457	(P) Hysteresis output 4 [%]	10	S				
P460	Watchdog cycle time [s]	10.0	S				
P465	Fixed frequency field [-01...-31]	0					
P466	(P) Max. frequ. process controller	0.0					
P470	Digital input 7	0					
P475	Connection/disconnection delay	0.000	S				
P480	Funct. bus I/O In bits	12	S				
P481	Funct. bus I/O Out bits	10	S				
P482	Scaling bus I/O Out bits [%]	100	S				
P483	Hyst. bus I/O Out bits [%]	10	S				
ADDITIONAL PARAMETERS							
P502	Value leading function	0	S				
P503	Leading function output	0	S				
P504	Pulse frequency [kHz]	6.0	S				

Parameter No.	Description	Default setting	Super-visor	Setting after intervention by the user			
				P 1	P 2	P 3	P 4
P505	(P) Abs. minimum frequency [Hz]	2.0	S				
P506	Autom. fault acknowledgement	0	S				
P507	PPO type	1					
P508	Profibus address	0					
P509	Control word source	0					
P510	Setpoint source	0 (auto)	S				
P511	USS baud rate	3	S				
P512	USS address	0					
P513	Telegram time-out [s]	0.0	S				
P514	CAN baud rate	4					
P515	CAN address	50					
P516	(P) Skip frequency 1 [Hz]	0.0	S				
P517	(P) Skipping zone 1 [Hz]	2.0	S				
P518	(P) Skip frequency 2 [Hz]	0.0	S				
P519	(P) Skipping zone 2 [Hz]	2.0	S				
P520	(P) Flying start connection	0	S				
P521	(P) Flying start conn. resolution [Hz]	0.05	S				
P522	(P) Flying start connection offset [Hz]	0.0	S				
P523	Factory settings	0					
P534	Torque based disconnection limit	401% (off)	S				
P535	I ² t motor	0	S				
P536	Current limit	1.5	S				
P537	Pulse disconnection [%]	150	S				
P538	Input voltage monitoring	3	S				
P539	(P) Output monitoring	0	S				
P540	Phase sequence mode	0	S				
P541	External output control	0000 (hex)	S				
P542	Analogue output ext. control [V]	0.0	S				
P543	(P) Actual value 1 for bus transm.	1	S				
P544	(P) Actual value 2 for bus transm.	0	S				
P545	(P) Actual value 3 for bus transm.	0	S				
P546	(P) Function setpoint 1 via bus	1	S				
P547	(P) Function setpoint 2 via bus	0	S				
P548	(P) Function setpoint 3 via bus	0	S				
P549	Function potentiometer box	0	S				
P550	ParameterBox job telegrams	0					
P551	Drive profile	0	S				
P554	Min. duty eff. chopper [%]	65	S				
P555	P - limitation of chopper [%]	100	S				
P556	Braking resistor [Ω]	120	S				
P557	Braking resistor rating [kW]	0	S				
P558	(P) Magnetisation time [ms]	1	S				

Parameter No.	Description	Default setting	Super-visor	Setting after intervention by the user			
				P 1	P 2	P 3	P 4
P559	(P) DC injection time [s]	0.50	S				
P560	EEPROM storage	1	S				

Parameter No.	Description	Current state or values displayed respectively				
INFORMATION, only for reading						
P700	(P) Current fault					
P701	Past faults 1...5					
P702	Freq. at past faults 1...5					
P703	Current at past faults 1...5					
P704	Voltage at past faults 1...5					
P705	DCLV at past faults 1...5					
P706	Param. set past faults 1...5					
P707	Software version (/ revision)					
P708	State of dig. inputs (bin/hex)					
P709	Voltage analogue input 1 [V]					
P710	Voltage analogue output [V]					
P711	State of relays [hex]					
P712	Voltage analogue input 2 [V]					
P714	Operating hours [h]					
P715	Oper. hrs since enable [h]					
P716	Current frequency [Hz]					
P717	Current speed [1/min]					
P718	Current setpoint frequ. 1..3 [Hz]					
P719	Instantaneous current [A]					
P720	Instantaneous torque current [A]					
P721	Instantaneous field current [A]					
P722	Current voltage [V]					
P723	Voltage component d [V]					
P724	Voltage component q [V]					
P725	Current cos phi					
P726	Apparent power [kVA]					
P727	Effective power [kW]					
P728	Input voltage [V]					
P729	Torque [%]					
P730	Field [%]					
P731	Parameter set					
P732	Phase U current [A]					
P733	Phase V current [A]					
P734	Phase W current [A]					
P735	Speed from shaft encoder [rpm]					
P736	D.C. link voltage [V]					
P737	Brake resistor duty cycle [%]					

Parameter No.	Description	Current state or values displayed respectively				
INFORMATION, only for reading						
P738	Motor duty cycle [%]					
P739	Heat sink temperature [°C]					
P740	Process data bus In [hex]					
P741	Process data bus Out [hex]					
P742	Data base version					
P743	Inverter type					
P744	Scope of extension					
P745	Subassembly version					
P746	Subassembly state					
P747	Inverter voltage range 230/400V					
P750	Overcurrent statistic					
P751	Overvoltage statistic					
P752	Mains failure statistic					
P753	Overtemperature statistic					
P754	Lost parameter statistic					
P755	System error statistic					
P756	Time-out statistic					
P757	Customer error statistic					
P799	Duration of faults 1...5					

6 Error signals

To prevent the inverter from being damaged the system ensures that the device is disconnected in the event of trouble. The two LED's mentioned in section 3 will show you whether everything is in good order.

When a fault has occurred, the following options are available to reset (acknowledge) it:

1. by switching the power off and then on again,
2. by programming a digital input for the purpose (function 12 of any of the parameters P420 ... P425 or P470),
3. by invalidating the "enable" command on the inverter (provided that no digital input is programmed for acknowledgement),
4. by an acknowledgement command transmitted via the bus or
5. by setting P506, the automatic fault acknowledgement parameter.

6.1 Error display with the SimpleBox / ControlBox

The **SimpleBox** or **ControlBox** will display errors with their number and the letter "E" preceding it. In addition current errors can be visualized by activating parameter P700. Past error messages are stored in parameter P701. More information regarding the state of the frequency inverter at the time the trouble occurred can be retrieved from the parameters P702 to P706 and P799.

When the cause of the failure has been eliminated the error display in the SimpleBox / ControlBox starts flashing prompting the user to acknowledge the error with the Enter key.

6.2 Table of the error messages the system will provide

Display		Type of failure	Cause
Group	Details see P700 / P701	Text shown in the ParameterBox	• What to do about it
E001	1.0	Inverter overtemperature	(Static) error signal from the output stage module • Reduce ambient temperature (to <40°C) • Check ventilation of switch cabinet
E002	2.0	Motor overtemperature (PTC resistor) <u>Not displayed unless a digital input (function 13) has been programmed accordingly.</u>	The motor temperature sensor has picked up. • Reduce load on the motor • Increase motor speed • Provide motor with separate ventilation
	2.1	Motor overtemperature (I ² t) <u>Not displayed unless the I²t motor limit has been programmed accordingly (P535).</u>	Disconnection at I ² t motor temperature limit • Reduce load on the motor • Increase motor speed
E003	3.0	Inverter overcurrent	Disconnection at I ² t inverter temperature limit, e.g. at > 1.5 x I _n for 60s • Avoid sustained inverter overload
	3.1	Brake chopper overcurrent	The U ² t limit for the brake chopper was reached • Avoid sustained brake chopper (resistor) overload
	3.2	Derating at overcurrent 125% reaction threshold	Derating (output reduction) at f < 2 Hz • 125% overcurrent for 50ms
	3.3	Dearting at overcurrent 150% reaction threshold	Derating (output reduction) at f < 2 Hz • 150% overcurrent
E004	4.0	Module overcurrent	(Brief) error signal from module • Short-circuit or ground fault at inverter output • Use external output choke (motor cable is too long)

Display		Type of failure	Cause
Group	Details see P700 / P701	Text shown in the ParameterBox	• What to do about it
E005	5.0	D.C. link overvoltage	Frequency inverter D.C. link voltage is too high • Reduce recovered energy by providing a brake resistor • Extend braking time (P103) • Except for lifting gear applications the mode for a delayed disconnection (P108) could be set • Prolong the time set for "quick stopping" (P426)
	5.1	Mains overvoltage	Mains voltage is too high • Please check the mains voltage 380V-20%...480V+10% or 200...240V $\pm$ 10% respectively
E006	6.0	D.C. link undervoltage (charging error)	Inverter input voltage/d.c. link voltage too low • Check mains voltage 380V-20% ... 480V+10% or 200...240V $\pm$ 10% respectively
	6.1	Mains undervoltage	
E007	7.0	Mains phase failure	One of the three mains supply phases was or still is interrupted • Check mains phases 380V-20% to 480V+10% or 200...240V $\pm$ 10% respectively, is any of the phases too weak? • All of the three mains phases must be symmetrical when applied.
OFF		NOTE: Display will show OFF when the inverter is regularly disconnected from the mains, with all three phase being equally reduced.	
E008	8.0	Parameters lost due to EEPROM trouble (Max. value was exceeded)	EEPROM data corruption • Software version of the stored data record does not match the software version of the inverter. NOTE: Parameters which have been <u>incorrectly set</u> are reloaded automatically (with factory settings). • Interference suppression is inadequate (cf. E020)
	8.1	Wrong inverter type	• EEPROM defective
	8.2	Ext. EEPROM copying error (ControlBox)	• Check proper fit of ControlBox • ControlBox EEPROM defective (P550 = 1).
	8.3	Customer interface fails to be correctly identified (KSE equipment)	System fails to recognize the actual frequency inverter scope of extension. • Switch the mains voltage off and then on again.
	8.4	Wrong database version	
	8.7	Original and image do not agree	
E009	---	ControlBox error	Communication fault affecting the SPI bus, ControlBox does not respond. • Check whether the ControlBox has been fitted correctly as specified. • Switch mains voltage off and then on again.
E010	10.0	Telegram time-out	Telegrams are not transmitted correctly, check connection of external devices (P513). • Check bus protocol program flow. • Check the bus master.
	10.2	External bus module telegram time-out	

Display		Type of failure	Cause
Group	Details see P700 / P701	Text shown in the ParameterBox	• What to do about it
	10.4	External bus subassembly initialization error	• Check P746. • Bus subassembly was not plugged in properly. • Check power supply of bus subassembly.
	10.1	External bus subassembly system error	For more information see the respective Supplementary Operating Instructions of the bus subassembly involved.
	10.3		
	10.5		
	10.6		
	10.7		
	10.8	External subassembly communication error	Faulty connection /fault in external subassembly
E011	11.0	ADU customer interface error	The reference voltage of the customer interface is not right (10V / 15V). This error signal is not displayed unless control proceeds via the control terminals (P509 = 0/1). Check control terminals for short-circuit fault.
E012	12.0	Customer watchdog / customer equipment error	The watchdog function having been assigned to a digital input, the required "high edge" was not applied to this input within the time interval selected in parameter >Watchdog cycle time<.
E013	13.0	Not available	
	13.1	Speed contouring error	Contouring error limit was reached. • Set a higher value in P327.
	13.2	Disconnection control response error	Contouring error limit was reached, the motor is no longer capable of ensuring the setpoint. • Set a higher torque limit value/ current limit in P112/P536.
E016	16.0	Motor phase error	One of the motor phases is not connected. • Check setting of P539 • Check whether the motor is properly connected
	16.1	Motor current control response during brake operation	Failure to ensure the magnetization current required at the moment of brake release • Check setting of P539 • Check whether the motor is properly connected
E018	18.0	Safety circuit	While the frequency inverter was in an enabled state the safety circuit has tripped. - Function not available yet -
E019	19.0	Parameter identification error	Automatic identification of the connected motor has failed.
	19.1	Star or delta connection of the motor not correct	• Check motor connection • Check preset motor data (P201...P209)
E020	20.0...21.3	System errors	Errors in program execution (system errors) as a result of electromagnetic interference. Please verify observance of the wiring instructions. It may be a good idea to fit an additional external line filter. The frequency inverter should be very thoroughly and effectively connected to earth.

7 Technical description

7.1 SK 500E / 520E General data

Function		Specification	
Output frequency		0.0 ... 400.0Hz	
Pulse frequency		3.0 ... 16.0kHz, default setting = 6kHz output reduction > 8kHz in 230V device, > 6kHz in 400V-device	
Typical overload capacity		150% for 60s, 200% for 3.5s	
Protection provisions against		Inverter overtemperature over- and undervoltage	short-circuit, ground fault over-load, no-load
Types of control		No-sensor vectorial current control (ISD), linear v/f characteristic	
Analogue setpoint input / PID input		2x 0...10V, 0/4...20mA, scalable, digital 7.5...24V	
Analogue setpoint resolution		10 bit related to measuring range	
Analogue output		0 ... 10V scalable	
Setpoint stability		analogue < 1% digital < 0.02%	
Motor temperature control		I ² t motor (UL-licensed), PTC / bimetallic relay (not UL-licensed)	
Digital input		5x (2.5V) 7.5...30V, R _i = (2.2kΩ) 6.1kΩ, cycle time = 1...2ms (Output 1, 2) additionally with SK 520E: 2x 7.5...30V, R _i = 6.1kΩ, cycle time = 1...2ms (Output 1, 2)	
Electrical isolation		Control terminals (digital and analogue inputs)	
Control outputs		2 relays 28V DC / 230V AC, 2A plus with the SK 520E: 2 digital outputs 15V, 20mA	
Interfaces		<u>Standard:</u> RS 485 (USS) RS 232 (single-slave) CANbus (with SK 520E) CANopen (with SK 520E)	<u>Option:</u> Profibus DP InterBus CANbus / CANopen DeviceNet AS Interface
Frequency inverter efficiency		approx. 95%, depending on the frame size	
Ambient temperature		0°C ... +40°C (S1-100% duty ratio), 0°C ... +50°C (S3-70% duty ratio 10min)	
Storage and shipping temperature		-20°C ... +60/70°C	
Long-term storage		Inoperative frequency inverters should be connected to mains voltage for 60 minutes after one year at the latest. Keep this rhythm up for as long as the devices are stored.	
Type of protection		IP20	
Maximum installation altitude a.m.s.l.		Up to 1000m: output is not affected 1000...4000m: output impairment 1%/ 100m (up to 2000m overvoltage cat. 3) 2000...4000m: only overvoltage cat. 2 can be ensured in this range, provisions for external voltage protection at the mains input are required	
Waiting period between one connection to the mains and the next		60 sec's for all device types, while they are regularly operated	
Con- nec- tion terminals	Mains/motor/br. resistor	4mm ² flexible with wire end sleeves, 6mm ² with rigid cable	Tightening moment of screw-type terminals: 0.5...0.6Nm
	Control section	1.0mm ² with wire end sleeves	
	Relays	1.5mm ² with wire end sleeves	
	RS485 / RS232	1x RJ12 (6-pole)	
	CANbus / CANopen	2x RJ45 (8-pole) - only with SK 520E -	

7.2 Electrical data 230V

Frame size 1					
Inverter type:	SK 500E... SK 520E...	-250-323-A	-370-323-A	-550-323-A	-750-323-A
Motor rating	230V	0.25 kW	0.37 kW	0.55 kW	0.75 kW
4-pole standard motor	240V	1/3 hp	1/2 hp	3/4 hp	1 hp
Mains phases	number	1 / 3 AC			
Mains voltage		200 ... 240V, $\pm 10\%$, 47 ... 63 Hz			
Output voltage		3 AC 0 – mains voltage			
Nominal output current	rms [A]	1.7	2.2	3.0	4.0
Brake resistor min.	accessory	240 Ω	190 Ω	140 Ω	100 Ω
Typ. input current	1 / 3 AC rms [A]	3.7 / 2.4	4.8 / 3.1	6.5 / 4.2	8.7 / 5.6
Recommended line protection (line fusing)	1 / 3 AC slow [A]	10 / 10	10 / 10	16 / 10	16 / 10
Type of ventilation		natural convection			
Weight	approx. [kg]	1.4			

Frame sizes 2 and 3						
Inverter type:	SK 500E... SK 520E...	-111-323-A	-151-323-A	-221-323-A	-301-323-A	-401-323-A
Motor rating	230V	1.1 kW	1.5 kW	2.2 kW	3.0 kW	4.0 kW
4-pole standard motor	240V	1½ hp	2 hp	3 hp	4 hp	5 hp
Mains phases	number	1 / 3 AC			3 AC	
Mains voltage		200 ... 240V, ± 10%, 47 ... 63 Hz				
Output voltage		3 AC 0 – mains voltage				
Nominal output current	rms [A]	5.5	7.0	9.0	12.5	16.0
Brake resistor min.	accessory	75 Ω	62 Ω	43 Ω	33 Ω	27 Ω
Typ. input current	1 / 3 AC rms [A]	12.0 / 7.7	15.2 / 9.8	19.6 / 13.3	17.5	22.4
Recommended line protection (line fusing)	1 / 3 AC slow [A]	16 / 16	20 / 16	25 / 20	20	25
Type of ventilation		fan cooling, temperature-controlled				
Weight	approx. [kg]	1.8			2.7	

7.3 Electrical data 400V

Frame sizes 1 and 2						
Inverter type:	SK 500E... SK 520E...	-550-340-A	-750-340-A	-111-340-A	-151-340-A	-221-340-A
Motor rating	400V	0.55 kW	0.75 kW	1.1 kW	1.5 kW	2.2 kW
(4-pole standard motor)	480V	¾ hp	1 hp	1½ hp	2 hp	3 hp
Mains phases	Number	3 AC				
Mains voltage		380 ... 480V, -20% / +10%, 47 ... 63 Hz				
Output voltage		3 AC 0 – mains voltage				
Nominal output current	rms [A]	1.7	2.3	3.1	4.0	5.5
Brake resistor min.	Accessory	390 Ω	300 Ω	220 Ω	180 Ω	130 Ω
Typ. input current	rms [A]	2.4	3.2	4.3	5.6	7.7
Recommended line protection (line fusing)	slow [A]	10	10	10	10	10
Type of ventilation		natural convection				blower, temp.-controlled
Weight	approx. [kg]	1.4		1.8		

Frame sizes 3 and 4					
Inverter type:	SK 500E... SK 520E...	-301-340-A	-401-340-A	-551-340-A	-751-340-A
Motor rating	400V	3.0 kW	4.0 kW	5.5 kW	7.5 kW
(4-pole standard motor)	480V	4 hp	5 hp	7½ hp	10 hp
Mains phases	number	3 AC			
Mains voltage		380 ... 480V, -20% / +10%, 47 ... 63 Hz			
Output voltage		3 AC 0 – mains voltage			
Nominal output current	rms [A]	7.5	9.5	12.5	16.0
Brake resistor min.	accessory	91 Ω	75 Ω	56 Ω	43 Ω
Typ. input current	rms [A]	10.5	13.3	17.5	22.4
Recommended line protection (line fusing)	slow [A]	16	16	20	25
Type of ventilation		fan cooling, temperature-controlled			
Weight	approx. [kg]	2.7		3.1	

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