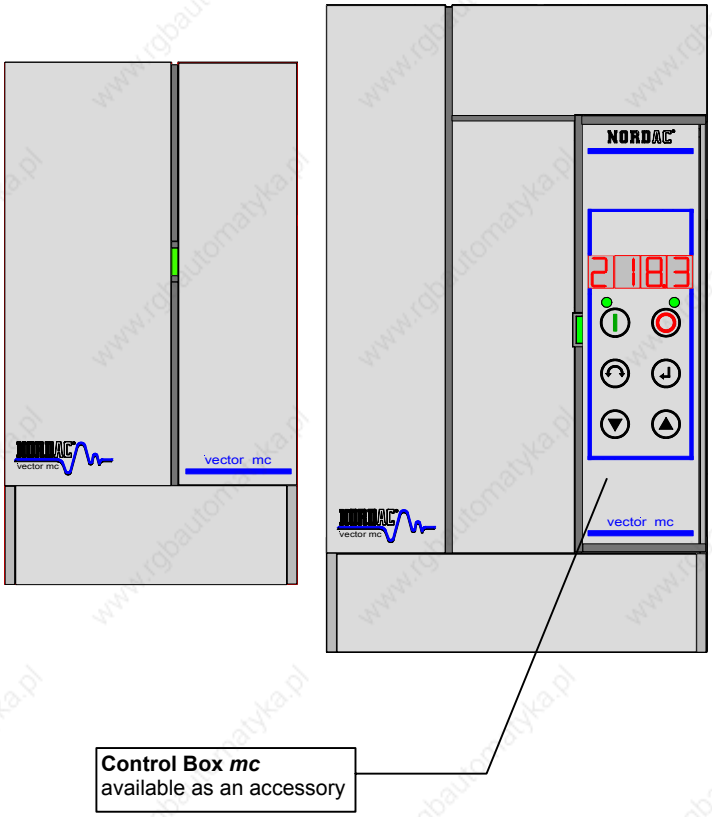
*OPERATING INSTRUCTIONS*

# NORDAC *vector mc*

## Frequency Inverter

SK 250/1 FCT ... SK 750/1 FCT
SK 1100/1 FCT ... SK 2200/1 FCT
SK 750/3 FCT ... SK 3000/3 FCT




**BU 4200 GB**
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**Getriebebau NORD**
**GmbH & Co. KG**

**... NORD Gear**

# NORDAC *vector mc* frequency inverter

## Instructions for the safety and use of converters feeding drives

(as provided in the 73/23/EEC low-voltage directive)

### 1. General

Depending on their type of enclosure, driving current converters may have live, bare, in some cases even moving or rotating parts as well as hot surfaces during operation.

Inadmissibly removing the required covers, improper use, incorrect installation or handling can be dangerous and may lead to serious damage to persons or to property.

See the documentation for more detailed information.

Any transport, installation, starting-up or maintenance work shall be performed by properly qualified, skilled and competent personnel (IEC 364 or CENELEC HD 384 respectively or DIN VDE 0100 and IEC 664 or DIN VDE 0110 and national accident prevention regulations to be observed).

Qualified, skilled personnel as mentioned in these basic safety instructions is understood to refer to persons who are familiar with the installation, assembly, setting-up and operation of the product and who have the qualifications required for the job of which they are in charge.

### 2. Intended use

Driving current converters are components designed to be integrated into electrical installations or machinery.

If the converters are installed in machines, they must not be put into operation (in other words, operation as intended by the manufacturer must not begin) until it has been established that the machine in question actually meets the requirements mentioned in the EG directive 89/392/EEC (Directive For Machines); EN 60204 is to be observed.

The device must not be put into operation (i.e. operation as intended by the manufacturer must not be started) unless the stipulations of the EMC directive (89/336/EEC) are fulfilled.

Driving current converters meet the requirements stated in the low-voltage directive 73/23/EEC. Likewise the accorded standards of the series prEN 50178/DIN VDE 0160 in conjunction with EN 60439-1/ VDE 0660 Part 500 and EN 60146/ VDE 0558 are applied to the driving current converters.

Refer to the rating plate and the documentation for details on technical data and connecting requirements and do not fail to observe them and to follow instructions.

### 3. Transport, storage

Follow the instructions for transport, storage, and proper handling.

Ensure climatic conditions as specified in prEN 50178.

### 4. Installation

The devices must be installed and cooled as directed in the relevant documentation.

The driving current converters must be protected against inadmissible stress. It is of particular importance that no components are bent and/or insulation distances changed during transport and handling. Do not touch electronic components and contacts.

Driving current converters contain electrostatically sensitive components which are easily damaged through improper handling. Electrical components must not be damaged or destroyed mechanically (potential health risks!).

### 5. Electrical connection

Follow the applicable national accident prevention rules (e.g. VBG 4) when working on driving current converters while they are live.

Electrical installation is to be performed in accordance with applicable rules and regulations (e.g. regarding conductor cross sections, fusing, PE connection). Apart from these, more instructions may be mentioned in the documentation.

Recommendations for meeting EMC standards in installation - for instance with regard to screening, earthing, filter arrangement and the routing of lines - are found in the converter documentation. CE-marked driving current converters are always subject to such instructions as well. It is the responsibility of the machine or plant manufacturer to ensure that the limit values stipulated by EMC legislation are duly met.

### 6. Operation

It may be necessary to provide facilities in which driving current converters are installed with additional monitoring and protecting devices to satisfy the applicable safety regulations, e.g. the law on technical work materials, accident prevention regulations etc. Modifications of the driving current converters by means of the operating software are allowed.

Do not touch live parts of the device or power terminals right after the converter has been disconnected from the supply voltage as capacitors may still be charged. The information plates on the driving current converter will give you precise details on the subject.

Keep all covers closed during operation.

### 7. Service and maintenance

As described in the manufacturer's documentation.

**Do keep these Safety Instructions for future reference!**

## Table of contents

**1 GENERAL ..... 4**
1.1 Instructions for safety and installation ..... 4

**2 MOUNTING AND INSTALLATION ..... 5**
2.1 Installation ..... 5
2.2 Wiring instructions ..... 5
2.3 Electrical connection ..... 5

**3 OPERATION AND DISPLAY ..... 9**
3.1 Displays without additional options ..... 9
3.2 Control Box *mc* (Option) ..... 9

**4 SETTING UP THE SYSTEM ..... 11**
4.1 Basic settings ..... 11

**5 PARAMETERISATION ..... 11**
5.1 Survey of parameters ..... 11

**6 ERROR SIGNALS ..... 20**

**7 RECOMMENDATIONS FOR SERVICE AND MAINTENANCE ..... 22**
7.1 Additional information ..... 22
7.2 UL/CUL Certification ..... 22

**8 TECHNICAL DATA ..... 23**
8.1 SK 250/1 FCT to SK 2200/1 FCT ..... 23
8.2 SK 750/3 FCT to SK 3000/3 FCT ..... 23
8.3 General Technical data ..... 24
8.4 Technical documentation ..... 24

# 1 General

NORDAC *vector mc* inverters are voltage-source d.c. link devices with microprocessor electronics designed to control the speed of three-phase motors in the power range 250W to 3.0kW.
Maximum torque and excellent stability of the desired motor speed are obtained using a system of vector current control. This enables the inverter to operate one three-phase motor connected to it at optimum voltage and frequency, without a sensor being required.

## 1.1 Instructions for safety and installation

NORDAC *vector mc* frequency inverters are designed for use in industrial equipment. Touching them may cause serious injuries, or even death, due to the voltages at which they are operated.

- Only skilled electricians/electrical engineers should be allowed to install or work on the devices, provided that these have previously been disconnected from supply. The personnel involved must have access to the Operating Instructions at any time and observe them conscientiously without exception.
- Local regulations governing the installation of electric plant as well as any regulations for accident prevention have to be observed.
- The device is still dangerously live for up to 5 minutes after its disconnection from the mains. Therefore the device must not be opened, or the cover or control panel be removed until 5 minutes after it has been disconnected from the supply. Replace all covers before switching the mains voltage on again.
- Even when the motor has stopped (e.g. following electronic disable, jamming of the drive, or a short-circuit of the output terminals), the supply terminals, the motor terminals, and the braking resistor terminals can be dangerously live. Even if the motor is not running it must not be assumed that it is also electrically isolated from the mains.
- **Attention, certain parameter settings may cause the inverter to start up automatically when it is connected to the mains.**
- The frequency inverter is designed 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). VDE 0160 demands that either a second earth conductor be connected, or that the earth conductor cross section be 10mm$^2$ minimum.
- With three-phase frequency inverters, conventional fault-current circuit breakers are inadequate without additional means of protection, if local regulations state that the leakage current must not contain any proportion of direct current. The construction of the standard fault-current circuit breakers should meet the new VDE 0664 requirements.

**CAUTION! DANGER!**

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

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

### CAUTION

- Ensure that neither children nor the general public will have access to the device or a chance to manipulate it!
- The device must not be used for any purpose other than the one intended by the manufacturer. Unauthorised modifications and the use of replacement parts and attachments which are not sold or recommended by the manufacturer, may cause fire, electric shock and injuries.
- Keep these Operating Instructions in a place where any potential user can find them, or give them to anyone involved in handling the device!

## European EMC Directive

If the NORDAC *vector mc* is installed in accordance with the instructions of the present manual, it will meet any requirements of the EMC directive as stipulated in the EN61800-3 EMC product standard for the electromagnetic compatibility of motor-driven systems.

CE

**For use in North America,** UL and CUL approval **File: E171342**

*"Suitable for connection to mains supplying 230 V (single-phase units) or 460 V (three-phase units), with a (symmetrical) short-circuit current never exceeding 5000 amps" and "if protected by J class fuses" as indicated in* ***Section 7.2 / 8****.*

c UL US LISTED

# 2 Mounting and installation

## 2.1 Installation

To provide the inverters with the amount of ventilation they require, we recommend that a clearance of > 100mm above and > 120mm below, is maintained between the devices and the sides of the switch cabinet. This extra room can be used to accommodate electrical components (such as cable ducts, contactors etc.) provided that they are kept at a minimum distance from the inverter of 2/3 of their respective height (example: height of cable duct 60mm → 2/3 · 60mm = 40mm distance from inverter). The mounting position is always vertical.

**Make provision for the hot air above the devices to be effectively removed!**

## 2.2 Wiring instructions

The inverters were designed not to be affected by the high level of electromagnetic interference usually prevailing in the industrial areas where they are operated. In general, if installation is carried out in a workmanlike manner, safe and trouble free operation is ensured. In case that limit values more rigid than those indicated in the EMC rules must be met, the instructions given below should be useful:

(1) Make absolutely sure that all devices in the cabinet are effectively earthed using short earth conductors with a large cross-section which should be connected to a common earth connection point or earth bus bar. It is of special importance that any control device connected to the inverters (e.g. an automation device) is linked with the same earth connection point as the inverter itself using a short conductor with a large cross- sectional area. Flat conductors (such as metal bows) should be preferred as they show less impedance at high frequencies.

The PE conductor of the motor controlled by the inverter should be connected as directly as possible to the earth connection point which is connected to the heat sink, along with the PE of the mains supply cable of the inverter involved. By providing a central earth bus bar in the switch cabinet and jointly connecting all PE conductors to this bar, trouble free operation is normally ensured.

(2) Use shielded cables for control circuits if possible. Terminate the cable ends carefully and see to it that no greater length of wire runs unshielded.

The shield of analogue setpoint cables should be earthed at the frequency inverter at one end only.

(3) When laying control wires and load wires they should be adequately spaced if possible using for instance separate cable ducts etc. When lines are crossing try to arrange them so as to form a 90° angle.

(4) Take appropriate measures to ensure that no interference will be emitted by the contactors in the cabinets. Alternate voltage contactors should be included in an RC circuit while direct current contactors should be provided with freewheeling diodes, **with the interference suppression components being fixed to the contactor coils**. Varistors for overvoltage limitation can also be used to achieve noise suppression. Especially if the contactors are controlled by the relays in the inverter, interference suppression is indispensable.

(5) Use screened or armoured cables for the load connections, and connect the screening/armouring to earth at both ends – if possible directly at the PE of the frequency inverter.

(6) If the drive is to work in an environment which is sensitive to electromagnetic interference, we recommend to use radio interference suppression filters to reduce the noise emitted by the inverter and the cabling. Fit the filter as closely as possible to the inverter and ensure very thorough earthing.

(7) Select the lowest switching frequency the inverter will allow. With this measure the intensity of the electromagnetic interference produced by the inverter is reduced.

**When installing the inverters never and on no account do anything to violate the safety regulations!**

## 2.3 Electrical connection

**WARNING**

THESE DEVICES MUST BE EARTHED.

For the device to work safely and reliably it must have been installed and put into operation by qualified personnel in a workmanlike manner, with all of the instructions mentioned in the present Operating Manual being followed as specified.

In particular both the generally and locally applicable installation and safety regulations for work on power installations (e.g. VDE) and the regulations concerning the professional use of tools and the use of any equipment for personal protection must be observed.

The mains input and the motor connecting terminals may be dangerously live even if the inverter is out of operation. Always use insulated screwdrivers in these terminal areas.

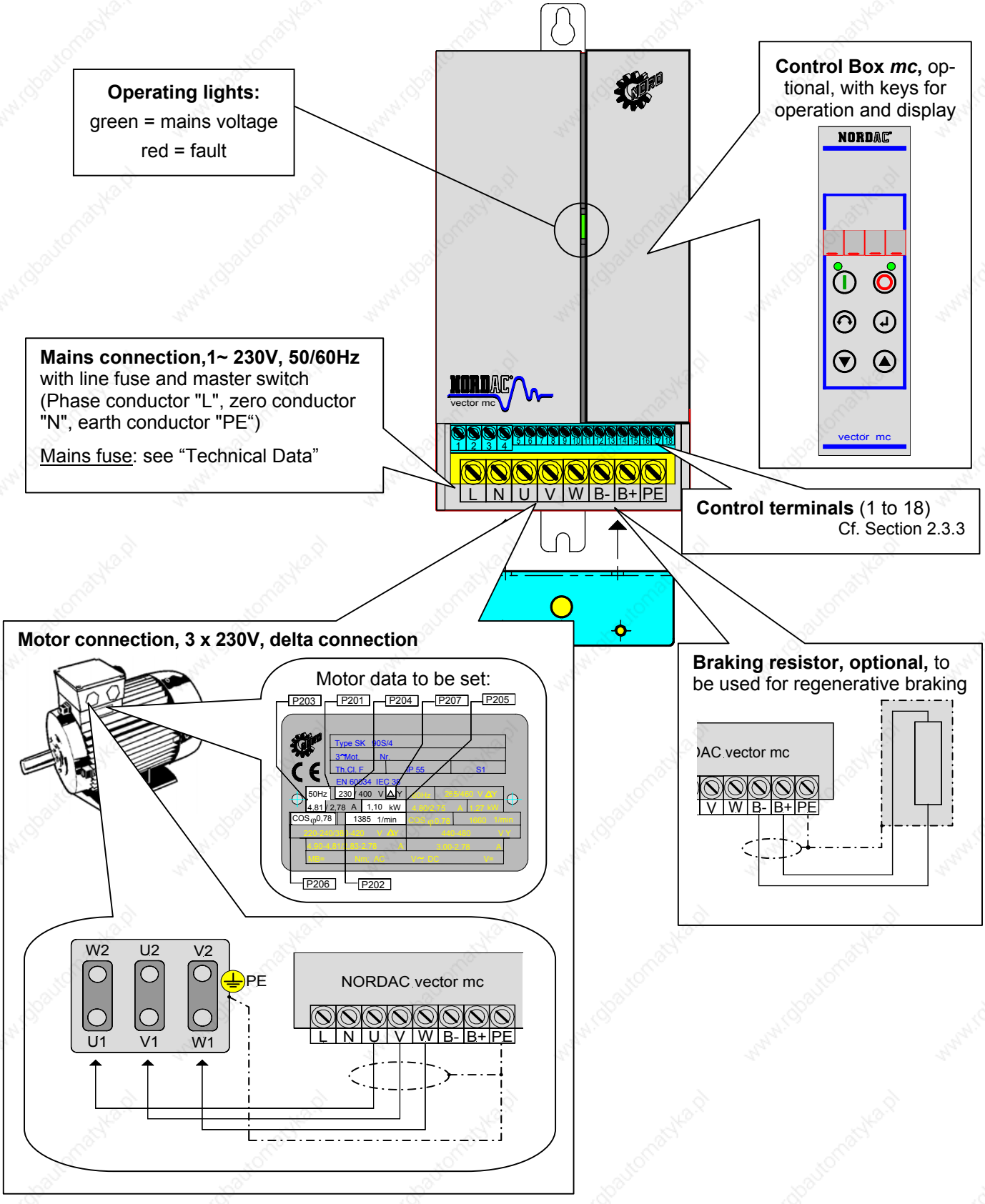
Make sure that the source of input voltage is disconnected before you establish connections to the unit or change them.

**WARNING**

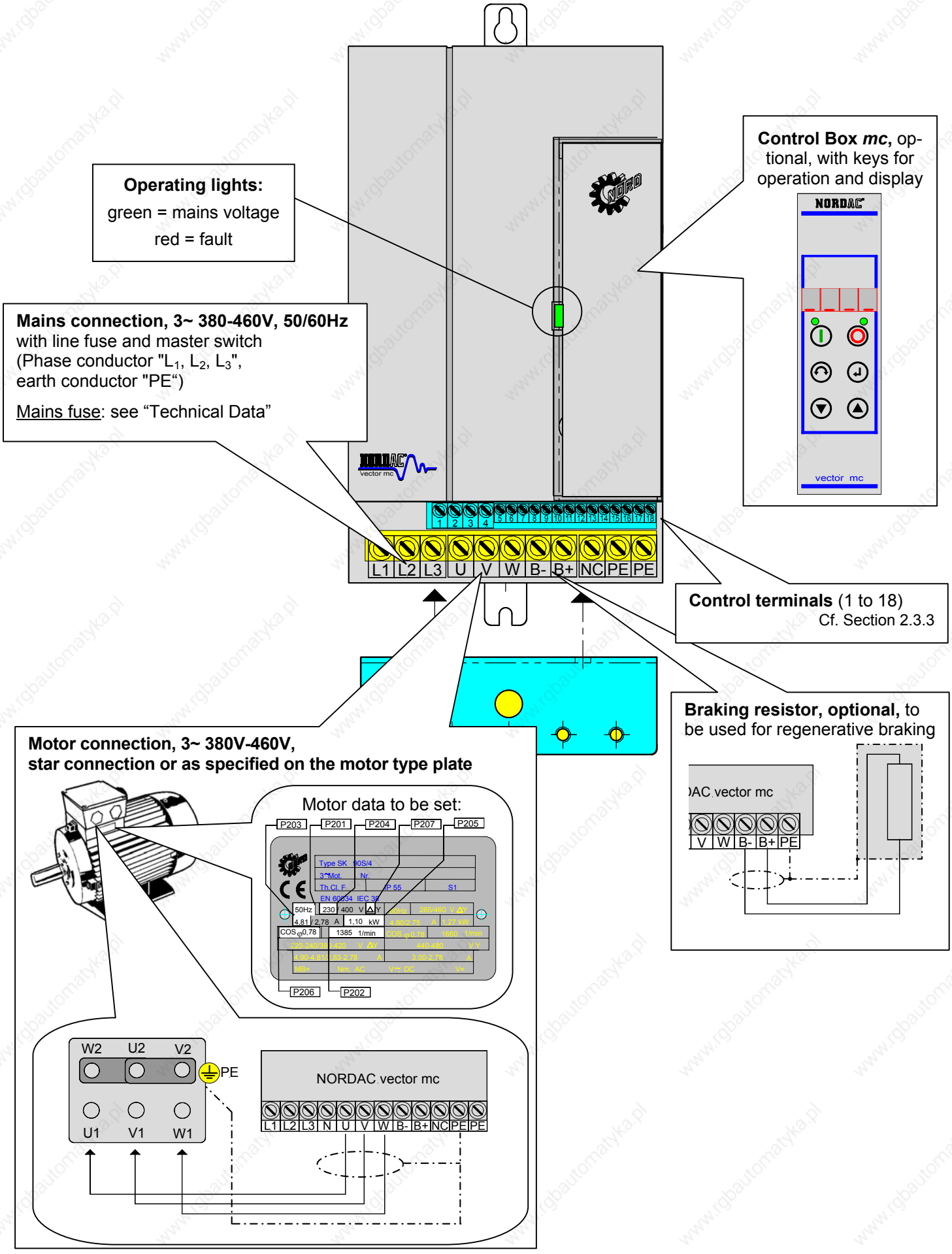
**Make sure that the motor is rated to match the connecting voltage. Single-phase 230V NORDAC *vector mc* frequency inverters must not be connected to a 400/460V three-phase network.**

If synchronous machines are connected or if several motors are coupled in parallel, inverter operation must be based on a linear voltage-to-frequency characteristic (P211= 0) and (P212 = 0).

## 2.3.1 Mains and motor connections SK 250/1 FCT to SK 2200/1 FCT



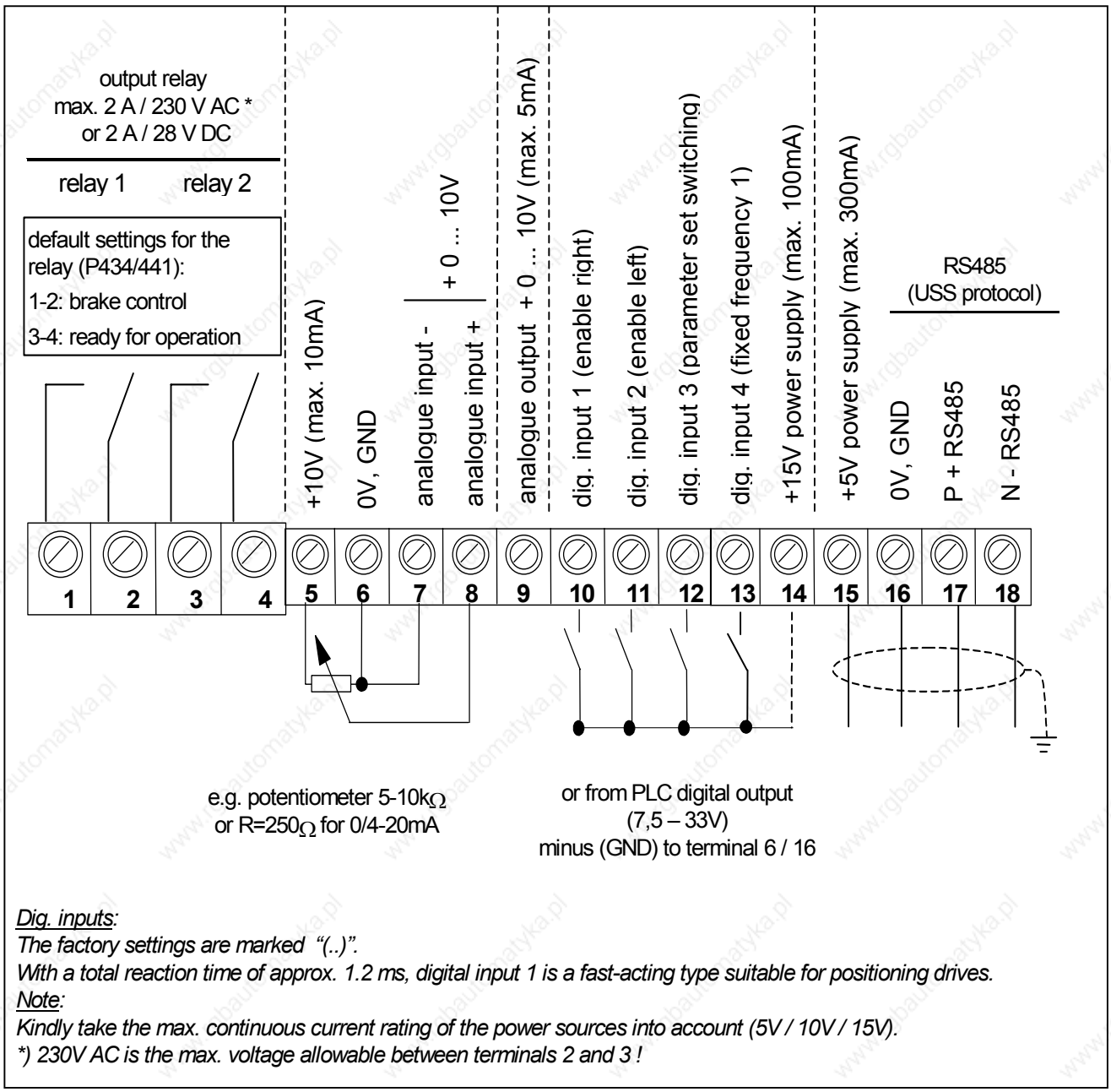
## 2.3.2 Mains and motor connections SK 750/3 FCT to SK 3000/3 FCT



### 2.3.3 Control terminals

Maximum connection cross-section: - 1.5 mm² for relay outputs
- 1.0 mm² for analogue and digital inputs and outputs

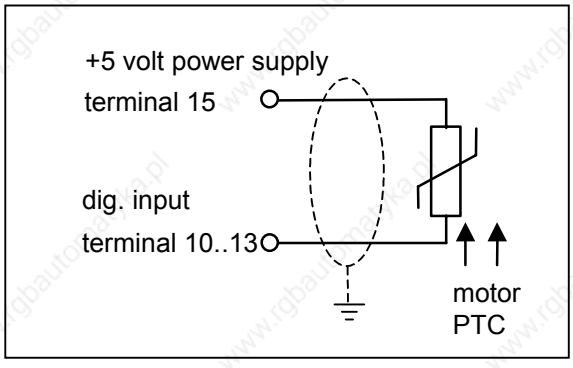
All voltages are related to a common reference potential (GND, terminals 6 / 16).




*Dig. inputs:*
*The factory settings are marked "(..)".*
*With a total reaction time of approx. 1.2 ms, digital input 1 is a fast-acting type suitable for positioning drives.*
*Note:*
*Kindly take the max. continuous current rating of the power sources into account (5V / 10V / 15V).*
**) 230V AC is the max. voltage allowable between terminals 2 and 3 !*

### 2.3.4 Motor temperature protection

The only reliable way to protect the motor from overheating is to incorporate temperature sensors (PTC thermistors) into the motor windings. The PTC thermistors can be connected to a digital input.
To enable evaluation the relevant parameter (P420 to P423) must be set to 13.
For the connection, please use shielded control cables.



# 3 Operation and display

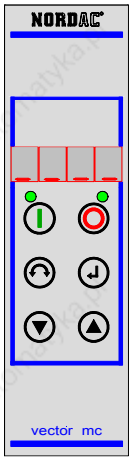
## 3.1 Displays without additional options

**Mains voltage being applied** to the NORDAC *vector mc* is indicated by an LED illuminated green.
If a **fault** has occurred a red LED will be glowing too.

Moreover factory settings allow for verification of the inverter's readiness for operation via the fault signalling relay (relay 2, control terminal 3-4).

→ contact closed = FI is ready for operation
→ contact open = fault has occurred

## 3.2 Control Box *mc* (Option)



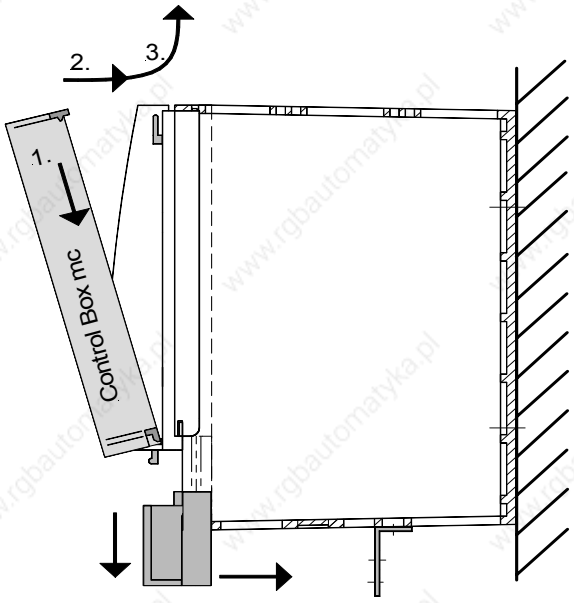

To assemble the Control Box *mc* proceed as follows:

1. Remove the blind cover.
2. Insert the Control Box into the lower guide rail.
3. Then make the upper end of the Control Box snap into place by pushing it slightly upwards and
4. towards the inverter at the same time.

Four dashes will signal readiness for operation.

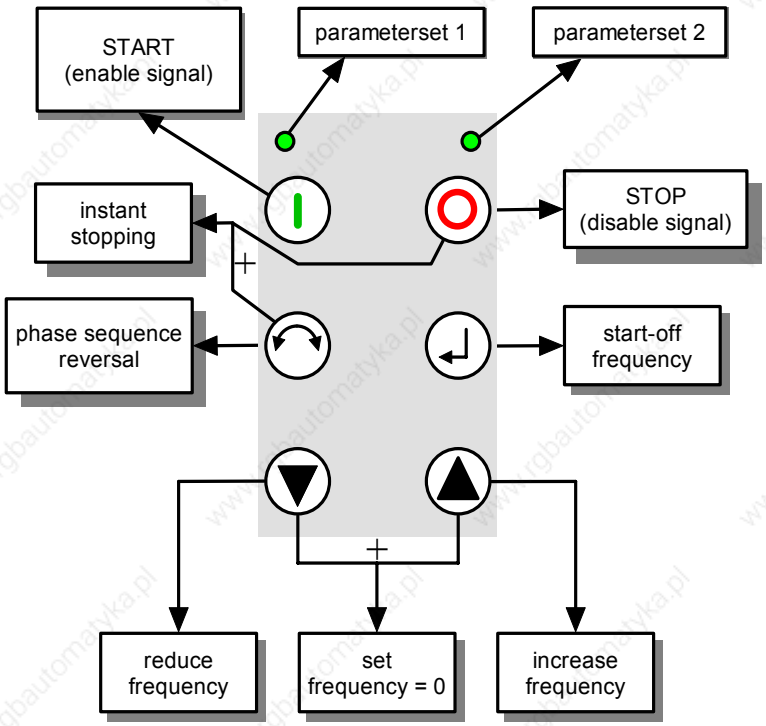
The green LED's indicate the parameter set which is being used at the time or has been selected for editing.

(left LED = P1, right LED = P2)




## Using the Control Box *mc* for inverter control

If you want to control the inverter using the Control Box *mc*, do not previously enable the inverter via the control terminals or a serial interface (P509 = 0).




Pressing the "START" key will make the inverter display the operating values (as selected in P001). The inverter will supply 0Hz or any other minimum frequency set at a level higher than 0Hz (P104).
To quit the operating value display mode and subsequently parameterise the inverter, switch the unit off using the "STOP" key.

**Frequency setpoint:**
The current frequency setpoint depends on the values set in the start-off frequency (P113) and minimum frequency (P104) parameters. This setpoint can be varied with the value+ and value- keys when the inverter is operated via the keyboard, and, by pressing the "ENTER" key, be permanently saved in P113 as a start-off frequency for the next time the inverter is switched on.

**Instant stopping:**
To bring about instant stopping, the "STOP" and "Phase sequence reversal" keys should be pressed simultaneously.

## Parameterisation with the Control Box *mc*

The Control Box *mc* allows for **parameter setting**

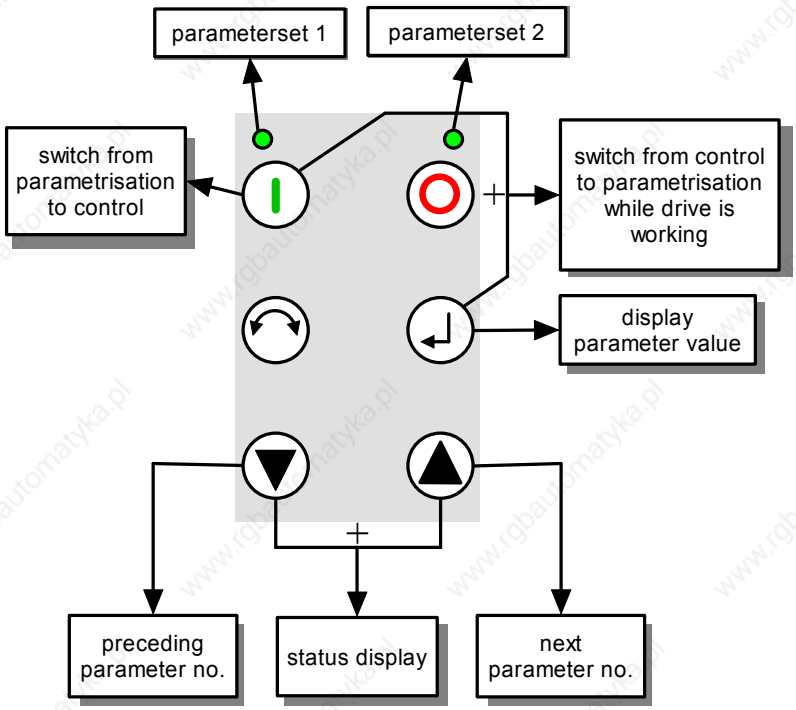
a. provided that it has not also been used before to enable (START) the inverter ...

   While the inverter is controlled via the control terminals, all parameters can be varied directly on-line any time.

   ... or

b. if the **"START"** and **"ENTER"** keys are operated **simultaneously**, and if the Control Box *mc* has been used for enable.

   To return to the control mode when the inverter is enabled, use the "START" key.



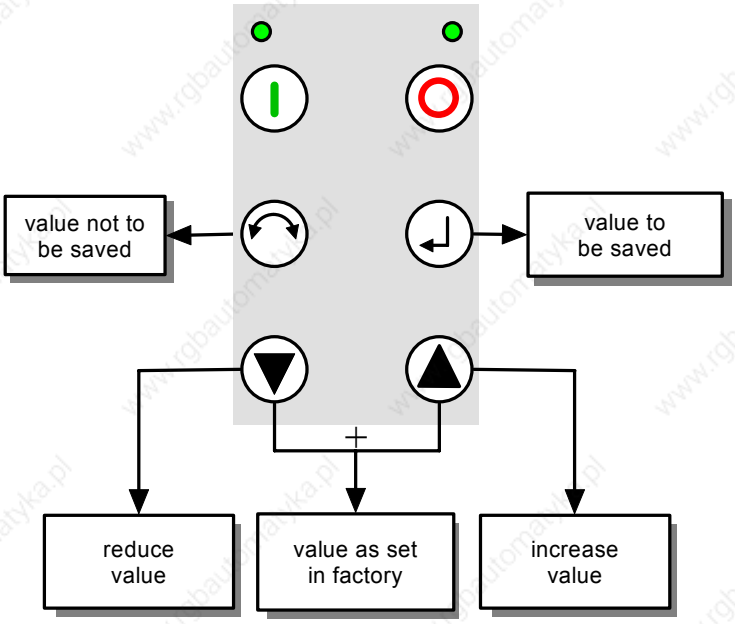

All parameters are arranged in a numerical order based on an ring structure enabling you to page backward or forward as required.

Each parameter is assigned a parameter number → Pxxx.

To **change a parameter value,** the "ENTER" key must be pressed while the parameter number in question is displayed.

The value display keeps flashing until a value, after having been changed, is also validated with the "ENTER" command. Only then will the new value have been stored in the inverter.

If you do not want the change to be permanent, you can quit the parameter using the phase sequence reversal key.



# 4 Setting up the system

## 4.1 Basic settings

**General**

As no master power switch is provided on the inverter, the device is always live while connected to mains voltage. It will be waiting with its output disabled until the START key is operated or until an external start signal is received.

In the factory the inverter is programmed in advance for standard uses involving 4-pole three-phase A.C. standard motors. A motor list is stored in the device. The motor actually to be controlled is selected via P200. The data are loaded into the parameters P201 – P208 automatically where they can be viewed to be compared once again with the actual data on the motor's type plate.
The data of any motor which is not mentioned in the list must be transferred from the type plate into parameters P201 to P208.
For the stator resistance to be determined automatically, P208 must be set = 0 and the "ENTER" key pressed to acknowledge the input. After that the stator resistance is automatically measured once. From the detected value the programme will calculate the phase winding resistance and store it as such (the latter varying according to which type of connection – star or delta – has been set in P207).

**Initial checking**
Check proper connection of all cables and whether all relevant safety instructions are being followed.
Connect inverter to mains voltage.
Make sure that starting up the motor will not lead to dangerous situations. Operate the START key on the Control Box *mc.* The display will change to **0.0**.
Check whether the motor will be rotating in the sense desired by pushing the ⏏ key.
The display shows the current output frequency.
Operate the STOP key. The motor will stop within the period set for braking. At the end of this period the display will change to _ _ _ _

Now you can adjust the parameters described below as required.

# 5 Parameterisation

**Note:** With parameter P523, the factory setting of any parameter can be restored any time. This may be helpful for instance to enable operation of a frequency inverter after the parameters were changed at some earlier occasion and still deviate from the factory settings.

**Important:** Remember to make a note of the settings you are going to abandon before you restore those programmed in the factory (by setting P523=1), or store them in the Control Box *mc* (P550=1).

## 5.1 Survey of parameters

(P) ⇒ only valid in one parameter set. These parameters can be set differently in the 2 parameter sets.

### 5.1.1 Operating display

| Parameter No. | Designation | Range of values | Factory setting | Settings after intervention by the user | |
|---|---|---|---|---|---|
| | | | | P. set 1 | P. set 2 |
| P000 | **Operating display** | -- | | | |
| P001 | **Selection of operating parameters to be displayed** | 0 ... 6 | 0 | | |

**0 = actual frequency [Hz],** is the output frequency currently supplied by the FI

**1 = speed [1/min],** is the actual speed as calculated by the inverter

**2 = nominal frequency [Hz],** is the output frequency which corresponds to the active setpoint value without however being necessarily equal to the current output frequency

**3 = current [A],** is the instantaneous output current measured by the FI

**4 = torque current [A],** is the torque generating output current of the FI

**5 = voltage [Vac],** is the current alternating voltage the FI supplies at its output

**6 = d.c. link voltage [Vdc],** is the internal direct voltage of the FI

## 5.1.2 Basic parameters

| Parameter No. | | Designation | Range of values | Factory setting | Settings after intervention by the user | |
|---|---|---|---|---|---|---|
| | | | | | P. set 1 | P.set 2 |
| P100 | | **Parameter set** | 0 / 1 | 0 | | |
| | | Selection of the parameter set you want to work with. Two parameter sets are available. All parameters which can be set differently in either parameter set are marked **(P)** .<br>**0 = parameter set 1** **1 = parameter set 2**<br>It is perfectly all-right to switch parameter sets while operation is in progress (on-line switching).<br>If the Control Box *mc* is used to enable the inverter, the set of operating parameters will be the one selected in P100.<br>With Control Box *mc* only:<br>While operation is going on, the operating parameter display (P000 + "ENTER") shows the parameter set currently active for control. During parameterisation it shows the parameter set which is being varied at the time.<br>*Left LED = parameter set 1, right LED = parameter set 2* | | | |
| P101 | | **Copy parameter set** | | 0 | | |
| | | Setting the value to **1** will initiate copying of the parameter set selected in P100 into the other parameter set. No effect is produced by setting the value to **0.** | | | | |
| P102 | (P) | **Acceleration time** | 0 ... 99.99 s | 2.00 | | |
| P103 | (P) | **Deceleration time** | | 2.00 | | |
| | | ... determines the ramp between 0Hz and the set maximum frequency.<br>Acceleration may take longer than provided for by the setting, e.g. as a result of inverter overload, setpoint delay (P107), ramp smoothing (P106) or of the current limit being reached (P112). | | | | |
| P104 | (P) | **Minimum frequency** | 0.0 ... 400.0 Hz | 0.0 | | |
| P105 | (P) | **Maximum frequency** | 0.1 ... 400.0 Hz | 50.0 | | |
| | | These frequency values define the operating range (0% to 100%) of an analogue setpoint. | | | | |
| P106 | (P) | **Ramp smoothing** | 0 / 10 ... 100 % | 0 | | |
| | | With this parameter a smoothing of the upward and downward ramp can be achieved. | | | | |
| P107 | (P) | **Brake reaction time** | 0 ... 2.50 s | 0.00 | | |
| | | During the period of delay which is adjustable as required the frequency inverter supplies the absolute minimum frequency set in P505. | | | | |
| P108 | (P) | **Disconnection mode** | 0 ... 4 | 1 | | |
| | | This parameter determines the way the output frequency will be reduced following the "disable" signal (controller enable → low):<br>**0 = Voltage disable:** The output signal is switched off undelayed.<br>**1 = Ramp:** The current output frequency is reduced within the portion of time which is left of the period set for braking.<br>**2 = Delayed ramp:** as in "ramp", however with a prolonged deceleration ramp in regenerative operation.<br>**3 = Instant d.c. braking:** The inverter will switch to the preselected direct current (P109) immediately.<br>**4 = Constant stopping distance:** This function results in the stopping distance being more or less equal regardless of the amount of frequency supplied at the moment of disconnection. This function will be executed even if the frequency setpoint is reduced to 0Hz. (Setpoint = 0.0V and minimum frequency = 0Hz → setpoint used for switching! | | | | |
| P109 | (P) | **D.C. brake current** | 0 ... 250 % | 100 | | |
| | | Setting the current for d.c. braking (if P108 = 3). | | | | |
| P112 | (P) | **Torque current limit** | 25 ... 400 % / 401 | 401 | | |
| | | Setting a torque limit based on the nominal motor data. **401 = OFF** | | | | |
| P113 | (P) | **Start-off frequency** | -400.0 ... 400.0 Hz | 0.0 | | |
| | | When the **Control Box *mc*** is used, the frequency supplied the moment it is enabled is referred to as start-off frequency. With control ensured via the control terminals, the start-off frequency can be activated via any of the digital inputs (P420 – 423 = 15). No extra enable signal will be required if none of the digital inputs has been programmed to execute the enable function (function 1/2). | | | | |

## 5.1.3 Motor data

| Parameter No. | | Designation | Range of values | Factory setting | Settings after user intervention | |
|---|---|---|---|---|---|---|
| | | | | | P. set 1 | P. set 2 |
| P200 | (P) | **Motor list** | 0 ... 15 | 0 | | |

| | | | |
|---|---|---|---|
| **0 = no data change** | **4 = 0.12kW** | **8 = 0.55kW** | **12 = 2.2kW** |
| **1 = no motor** | **5 = 0.18kW** | **9 = 0.75kW** | **13 = 3.0kW** |
| **2 = 0.06kW** | **6 = 0.25kW** | **10 = 1.1kW** | **14 = 4,0kW** |
| **3 = 0.09kW** | **7 = 0.37kW** | **11 = 1.5KW** | **15 = 5,5kW** |

The basic settings of a 4-pole three-phase standard motor can be activated selecting the applicable option from P200. With the control job finished, this parameter will automatically be reset to zero.

To initiate a stator resistance measurement, set P208 = 0 and operate the "ENTER" key afterwards.

| | | | | | | |
|---|---|---|---|---|---|---|
| P201 | (P) | **Motor nominal frequency** | 20.0 ... 399.9 Hz | 50.0 | | |
| P202 | (P) | **Motor nominal speed** | 0 ... 24000 U/min | 1375 * | | |
| P203 | (P) | **Motor nominal current** | 0.00 ... 15.00 A | 3.64 * | | |
| P204 | (P) | **Motor nominal voltage** | 100 ... 500 V | 230 | | |
| P205 | (P) | **Motor rating** | 0 ... 9999 W | 750 * | | |
| P206 | (P) | **Motor cos φ** | 0.50 ... 0.90 | 0.74 * | | |
| P207 | (P) | **Motor connection** | 0 = star, 1 = delta | 1 * | | |
| P208 | (P) | **Stator resistance** | 0.00 ... 300.00 Ω | 10.20 * | | |

*) These settings vary with the inverter type being used. The data indicated refer to an SK 750/1 FCT.

| | | | | | | |
|---|---|---|---|---|---|---|
| P210 | (P) | **Static boost** | 0 ... 250 % | 100 | | |
| P211 | (P) | **Dynamic boost** | 0 ... 150 % | 100 | | |
| P212 | (P) | **Slip compensation** | 0 ... 150 % | 100 | | |
| P213 | (P) | **ISD control gain** | 25 ... 400 % | 100 | | |

In the factory the inverter is adjusted to non-sensor vectorial current control. This mode is suitable if one three-phase standard motor is connected only. The inverter will automatically adapt the output voltage and output frequency required to the load.

For the inverter to operate in accordance with a linear voltage-to-frequency characteristic (multiple-motor control), the following settings are required: P211 = 0 and P212 = 0.

| | | | | | | |
|---|---|---|---|---|---|---|
| P214 | (P) | **Torque derivative control** | -200 ... 200 % | 0 | | |
| P215 | (P) | **Boost derivative control** | 0 ... 200 % | 0 | | |
| P216 | (P) | **Time of boost derivative control** | 0.0 ... 10.0 s | 0.0 | | |

Derivative-action control of the torque (P214 – P216) is required for applications in which the drive is to start up against a high negative or positive torque (as e.g. with lifting and hoisting gear).

While the setting selected for "torque derivative control" will affect ISD control, the "boost derivative control" setting ensures that the voltage will be raised by a fixed amount as soon as the inverter is enabled, with the voltage boost being limited to the period set in the P216 parameter.

Execution of the "boost derivative control" function depends on the linear characteristic having been activated (P211=0% and P212=0%).

## 5.1.4 Control terminals

| Parameter No. | Designation | Range of values | Factory setting | Settings after user intervention | |
|---|---|---|---|---|---|
| | | | | P. set 1 | P. set 2 |
| P400 | **Analogue input function** | 0 ... 16 | 1 | | |

**0 = Off**, no function is assigned to the analogue input.

**1 = Nominal frequency**, according to the analogue range specified (P402/P403), the output frequency is varied between the maximum and minimum frequencies set (P104/P105).

**2 = Torque current limit**, proceeding from the torque current limit as set in P112, this limit can be changed by providing an analogue value. The torque current limit that was set is considered to be the 100% setpoint value.

**3 = PID actual frequency**, is required for control loop configuration. The analogue input (actual value) is compared with the setpoint (e.g. a fixed frequency). The output frequency is adjusted as far as possible until the actual value has become equal to the setpoint (cf. controlled variables P413 – P415).

**4 = Frequency addition**, this function is available on the condition that a setpoint is transmitted via a secondary setpoint (P410/411). In such a case the analogue setpoint will be added to the secondary setpoint.

**5 = Frequency subtraction,** the secondary setpoint received will be subtracted from the analogue setpoint.

*6 / 7 = permanently allocated*

**8 = PID actual frequency limited,** basically the same as function 3, PID actual frequency, however with the output frequency being prevented from dropping below the value programmed as the minimum frequency in parameter 104 (no spontaneous reversal of the phase sequence)

**9 = PID actual frequency monitored,** basically the same as function 3, PID actual frequency, however with the inverter disconnecting the output when the frequency has dropped so far as to equal the minimum frequency value set in P104.

*10 – 13 = permanently allocated*

**14 = Process controller actual value *,** this setting will activate the PI process controller. Analogue input 1 to be connected to the actual value encoder (dancer roll, pressure capsule, rate meter, ...). The corresponding mode (0-10V or 0/4-20mA respectively) is set in P401.

**15 = Process controller setpoint *,** comparable to function 14, however with - in this case - the setpoint being fed to the system, e.g. by a potentiometer. The actual value will have to be applied to a different input.

**16 = Process controller derivative action *,** function ensuring that an adjustable additional setpoint will be added to the setpoint fed to the PI process controller.

*) For more details regarding the PI process controller see **BU 4100** section 8.4

| | | | | |
|---|---|---|---|---|
| P401 | **Analogue input mode** | 0 ... 3 | 0 | |

**0 = 0 – 10V limited.** Analogue setpoints less than the programmed matched value of 0% (P402) neither result in a decrease of the frequency below the programmed minimum value (P104) nor in a reversal of the phase sequence.

**1 = 0 – 10V** will even permit output frequencies below the programmed minimum frequency (P104) if a setpoint less than the programmed matched value of 0% (P402) is effective. This is a conventional way of ensuring a reversal of the phase sequence by means of a potentiometer.

**2 = 0 – 10V monitored:** When the setpoint value drops below: [min. setpoint (P402) - (10% * (max. setpoint (P403) – min setpoint (P402)))], the inverter output is turned off. The output signal is restored when the setpoint is increased to above [P402 – (10%*(P403-P402))].

**3 = ± 10V:** when reversing with the analogue setpoint (P402 > 0V), a relay that is configured for 'Brake Control' (P434/P441 = 1/6) does not drop out below the absolute minimum frequency (P505).

| | | | | |
|---|---|---|---|---|
| P402 | **Analogue input alignment 0%** | 0.0 ... 10.0 V | 0.0 | |
| P403 | **Analogue input alignment 100%** | 0.0 ... 10.0 V | 10.0 | |
| P404 | **Analogue input filter** | 10 ... 400 ms | 100 | |

With these parameters the voltage range of the analogue input is defined. Additional filtering may be provided as well.

| | | | | |
|---|---|---|---|---|
| P410 | **Secondary setpoint min. frequ.** | 0.0 ... 400.0 Hz | 0.0 | |
| P411 | **Secondary setpoint max. frequ.** | 0.0 ... 400.0 Hz | 50.0 | |

Section of the minimum/maximum frequency which, in the form of a secondary setpoint, is capable of affecting the (principal) setpoint. The term secondary setpoint refers to any frequency which is supplied to the inverter in addition to the main setpoint to allow more functions to be executed.

PID actual frequency Frequency addition Frequency subtraction

| | | | | |
|---|---|---|---|---|
| P412 | **Setpoint Process Controller** | 0.0 … 10.0 V | 5.0 | |
| P413 | **P component of PID controller** | 0 ... 400.0 % | 10.0 | |
| P414 | **I component of PID controller** | 0 ... 400.0 %/ms | 1.0 | |

| Parameter No. | Designation | Range of values | Factory setting | Settings after user intervention | |
|---|---|---|---|---|---|
| | | | | P. set 1 | P. set 2 |
| P415 | **D component of PID controller** | 0 ... 400.0 %ms | 1.0 | | |
| P416 | **Ramp of PID controller** | 0.00 ... 99.99 s | 2.00 | | |
| | Setting values of PID controller | | | | |
| P418 | **Analogue output function** | 0 ... 30 | 0 | | |

**0 = Off**

**1 = Output frequency**

**2 = Motor speed**, is the synchronous speed calculated by the inverter on the basis of the setpoint which is effective at the time. Load-dependent speed fluctuations are not taken into account.

**3 = Output current**, is the effective value of the output current supplied by the inverter.

**4 = Moment current,** indicates the percentage of the motor load moment calculated by the inverter.

**5 = Output voltage**, is the output voltage the inverter supplies.

**6 = D.C. link voltage**, 10 volts, with 100% scaling, correspond to 600 volts D.C.!

P419 can be used to adjust the analogue output to the desired working range. The maximum analogue output (10V) will correspond to the respective scaling value selected.

**7 = External control**, use P542 to set the analogue output to 0.0V ... 10.0V.

**...**

**30 = Current setpoint frequency before ramping is started**, setpoint frequency generated by internal controllers.

| | | | | | |
|---|---|---|---|---|---|
| P419 | **Analogue output scaling** | 10 ... 500 % | 100 | | |
| P420 | **Function digital input 1**<br>Dig. input 1, response time approx. 1.2ms | 0 ... 42 | 1 | | |
| P421 | **Function digital input 2** | | 2 | | |
| P422 | **Function digital input 3** | | 8 | | |
| P423 | **Function digital input 4** | | 4 | | |

**0 = No function**

**1 = Enable right** (high level)

**2 = Enable left** (high level)

**3 = Phase sequence reversal** (high level)

**4 = Fixed frequency 1** (high level), P429

**5 = Fixed frequency 2** (high level), P430

**6 = Fixed frequency 3** (high level), P431

**7 = Fixed frequency 4** (high level), P432

**8 = Parameter set switching**
(low level = parameter set 1,
high level = parameter set 2)

**9 = Maintain frequency** (low level), the output frequency will always be maintained

**10 = Voltage disable** (low level)

**11 = Quick stop** (low level)

**12 = Fault acknowledgement** (edge 0 → 1)

**13 = PTC resistor input** (analogue signal recognition, switching threshold at 2.5 volt)

**14 = Remote control** (low level = control terminals, high level = bus control)

**15 = Inching frequency** (high level), P113

**16 = Maintain the frequency "motor potentiometer"** (low level), the output frequency is maintained in the range between the minimum and the maximum frequency only.

**...**

**18 = Watchdog,** the 1st "high" edge applied to the watchdog input is the start signal for the watchdog function which from then on must be triggered periodically (by other "high" edges) according to the cycle time selected in P460. If the required signal fails to be provided within this time, the inverter will de-energize the output reading out an E012 error information.

The same external watchdog error E012 will be read out if a "high" signal is continuously supplied.

**19 = ON/OFF analogue setpoint**, will switch off the analogue input (P400-P404)

**...**

**Analogue functions** for digital inputs can be assigned to any of the inputs. With a resolution of 7 bits they are primarily used for simple application requirements.

**26 = Torque**

**27 = PID actual frequency**

**28 = Addition of frequencies**

**29 = Subtraction of frequencies**

**30 = Disable PID controller,** to enable it again a high signal will have to be applied.

**...**

**40 = Process controller actual value**

**41 = Process controller setpoint**

**42 = Process controller derivative action**

Detailed inform. provided in P400 and in BU 4100 section 8.4

| | | | | | | |
|---|---|---|---|---|---|---|
| P426 | (P) | **Quick stop time** | 0 ... 10.00 s | 0.10 | | |

| Parameter No. | | Designation | Range of values | Factory setting | Settings after user intervention | |
|---|---|---|---|---|---|---|
| | | | | | P. set 1 | P. set 2 |
| P428 | | **Automatic start feature** | 0 ... 1 | 0 | | |
| | | With the setting at default (P428 = **0 → off**) the inverter requires an edge (change of signal from "low" to "high") at the respective digital input.<br>With the setting P428 = **1 → on,** the inverter responds to a "high" level. | | | | |
| P429 | (P) | **Fixed frequency 1** | -400.0 Hz ... 400.0 Hz | 0.0 | | |
| P430 | (P) | **Fixed frequency 2** | | 0.0 | | |
| P431 | (P) | **Fixed frequency 3** | | 0.0 | | |
| P432 | (P) | **Fixed frequency 4** | | 0.0 | | |
| | | Fixed frequency setting. If more than one frequency is selected the values are added. If no digital input is programmed to an enable, selection of one fixed frequency will enable the inverter. | | | | |
| P434 ** | (P) | **Function relay 1** | 0 ... 12 | 1 | | |
| | | **0 = no function**<br>**1 = external brake**, to control a brake provided on the motor. The contact will open or close at the programmed absolute minimum frequency (P505).<br>**2 = Inverter is working**<br>**3 = Current limit is reached ***, depends on the nominal motor current set in P203.<br>**4 = Torque current limit ***, depends on the motor data set in P203 and P206.<br>**5 = Frequency limit ***, depends on the nominal motor frequency set in P201.<br>*) Hysteresis = 10%, scaling with P435<br>**6 = Level with setpoint**, hysteresis = 1Hz<br>**7 = Fault signal**, fault is active or has not been acknowledged yet<br>**8 = Warning**, inverter is approaching any of the limit values<br>**9 = Overcurrent warning**, p.a. 130% of nominal inverter current for 30 sec. ($I^2t$ function)<br>**10 = Motor overtemperature warning**<br>**11 = Torque current limit active warning**, the limit value set in P112 has been reached. Hysteresis = 10%.<br>**12 = External control**, control to be selected in P541. | | | | |
| P435 | (P) | **Scaling relay 1** | -400 % ... 400 % | 100 | | |
| | | Negative scaling will result in an inversion of relay operation. | | | | |
| P441 ** | (P) | **Function relay 2** | 0 ... 12 | 1 | | |
| | | **0 = No function**<br>**1 = Fault**<br>**2 = Warning**<br>**3 = Overcurrent warning**, p.a. 130% of nominal inverter current for 30 sec. ($I^2t$ function)<br>**4 = Motor overtemperature warning**<br>**5 = Torque current limit active warning**, the limit value set in P112 has been reached. Hysteresis = 10%.<br>**6 = Control external brake** , f > P505 (cf. P107)<br>**7 = External control**, relay control with P541 setting.<br>**8 = Fault signalling deactivated** (inversion of 1)<br>**9 = Warning deactivated** (inversion of 2)<br>**10 = Overcurrent warning deactivated** (inversion of 3)<br>**11 = Motor overtemperature warning deactivated** (inversion of 4)<br>**12 = Torque current limit deactivated warning** (inversion of 5) | | | | |
| | | **) The relay contact will open at a fault or a warning. It will close when any other signal type is received. | | | | |
| P460 | | **Watchdog cycle time** | 0.0 / 0.1 ... 999.9 s | 10.0 s | | |
| | | Period within which a "high" edge is to be applied to the respective digital input (cf. P420 - P423). If it isn't, the inverter will de-energize the output generating an E012 error message. | | | | |

## 5.1.5 Additional parameters

| Parameter No. | Designation | Range of values | Factory setting | Settings after user intervention | |
|---|---|---|---|---|---|
| | | | | P. set 1 | P. set 2 |
| P503 | **Output master function** | 0 ... 4 | 0 | | |
| | For this parameter to take effect it is indispensable first to decide on the source for inverter control in P509. If ***mode 1*** is selected in that parameter, the master frequency (setpoint 1 and control word) will be transmitted exclusively, whereas selection of ***mode 2*** ensures transmission of the actual values selected in P543, P544, and P545. | | | | |

| Parameter No. | | Designation | Range of values | Factory setting | Settings after user intervention | |
|---|---|---|---|---|---|---|
| | | | | | P. set 1 | P. set 2 |
| | | **0 = Off**<br>**1 = USS mode 1** **3 = USS mode 2**<br>**2 = CAN mode 1** (optional), up to 250Kbaud **4 = CAN mode 2** (optional), up to 250Kbaud | | | | |
| P504 | | **Pulse frequency** | 3.0 ... 15.0 kHz | 6.0 | | |
| P505 | (P) | **Absolute minimum frequency** | 0.1 ... 10.0 Hz | 2.0 | | |
| P506 | | **Automatic acknowledgement** | 0 ... 7 | 0 | | |
| | | **0 = no automatic fault acknowledgement**<br>**1 ... 5 = number** of allowable fault acknowledgements within one power-on cycle. Disconnection of the inverter from the mains followed by a reconnection will restore the full number of allowable fault acknowledgements.<br>**6 = Always**, a fault signal is automatically acknowledged whenever the system has ceased to report the cause of the failure.<br>**7 = Fault acknowledgement is de-activated** when the enable command (via the digital input) is cancelled. | | | | |
| P507 | | **PPO type (optional)** | 1 ... 4 | 1 | | |
| P508 | | **Profibus address (optional)** | 1 ... 126 | 1 | | |
| P509 | | **Interface** | 0 ... 20 | 0 | | |
| | | **0 = Control terminals or keyboard control** with the Control Box *mc* (optional accessory)<br>**1 = Control terminals only**<br>**2 = USS setpoint**, the frequency setpoint is transmitted via the USS protocol. Control via the digital inputs is still active as well.<br>**3 = USS control word**, the control signals (enable, phase sequence, ...) are transmitted via USS, the setpoint via the analogue input or the fixed frequencies.<br>**4 = USS**, all of the control information is transmitted via the USS protocol. No function is assigned to the analogue input and the digital inputs.<br>**5 = CAN setpoint** (option)<br>**6 = CAN control word** (option)<br>**7 = CAN** (option)<br>**8 = Profibus setpoint** (option)<br>**9 = Profibus control word** (option)<br>**10 = Profibus** (option)<br>**11 = CAN bus "broadcasting"** (option)<br>**…**<br>**15 = CANopen setpoint** (option)<br>**16 = CANopen control word** (option)<br>**17 = CANopen** (option)<br>**18 = DeviceNet setpoint** (option)<br>**19 = DeviceNet control word** (option)<br>**20 = DeviceNet** (option) | | | | |
| P511 | | **USS baud rate** | 0 ... 3 | 3 | | |
| | | **0 =** 4800 baud **1 =** 9600 baud **2 =** 19200 baud **3 =** 38400 baud | | | | |
| P512 | | **USS address** | 0 ... 30 | 0 | | |
| P513 | | **Telegram time-out** | 0.0 ... 100.0 s | 0.0 | | |
| P514 | | **CAN bus baud rate (option)** | 0 ... 7 | 4 | | |
| | | **0 =** 10 kBaud **2 =** 50 kBaud **4 =** 125 kBaud **6 =** 500 kBaud<br>**1 =** 20 kBaud **3 =** 100 kBaud **5 =** 250 kBaud **7 =** 1 MBaud (not always practicable) | | | | |
| P515 | | **CAN bus address (option)** | 0 ... 255 | 0 | | |
| P516 | (P) | **Skip frequency**, ± 2 Hz | 0.0 ... 400.0 Hz | 0.0 | | |
| P518 | (P) | **Skip frequency**, ± 2 Hz | | 0.0 | | |
| P520 | (P) | **Flying start connection** | 0 ... 4 | 0 | | |
| | | **0 = Off**<br>**1 = both directions**, the inverter will search for a speed in either sense of rotation<br>**2 = in the direction of the setpoint**, search only in the direction of the selected setpoint<br>**3 = both directions, only after mans failure and fault**<br>**4 = in the direction of the setpoint, only after mains failure and fault** | | | | |
| P523 | | **Restore factory settings** | 0 ... 1 | 0 | | |
| | | **0 =** settings remain unchanged<br>**1 =** factory settings are loaded<br>**2 =** factory setting are loaded, without BUS parameters<br>When the loading operation has been initiated with the ENTER key, the four central segments of the Control Box mc display start flashing. | | | | |

| Parameter No. | | Designation | Range of values | Factory setting | Settings after user intervention | |
|---|---|---|---|---|---|---|
| | | | | | P. set 1 | P. set 2 |
| P535 | | **$I^2t$ of motor** | 0 ... 1 | 0 | | |
| | | **0 =** off<br>**1 =** on | The motor temperature is calculated on the basis of the output current, the time of operation, and the output frequency. Whenever the result equals the temperature limit, the inverter disconnects the motor and produces an E002 error message (motor overtemperature). The programme will not take into account the potential effects – positive or negative - of ambient conditions however. | | | |
| P537 | | **Current limit, by pulse disconnection** (approx. 150% $I_{NFI}$) | **0 =** Off **1 =** On | 1 | | |
| P540 | | **Disable phase sequence** | 0 ... 3 | 0 | | |
| | | **0 = either phase sequence is available**<br>**1 = disable phase sequence commutation**, the phase sequence key on the Control Box *mc* is disabled<br>**2 = positive phase sequence only**, solely the clockwise sense of rotation is available<br>**3 = negative phase sequence only**, solely the anticlockwise sense of rotation is available | | | | |
| P541 | | **External relay control** | 0 ... 3 | 0 | | |
| | | This function is binary-coded : **1 =** relay 1 **2 =** relay 2 **3 =** both relays (P434 / P441) | | | | |
| P542 | | **Ext. control of analogue output** | 0.0V ... 10.0V | 0 | | |
| | | The value set is supplied at the analogue output (terminal 7/9, P418). | | | | |
| P543 | (P) | Selection of **bus actual value 1** | 0 ... 9 | 1 | | |
| P544 | (P) | Selection of **bus actual value 2** | 0 ... 9 | 0 | | |
| P545 | (P) | Selection of **bus actual value 3** | 0 ... 9 | 0 | | |
| P546 | (P) | Selection of **bus setpoint 1** | 0 ... 1 | 1 | | |
| P547 | (P) | Selection of **bus setpoint 2** | 0 ... 16 | 0 | | |
| P548 | (P) | Selection of **bus setpoint 3** | 0 ... 16 | 0 | | |
| | | Parameters 543 to 548 provide for selecting a feed-back value or a setpoint value when the inverter is bus-controlled.<br>**Please note:** Detailed information is contained in the various bus operating instructions and in BU 4100. | | | | |
| P550 | | **Save data record,** optionally with **Control Box *mc*** | 0 ... 3 | 0 | | |
| | | The optional **Control Box *mc*** allows for saving a data record (parameter sets 1 and 2) of the connected inverter. As the data record is saved in a non-volatile memory contained in the box, it can be transferred to other NORDAC *vector mc* units with the same database version (P742).<br>**0 = no function**<br>**1 = FI → Control Box *mc***<br>**2 = Control Box *mc* → FI**<br>**3 = exchange**, the data record of the inverter is exchanged for that of the Control Box *mc*.<br>**Note**: To transfer a parameter set from an inverter operated on an earlier software (< 24.6) to a new one, load the data record of the new inverter into the Control Box first ( = **1**). Then load the parameter information of the old device into the Control Box *mc* as well and have it copied to the inverter operated on the new software version. | | | | |
| P551 | | **Drive profile** | 0 / 1 | 0 | | |
| | | CANopen drive profile, DS401 profile, or ODVA profile (DeviceNet) | | | | |
| P558 | (P) | **Magnetization time** | 0 / 1 / 2 ... 500 ms | 1 | | |
| | | **0 =** no magnetization time<br>**1 =** magnetization time determined automatically<br>**2 ... 500 =** magnetization time as set | A certain magnetization time is required in order to allow for a magnetic field to be created in the motor before the inverter will supply a rotating field.<br>Whenever magnetization time is a critical element in an application, the desired value may be adjusted by hand or even switched off altogether. | | | |
| P559 | (P) | **Time of DC injection for after-running prevention** | 0.00 ... 5.00 s | 0.50 | | |
| | | Some driven components with a high inertia or little friction will not stop right away when the deceleration ramp is finished. This behaviour can be remedied if a direct voltage is subsequently applied.<br>A direct voltage to be applied for a limited period of time following completion of the braking ramp can be set here. The voltage amount depends on the data of the motor involved. | | | | |

## 5.1.6 Information

| Parameter No. | | Designation | | Range of values |
|---|---|---|---|---|
| **P700** | | Current fault | Cf. Section 6, Error signals | 0 ... 20 |
| **P701** | | Last fault | | 0 ... 20 |
| **P707** | **...-01** | Software version ... version number (e.g. **27.**x) | | 0 ... 9999 |
| | **...-02** | Software version ... revision number (e.g. xx.**0**) | | |
| **P708** | | Status of digital inputs, indicates the current status as a 0 (= low) or 1 (= high) level of the 1st to the 4th input. | | 0000 ... 1111 (binary) |
| **P709** | | Analogue input voltage | | 0 ... 10.0 |
| **P710** | | Analogue output voltage | | 0 ... 10.0 |
| **P711** | | Status of output relay, indicates the current status of the two signalling relays. 00 ... 11 (binary) – left = relay 1 (P434), right = relay 2 (P441) | | 00 ... 11 (binary) |
| **P716** | | Current output frequency | | -400.0 ... 400.0 Hz |
| **P717** | | Current motor speed, calculated | | 0 ... 9999 $min^{-1}$ |
| **P718** | **...-01** | Current setpoint frequency ... as transmitted from the setpoint source | | -400.0 ... 400.0 Hz |
| | **...-02** | Current setpoint frequency ... after having passed through various internal processing stages of the inverter | | |
| | **...-03** | Current setpoint frequency ... when the frequency ramp has been completed | | |
| **P719** | | Instantaneous output current | | 0 ... 20.0 A |
| **P720** | | Instantaneous torque current | | -20.0 ... 20.0 A |
| **P722** | | Current output voltage | | 0 ... 1000 V A.C. |
| **P728** | | Current mains voltage | | 0 ... 1000 V A.C. |
| **P736** | | D.C. link voltage | | 0 ... 1000 V D.C. |
| **P740** | **...-01** | Control word in bus transmission | ... control word | 0000 ... FFFF hex |
| | **...-02** | (process input data) | ... setpoint 1 (P546) | |
| | **...-03** | | ... setpoint 2 (P547) | |
| | **...-04** | | ... setpoint 3 (P548) | |
| **P741** | **...-01** | Status word in bus transmission | ... status word | 0000 ... FFFF hex |
| | **...-02** | (process output data) | ... actual value 1 (P543) | |
| | **...-03** | | ... actual value 2 (P544) | |
| | **...-04** | | ... actual value 3 (P545) | |
| **P742** | | Database version (e.g. **6**) | | 0 ... 9999 |
| **P743** | | Inverter type | | 0 ... 9999 |
| **P744** | | Scope of extension (RS485 / CANbus) | | 0 / 1 |
| **P745** | | Version of subassembly (only provided that CANopen or DeviceNet are being used) | | 0 ... 9999 |
| **P746** | | State of subassembly (only provided that CANopen or DeviceNet are being used) | | 0000 ... FFFF hex |

# 6 Error signals

If any operating trouble occurs, the inverter is disconnected immediately and the red LED begins to glow. When the Control Box *mc* is used, the error code is read out in the display enabling the type of trouble to be assessed right away.

More information, especially regarding the values displayed when either parameter P700 or parameter P701 has been activated, is provided in the BU 4100 manual.

| Display | | Type of failure | Cause<br>➢ **What to do about it** |
|---|---|---|---|
| group | details see P700 / P701 | | |
| **E001** | **1.0** | Inverter overtemperature | (Static) error signal from the output stage module<br>➢ Reduce ambient temperature (to <50°C or even to <40°C, see also 'Technical Data' section 8)<br>➢ Check ventilation of switching cabinet |
| **E002** | **2.0** | Motor overtemperature (PTC resistor)<br>Not displayed unless a digital input (function = 13) has been programmed | The motor temperature sensor has picked up<br>➢ Reduce load on the motor<br>➢ Increase motor speed<br>➢ Use forced ventilation on the motor |
| | **2.1** | Motor overtemperature ($I^2t$)<br>Not displayed unless $I^2t$ motor (P535) has been programmed | Disconnection at $I^2t$ motor temperature limit<br>➢ Reduce load on the motor<br>➢ Increase motor speed |
| **E003** | **3.0** | Inverter overcurrent | Disconnection at $I^2t$ inverter temperature limit, e.g. > 1.5 x $I_n$ for 30s (it will be a good idea also to check the setting of the pulse frequency in P504)<br>➢ Avoid sustained overloading of the inverter output |
| **E004** | **4.0** | Module overcurrent | (Brief) error signal from module<br>➢ Short-circuit or ground fault at inverter output<br>➢ Use external output choke (motor cable is too long) |
| **E005** | **5.0** | D.C. link overvoltage | Inverter D.C. link voltage too high<br>➢ Reduce recovered energy by providing a brake resistor<br>➢ Extend braking time (P103)<br>➢ Except for lifting gear applications the mode for a delayed disconnection could be set (P108)<br>➢ Prolong "quick stop time" (P426) |
| | **5.1** | Mains overvoltage | Mains voltage is too high<br>➢ Please check the mains voltage (380V –20% to 460V +10%) |
| **E006** | **6.0** | D.C. link undervoltage (charging error) | Inverter D.C. link voltage too low<br>➢ Check mains voltage (380V –20% to 460V +10%), may be too weak |
| | **6.1** | Mains undervoltage | |
| **E007** | **7.0** | Mains phase failure<br>(only with 3~ 400V *vector mc*) | One of the three mains supply phases was or still is interrupted or too weak.<br>➢ Check supply phases (380V -20% to 460V +10%)), is any of them too weak?<br>➢ All of the three mains phases must be symmetrical when applied. |
| | **OFF** | **Note:**<br>(only with 3~ 400V *vector mc*) | Shown in the display when the inverter is regularly disconnected from the mains, with all three phases being equally reduced |
| **E008** | **8.0** | Parameter lost | EEPROM data corruption<br>Software version of the stored data record does not match the software version of the inverter<br>**Note:** Parameters which have been incorrectly set are reloaded automatically (with factory settings)<br>Interference suppression is inadequate (cf. E020) |
| | **8.1** | Wrong inverter type | ➢ EEPROM defective |
| | **8.2** | External EEPROM copying error (Control Box *mc*) | ➢ Check proper fit of Control Box *mc*.<br>➢ Control Box *mc* EEPROM defective (P550 = 1). |

| Display group | Display details see P700 / P701 | Type of failure | Cause<br>➢ What to do about it |
|---|---|---|---|
| **E009** | **---** | Control Box *mc* error | Communication fault between inverter and Control box *mc*<br>➢ Switch mains voltage off and then on again<br>➢ Clip on Control Box *mc* again |
| **E010** | **10.0** | USS timeout (P513) | ➢ Telegrams are not transmitted correctly, check connection of external devices.<br>➢ Check program flow of bus protocol.<br>➢ Check bus master. |
| | **10.2** | Telegram timeout external bus subassembly | |
| | **10.4** | External bus subassembly initialization error | ➢ Check P746.<br>➢ Bus subassembly was not plugged in properly.<br>➢ Check power supply of bus subassembly. |
| | **10.1**<br>**10.3**<br>**10.5**<br>**10.6**<br>**10.7** | External bus subassembly system error | For more information see the respective Supplementary Operating Instructions of the bus subassembly involved. |
| **E011** | **11.0** | Reference voltage | Reference voltage of customer interface is not right (10V/15V). This error signal is not displayed unless control proceeds via the control terminals (P509 = 0/1).<br>➢ Check control terminals for short-circuit fault |
| **E012** | **12.0** | External watchdog | The watchdog function having been assigned to a digital input, the required "high edge" was not applied within the time interval selected in P460 >watchdog cycle time<.<br>➢ External control error<br>➢ Cable interruption |
| **E013** | **13.2** | Disconnection control response error | The motor was brought to a halt by means of an "emergency stop".<br>➢ The torque current has reached the limit value (P112) . |
| **E020** | **20.0** | External RAM error | Error in the program execution as a result of electromagnetic interference<br>➢ Please verify observance of the ‘wiring instructions’ section 2.2<br>➢ Use additional external mains filter<br>➢ The inverter should be very effectively connected to earth |
| | **20.1** | Watchdog | |
| | **20.2** | Stack overflow | |
| | **20.3** | Stack underflow | |
| | **20.4** | Undefined opcode | |
| | **20.5** | Protected instruction | |
| | **20.6** | Illegal word access | |
| | **20.7** | Illegal instruction access | |
| | **20.8** | EPROM error | |
| | **20.9** | Dual-port memory error | |
| | **21.0** | NMI (not used were hardware is concerned) | |
| | **21.1** | Wrong PLL | |

# 7 Recommendations for service and maintenance

NORDAC *vector mc* frequency inverters do not need any maintenance when operated according to instructions.

If the frequency inverter is operated in dust-laden air, the cooling surfaces must be regularly cleaned with compressed air. Likewise any air inlet filters provided in the control cabinet must be cleaned or replaced at regular intervals.

If a repair is necessary please send the device to:

**your local NORD distribution agency**

Any information required concerning repair should be obtained from:

**your local NORD distribution agency**

If a frequency inverter is sent to the manufacturer for repair, no responsibility can be assumed for attachments such as line cables, potentiometers, external displays etc! Please remove all non-NORD parts from the inverter before return.

## 7.1 Additional information

The **manual BU 4100** containing complete and detailed information is provided on our Internet page in German, English, and French and is recommended for use complementary to the present Operating Instructions.

http://www.nord.com/

The manual may also be ordered from your local distribution agency.

## 7.2 UL/CUL Certification

**For use in North America,** UL and CUL approval **File: E171342**

"Suitable for connection to mains supplying 230V (single-phase units) or 460V (three-phase units), with a (symmetrical) short-circuit current never exceeding 5000amps" and "if protected by J class fuses" as indicated in Section 8.

- Tightening moments for field wiring terminals:

  5.3 pound-inches (0.6Nm): control terminals 1 to 4
  mains connection
  motor connection
  braking resistor connection

  2.2 pound-inches (0.25Nm): control terminals 5 to 18

- Overload protection of the motor not included as standard
- Overload protection of motor to be ensured by the owner of the plant
- Overspeed protection not incorporated as standard
- Ambient temperature 40°C max.

# 8 Technical data

## 8.1 SK 250/1 FCT to SK 2200/1 FCT

| **NORDAC *vector mc* single-phase inverters for 230 V,** with integrated line filter | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Inverter type | **SK ... FCT** | **250/1** | **370/1** | **550/1** | **750/1** | **1100/1** | **1500/1** | **2200/1** |
| Mains voltage | | 1 AC 230 V ±15%, 47 to 63 Hz | | | | | | |
| Motor rating | (kW) | 0.25 | 0.37 | 0.55 | 0.75 | 1.1 | 1.5 | 2.2 |
| 4-pole three-phase standard motor | (hp) | 1/3 | ½ | ¾ | 1 | 1½ | 2 | 3 |
| Inv. continuous output | at 230V | 680 VA | 780 VA | 1.05 kVA | 1.45 kVA | 2.0 kVA | 2.5 kVA | 3.5 kVA |
| Nominal output current | (A) | 1.7 | 1.9 | 2.6 | 3.6 | 5.0 | 6.3 | 8.6 |
| Nom. (min.) brake resistance | | 180Ω S3-40% (82Ω S3-20%), 2 min. | | | | 82Ω S3-20% (82Ω S3-20%), 2 min. | | |
| Typical input current (I rms) | (A) | 3.3 | 4.5 | 6.2 | 8.2 | 10 | 13 | 18 |
| Recommended line fuse | **slow-blow** | 10 A | | 16 A | | 16 A | | 25 A |
| North America: 'J class fuse' | | 10 A | | 15 A | | 15 A | | 25 A |
| Connection cross-section | input | 1.0 – 2.5 mm² | | 1.5 – 2.5 mm² | | 1.5 – 2.5 mm² | | 2.5 - 4mm² |
| | output | 1.0 – 2.5 mm² | | | | 1.5 – 2.5 mm² | | |
| Ambient temperature | | 0°C to +50°C (cf. Section 8.3) | | | | | | |
| Type of ventilation | | convection cooling | | | | fan cooling | | |
| Dimensions (H x W x D) | (mm) | 154 x 86 x 134 | | | | 191 x 112 x 135 | | |
| Weight approx. | (kg / lb) | 1.3 / 2.9 | | | | 1.7 / 3.8 | | |

## 8.2 SK 750/3 FCT to SK 3000/3 FCT

| **NORDAC *vector mc* three-phase 380 - 460 V,** with integrated line filter | | | | | | |
|---|---|---|---|---|---|---|
| Inverter type | **SK ... FCT** | **750/3** | **1100/3** | **1500/3** | **2200/3** | **3000/3** |
| Mains voltage | | 3 AC 380 - 460 V -20% +10%, 47 to 63 Hz | | | | |
| Motor rating | (kW) | 0,75 | 1,1 | 1,5 | 2,2 | 3,0 |
| 4-pole three-phase standard motor | (hp) | 1 | 1½ | 2 | 3 | 4 |
| Inv. continuous output | at 400V | 1,5 kVA | 2,0 kVA | 2,5 kVA | 3,6 kVA | 4,8 kVA |
| Nominal output current | (A) | 2,2 | 3,0 | 3,7 | 5,5 | 7,0 |
| Nom. (min.) brake resistance | | 120Ω (90Ω), S3-50%, 2 min. | | | 120Ω (60Ω), S3-50%, 2 min. | |
| Typical input current (I rms) | (A) | 3,1 | 4,2 | 5,2 | 7,7 | 9,8 |
| Recommended line fuse | **slow-blow** | 10 A | | | 16 A | |
| North America: 'J class fuse' | | 10 A | | | 15 A | |
| Connection cross-section | input / output | 1.5 - 2,5 mm² | | | | |
| Ambient temperature | | 0°C to +40°C (cf. section 8.3) | | | | |
| Type of ventilation | | convection cooling | fan cooling, temperature-controlled | | | |
| Dimensions (H x W x D) | (mm) | 191 x 112 x 135 | | | | |
| Weight approx. | (kg / lb) | 1.7 / 3.8 | | | | |

## 8.3 General Technical data

| | |
|---|---|
| Power factor: | $\lambda \geq 0.7$ |
| Range of output frequencies: | 0.1 Hz to 400.0 Hz |
| Overload capacity: | 150% for 30 s (related to the nominal inverter current) |
| Protective measures against: | inverter overtemperature, over- and undervoltage<br>short-circuit, earth fault, overload, no-load |
| Types of control: | No-sensor vectorial current control; linear v/f characteristic |
| Analogue setpoint input/PID input: | 0 .... 10 V (recommended potentiometer 5 to 10 kΩ), adjustable |
| Analogue setpoint resolution: | 10-bit related to measuring range |
| Analogue output: | 0 .... 10 V scalable |
| Setpoint stability: | analogue < 1%, digital < 0.02% |
| Control outputs:<br>**IMPORTANT:** | 2 relays 230 V AC / 2 A (overvoltage cat.2); 28 V DC / 2 A<br>external inductive loads must be adequately suppressed,<br>e.g. by means of a free-wheeling diode or varistors |
| Interface: | RS 485 (standard), RS 232 (optional), CAN bus (optional), CANopen (optional), DeviceNet (optional), Profibus (optional) |
| Inverter efficiency: | approx. 95% |
| Ambient temperature: | 0°C to +50°C, S1 mode for SK 250/1 FCT to SK 550/1 FCT<br>0°C to +50°C, S3-50% (5min.), for SK 750/1 FCT to SK 2200/1 FCT<br>0°C to +40°C, S1 mode for all NORDAC *vector mc* types<br>The cooling medium must be free of humidity and aggressive gases.<br>Protect the inverter against dirt (dust, fluffs,...). |
| Storage and shipping temperature: | -40°C to +70°C, free of humidity and aggressive gases |
| Rel. humidity of the air: | 90% without condensation |
| Place of installation altitude a.m.s.l.: | < 1000 m without the power being affected |
| Type of enclosure: | IP20 |
| Electric isolation: | Control terminals (customer interface) |
| Maximum allowable mains connection frequency: | 250 switching operations / h |

## 8.4 Technical documentation

Complete and detailed information on all matters concerning the inverter types dealt with herein is provided in the **BU 4100 manual** which has been prepared in German, English, and French. It is recommended for complementary use and can be downloaded from the NORD site in the Internet (www.nord.com → products).
If you are not equipped to access the Internet, order the manual from your local NORD distribution agency any time.

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