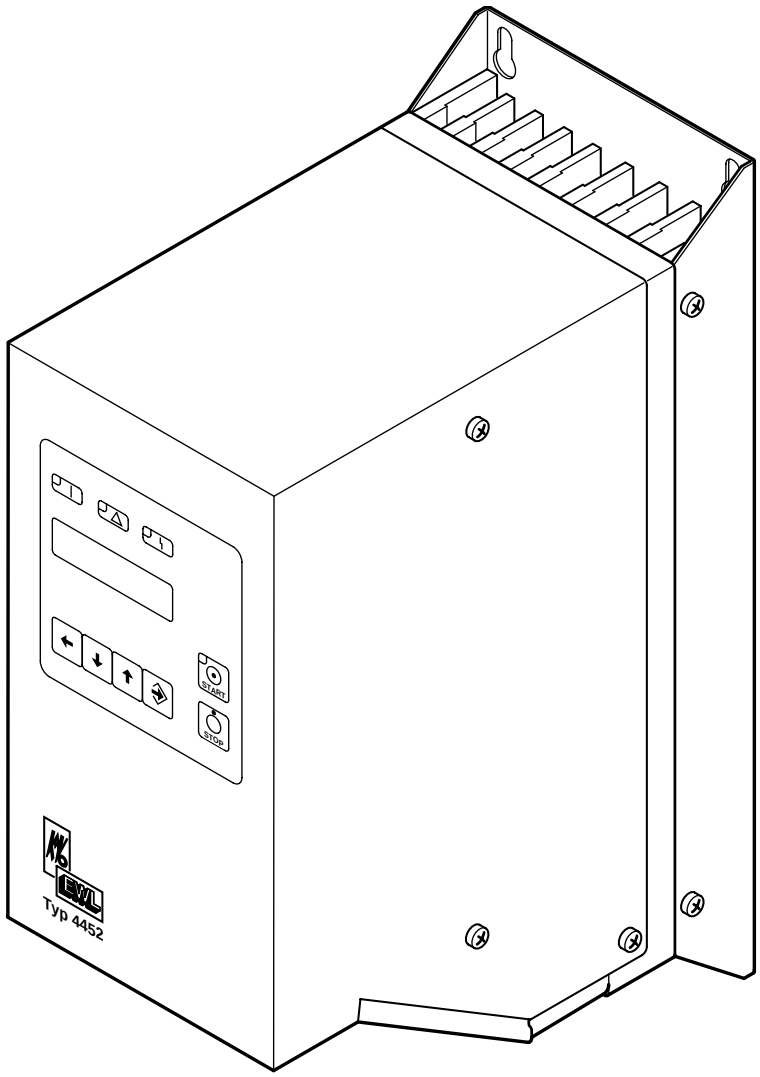
Operating Instructions



# Frequency inverter type EWL 4452

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CE

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## A 1 User information

### A 1.1 Meaning of the pictograms

*Situation which may lead to danger, damage to material or operating faults in the event of failure to follow the instructions.*

*Important information for operator and engineer.*

Automatic mode
Automatic sequence

Close, screw in, fasten, etc.

*Open, slacken, loosen*

\+ more, higher

\- less, lower

∞ Continuous operation

*Time, time sequence*

*Disconnect mains plug*

### A 1.2 Important information

*The User Manual must be read by the user/operator prior to commissioning, in order to avoid incorrect operation and other damage. If further language versions are required, please request them from your responsible KaVo agent. Duplication and distribution of the User Manual (UM) require prior consent from KaVo.*

All technical data, information and properties of the product described in this UM correspond to the state on going to press.

Modications and improvements to the product on the basis of new technical developments are possible.

This does not imply any right to retrofitting of existing devices.

KaVo assumes no responsibility for damage arising through:

- external influences (poor quality of the media or poor installation)
- use of incorrect information
- improper use
- improperly performed repairs.

Repair and maintenance work - except for the activities described in this User Manual - may be performed only by qualified specialists.

In the event of modifications by third parties, the approvals shall become null and void. KaVo recommends using only original spare parts for operation and for repair.

*For safety reasons, the inverter supplied has not been configured.*
*Since it is not known which motor will be connected, an incorrect configuration could damage or destroy the motor or the inverter.*
*In order to configure the inverter, please read Section B2 Fast commissioning.*

### A 1.3 Precautions

Safe operation and protection of the device is ensured only by proper use, in accordance with the User Manual, with the tools approved for this purpose. The following should also be observed:

• the work safety regulations,
• the accident prevention regulations.

Before installation and commissioning of this device, please read this safety and warning information carefully and observe all warning signs mounted on the device.

■ *The frequency inverter type 4452 controls dangerously rotating mechanical parts and generates dangerous electrical voltages. If these operating instructions are not followed, severe damage to property, injuries and even death may result.*
■ *Safe operation of this device depends on the proper installation, handling and operation of the device.*
■ *Only appropriately qualified personnel may put this device into operation, maintain it and work on it. Connection, commissioning and rectification of faults may be performed only by specialists.*
■ *The device has no mains switch. When working on the open device, it must be completely disconnected from the mains beforehand. The device has no mains input fuses.*
■ *The capacitor of the DC voltage intermediate circuit remains charged with dangerously high voltage for some time even after the mains voltage has been switched off. It is essential to wait for two minutes after switching off the mains voltage before opening the device.*
■ *This device may start up automatically with certain settings after a mains failure.*
■ *This device may not be used as an "emergency stop mechanism" (see EN 60204).*
■ *The device may be used only for the purpose intended by the manufacturer. Unauthorized modifications and the use of additional equipment not recommended by the manufacturer can cause fires, electric shocks and injuries.*

### Definitions

**ASM motor** 3-phase asynchronous motor

**BLDC-Motor** 3-phase brushless DC motor without position sensors
The inverter performs the position synthesis by measuring the motor voltage (e.m.f.).

**BLDCS-Motor** 3-phase brushless DC motor with position sensors

**EEPROM** Electrically Erasable Program Memory. In the EEPROM, all important alterable data (parameters, calibration values) of the frequency inverter type 4452 are stored, and the data remain stored even during a voltage failure.

**Danger** In the context of this User Manual and of the warnings mounted on the device, this means that death, serious injury or considerable damage to property may occur if the corresponding precautions are not taken.

**Note** In the context of this User Manual, a note constitutes important information which is of particular importance for the understanding and the operation of the device.

**Combi display** Combination display consisting of motor parameter memory, motor frequency or speed, motor voltage and motor current. The motor parameter memory is displayed only with active motor code or after recall or storing of the motor parameters. With parameter P8, it is possible to switch between frequency display and speed display.

**Microstep startup** With microstep startup, the BLDC motor is operated as a synchronous motor with constant current. The output frequency is slowly increased from 0 Hz to the startup frequency, after which the system switches to regulated motor running. The microstep startup permits startup of sensor-free BLDC motor with large centrifugal masses (e.g. vacuum pumps) for which the normal startup fails owing to the large mass moment of inertia.

**Normal state** If no error occurs after switching on, the standard display appears on the LCD display H1 and the LED H3 “Operation” (green) lights up. This machine state is called the normal state. By repeatedly pressing the key ← (cancel, transfer), it is possible to exit the state and return to it.

**Configuration** Configuration is the operating procedure for setting up the inverter for use, motor settings and device-specific settings being implemented via the control panel. It is also possible to display different measured values.

**Qualified personnel** are in the context of this User Manual persons who are familiar with the installation, assembly, commissioning and operation of the product and with the possible dangers.

**Standard display** With parameter `P4-display`, the value or the value combination (combi display) which is displayed in the normal state can be selected. This is the standard display.

**Caution** In the context of the User Manual and of the warning signs mounted on the device, this means that slight injury or damage to property may occur if the corresponding precautions are not taken.

**Warning** In the context of the User Manual and of the warning signs mounted on the device, this means that death, serious injury and considerable damage to property may occur if the corresponding precautions are not taken.

### A 1.4 Purpose and potential applications

KaVo EWL frequency inverters, type 4452, have been specially constructed for the operation of three-phase asynchronous motors (ASM) and brushless DC motors (BLDC), as used in spindles, e.g. for grinding, cutting and drilling units on machine tools.
They can also be used for operating motors which are constructed from motor elements and serve, for example, as a drive for test stands or other physical equipment (e.g. vacuum pumps, centrifuges, optical systems etc.).
Gentle operation of the motors is achieved by the pulse amplitude modulation (PAM) used.

Specifically, the following motor types can be operated:
- Asynchronous motors (ASM)
- Brushless DC motors without sensors (BLDC)
- Brushless DC motors with sensors (BLDCS)

Switching to the various motor types is performed without hardware or software replacement but only by changing the operating parameters.

An integrated load compensation offers high speed constancy and - through low idling currents - avoids unnecessary heating up of the connected motors.

At the stop command, the connected motor is braked until it stops.

The control and monitoring of the inverter are performed by several microprocessors. This ensures high reliability and flexibility.

A firmware update can be performed on a PC via a serial interface (RS232); contact KaVo-EWL in this context.

The inverter can be completely remote-controlled. Various inputs and outputs are freely programmable.

The inverter is cooled by an integrated fan.

## A 1.5 Technical data

| | |
|---|---|
| Operation | Menu-controlled with plain text display with two lines of 16 characters each, four keys for menu control, one start key, one stop key, indicator lamps for operation (green), overload (yellow), fault (red) and start (green). All inverter parameters can be input and changed on the control panel. |
| Display | all parameter settings and operating procedures can be displayed in plain text in various languages on the LCD display |
| Dimensions | approx. 134 mm wide, 350 mm high, 238 mm deep, as built-in switch cabinet housing (incl. mounting bracket) |
| Operating temperature | 0 ... 40°C |
| Humidity of the air: | lower than 90 % relative humidity, non-condensating |
| Weight | approx. 7.2 kg |
| Tests and standards | TÜV tested according to EN 50178<br>EMC according to EN 61800-3 |
| Ingress protection | IP20 according to DIN 40050 |

### Power unit

| | |
|---|---|
| Electrical connection | single-phase 200...240V~, 50/60 Hz |
| Current consumption | 16A~ |
| Output power | max. 2500 VA continuous operation |
| Output voltage | 3 * 220 V~ at 8 A |
| Output current | max. 8A~ per phase, continuous operation (< 1 minute: max. 12A~) |
| Output frequency | 30 ... 3000 Hz for ASM motors (180.000 $min^{-1}$)<br>30 ... 2000 Hz for BLDC motors (120.000 $min^{-1}$) |
| Braking resistance | internal 80 W<br>external (option): rated resistance 27 ... 100 Ω; power 150 ... 1000 W |
| Efficiency | 93 % (at 2500 VA, cos phi motor 86 %) |

### Motor sensors

| | |
|---|---|
| Motor temperature sensor PTC (cold conductor) | according to DIN 44081 |
| Initial resistance | Rk < 550 Ω |
| Tripping resistance (warm): | Ra >= 1350 Ω |
| Tripping temperature: | depending on PTC, 90...130°C |
| Operating voltage: | 12V, via 2200 Ω pullup resistance |
| Recommended Type PTC: | Siemens+Matsushita M1100 B59100-M90-A70 |
| Recommended Type KTY: | Semiconductor sensor KTY84, cut-out threshold configurable |

Hall sensor connection, motor code and speed sensor (option):

| | |
|---|---|
| Ouptut voltage: | 12V -10% |
| Output current: | max. 100mA |
| Signal level: | active low |
| Switching current: | Is = 15mA |
| Pullup resistance: | internal 3 time R = 2200 Ω |

⚠ *All connections at the 6-pin terminal X7 are based on the negative potential of the intermediate circuit voltage, i.e. not isolated from the mains potential.*

**Remote control**
The function of the programmable inputs and outputs is described under Description of function A 4.4.

Digital control inputs

| | |
|---|---|
| FB_IN1 ... 6 | opto-decoupled, Re = 10 kΩ, unwired=low<br>U_low = 0...+5 V, U_high = +13...+35V, Ie = 2.4 mA at 24 V<br>Input protected up to max. ± 35V, minimum pulse width 60 ms. |
| FB_C_IN | Reference point of digital inputs |

Relay switching outputs

| | |
|---|---|
| FB-REL1 ... 3 | Contact type: normally open contact, max. 25V~, 1A, max. 30V-, 1A<br>min. switching current 1 mA at 24V (10 mA at 10 V))<br>The contact is open in the currentless state |
| FB_REL4 | Contact type: change-over contact, max. 25V~, 1A, max. 30V-, 1A<br>min. switching current 1 mA at 24V (10 mA at 10 V) |
| FB-C-REL | common connection of relays REL1 to REL4 |

Analogue inputs

| | |
|---|---|
| FB-AIN1 ... 2 | Ue = 0...10V, Re ≥ 100kΩ, Ie = 0.1mA at 10 V,<br>unwired 0V, input protected up to max. ± 40V |

Analogue outputs

| | |
|---|---|
| FB-AOUT1 ... 2 | Ua = 0...10V, Iout = max. 10mA<br>Output short-circuit-proof |

Frequency output

| | |
|---|---|
| FB-OUT-FREQ | 3 times output frequency of the inverter, pulse duty factor 50%<br>open collector, U_max = 24V, I_max = 30 mA |

Supply and auxiliary voltages

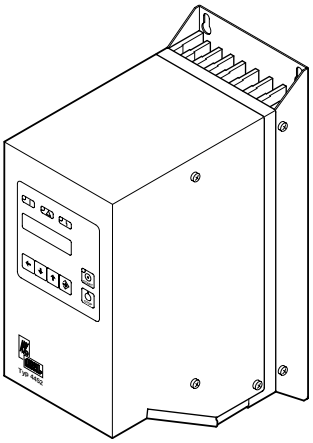
| | |
|---|---|
| FB+10V | Uout = 10V +-3%, Iout = max.15mA,<br>short-circuit-proof I_k = max. 40mA |
| FB+24V (X4-18) | +24V -15...+5%, I_a = 0...80mA,<br>short-circuit-proof I_k = max. 300mA |
| FB-GND | Earth reference point for FB+10V, FB+24V<br>analogue inputs and outputs and frequency output |
| Earth | Flange of X4 earth connection for screening the control lines,<br>connected internally to PE (protective conductor) |

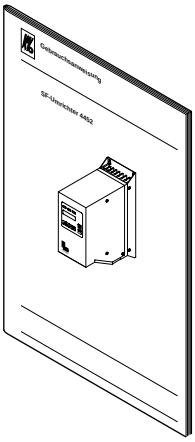
*All connections to the 25-pole jack X4 are potentially isolated from the control and relative to the protective conductor up to max. 60 V DC or 25V AC. The analogue connections and the reference voltage output are based on the operating voltage output FB-GND, and the digital inputs are independently electrically isolated, as are the relay outputs.*

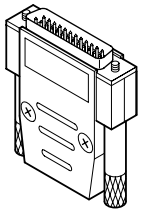
## A 2 Scope of delivery - Accessories

### A 2.1 Scope of delivery

- Frequency inverter type 4452 Mat. No. 0.641.7700
- Mounting plate for mounting switch cabinet (mounted on the inverter)
- Instructions for use and assembly
- 25-pin Sub-D plug with solder connection, Mat. No. 0.223.1634, and metallized housing, incl. screw union, Mat. No. 1.000.2790. (Omitted in the case of delivery of the connection adapter accessory, Mat. No. 1.000.2811).



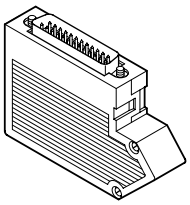


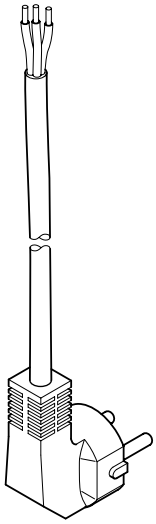


### A 2.2 Accessories

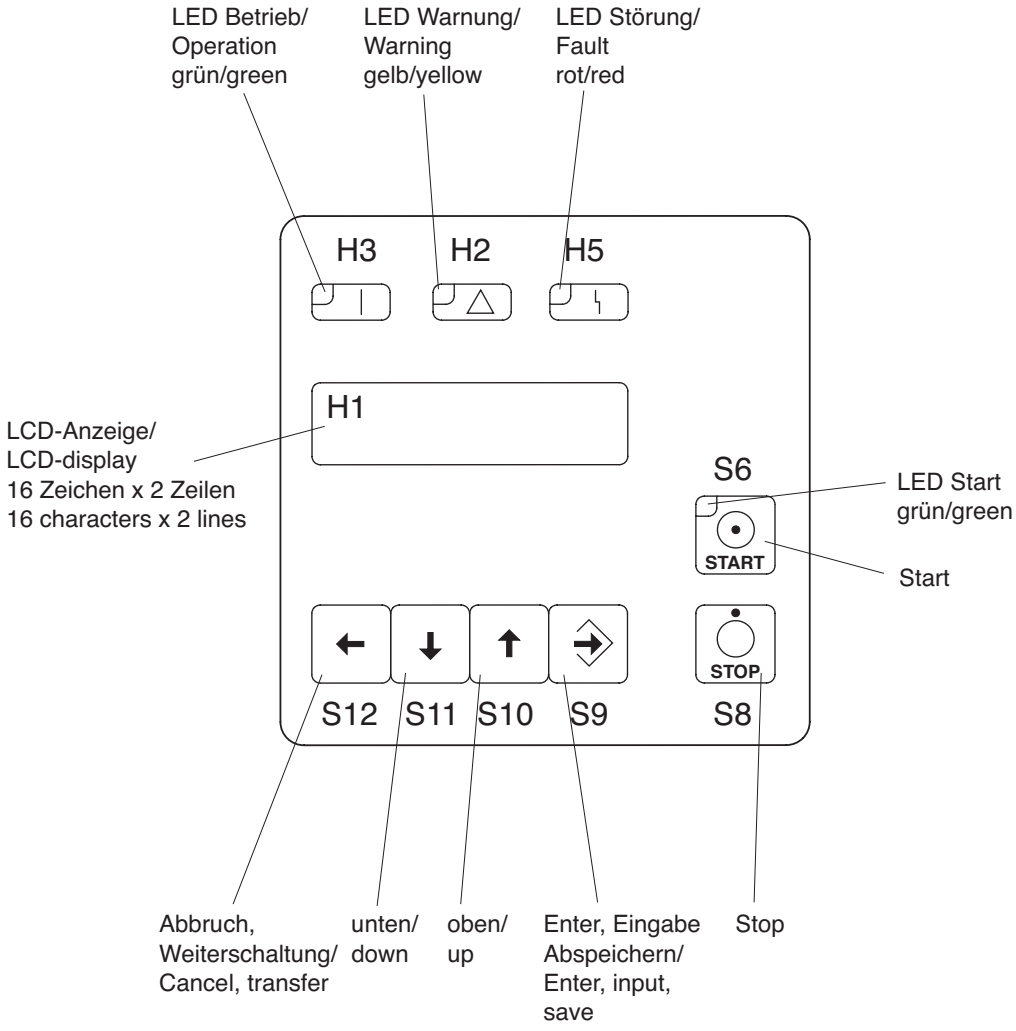
- Connection adapter for 25-pin Sub-D plug with screw connection, incl. metallized housing and screw union, Mat. No. 1.000.2811.

- Mains cable with safety plug for Germany, length 2 m, Mat. No. 1.000.3263

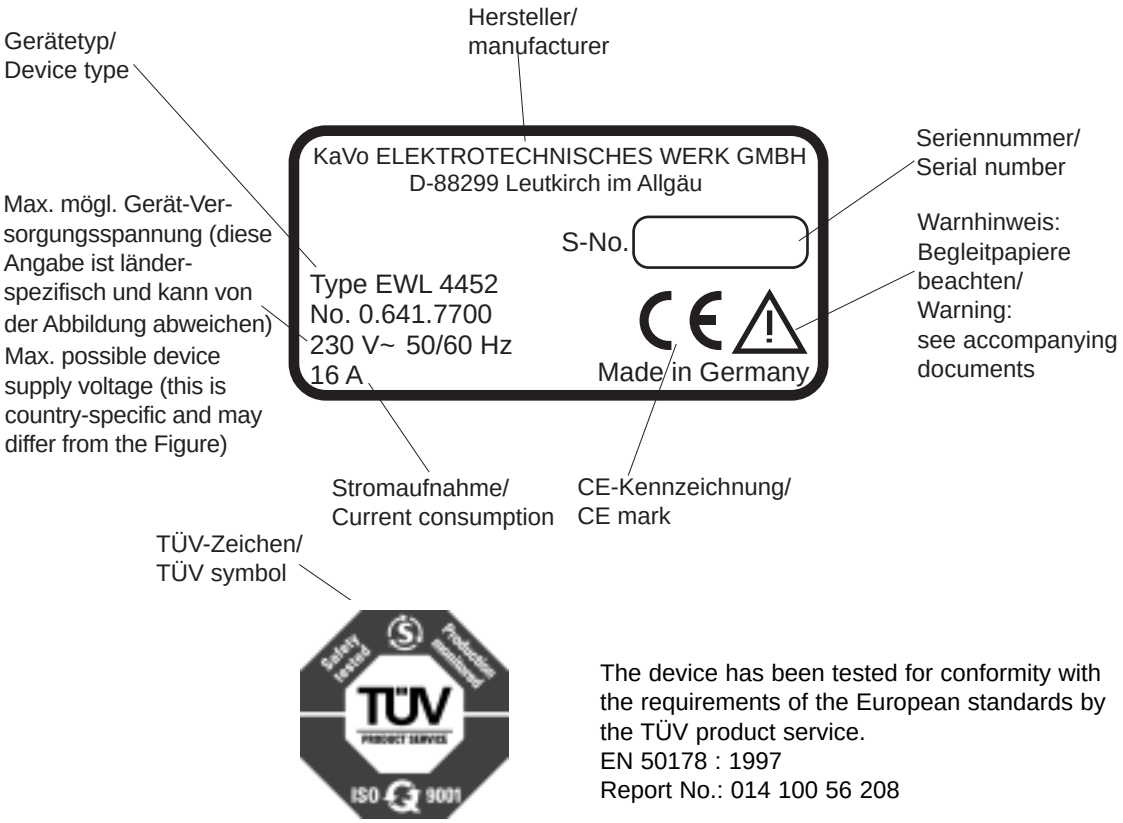




### A 3 Controls


LED Betrieb/
Operation
grün/green
LED Warnung/
Warning
gelb/yellow
LED Störung/
Fault
rot/red
H3
H2
H5
H1
LCD-Anzeige/
LCD-display
16 Zeichen x 2 Zeilen
16 characters x 2 lines
S6
LED Start
grün/green
START
Start
STOP
S12
S11
S10
S9
S8
Abbruch,
Weiterschaltung/
Cancel, transfer
unten/
down
oben/
up
Enter, Eingabe
Abspeichern/
Enter, input,
save
Stop

## A 3.1 Rating plate




The device has been tested for conformity with the requirements of the European standards by the TÜV product service.
EN 50178 : 1997
Report No.: 014 100 56 208

## A 4 Description of functions

The max. output frequency is 3000 Hz (180 000 $min^{-1}$) for ASM motors and 2000 Hz for DC motors.
The max. output power is 2.5 kVA.

The frequency inverter type 4452 is suitable for the variable-frequency control of various motors, especially with high frequencies of up to 3 kHz, corresponding to 180,000 $min^{-1}$. The output voltage is set via a pulse amplitude modulation (PAM) with 120° blocks.

### A 4.1 Three-phase asynchronous motor (ASM)

Three-phase asynchronous motors (ASM) are controlled by means of pulse amplitude modulation (PAM). The voltage/frequency table serves as a basis for determining the motor voltage. Various control procedures are available for compensating speed changes under load. Specifically, these are IR and load compensation, slip compensation and speed regulation.

### A 4.2 Brushless DC motor without sensors (BLDC)

Brushless DC motors have a pemanent magnet rotor and a fixed three-phase winding. The winding is preferably designed as an air-gap winding with yoke, but a grooved version similar to an ASM motor is also possible. The motor is controlled as a function of the rotor position. The rotor position is simulated by the inverter by measuring the e.m.f. voltage from the three part-windings. No position sensors are required. In order to permit measurement of the e.m.f. voltage, the motor inductance may not be too large.

### A 4.3 Brushless DC motor with position sensors (BLDCS)

The design of this motor is identical to that of the BLDC motor described above. For position detection, however, 3 additional Hall sensors are installed in the motor.
This motor design is not supported in the basic version of the frequency inverter type 4452, and a firmware update is required for this purpose.

### A 4.4 Remote control

The voltages at the remote control plug may be max. 60 V DC or 25V AC according to SELV (EN50178).
All connections are potentially isolated from the control and with respect to the protective conductor.
The remote control provides a large number of programmable inputs and outputs:

6 digital inputs
opto-decoupled, PLC-compatible (24 V). The inputs IN1 ... IN4 are programmable with the parameters `P110-input IN1` ... `P113-input IN4`. The inputs IN5 and IN6 are reserved for the selection of the fixed frequencies (see Section A4.6)

4 relay outputs
(potential-free max. 25 V~, 30 V- / 1 A) for outputting various status signals
(see parameter `P120-relay REL1` ... `P123-relay REL4`)

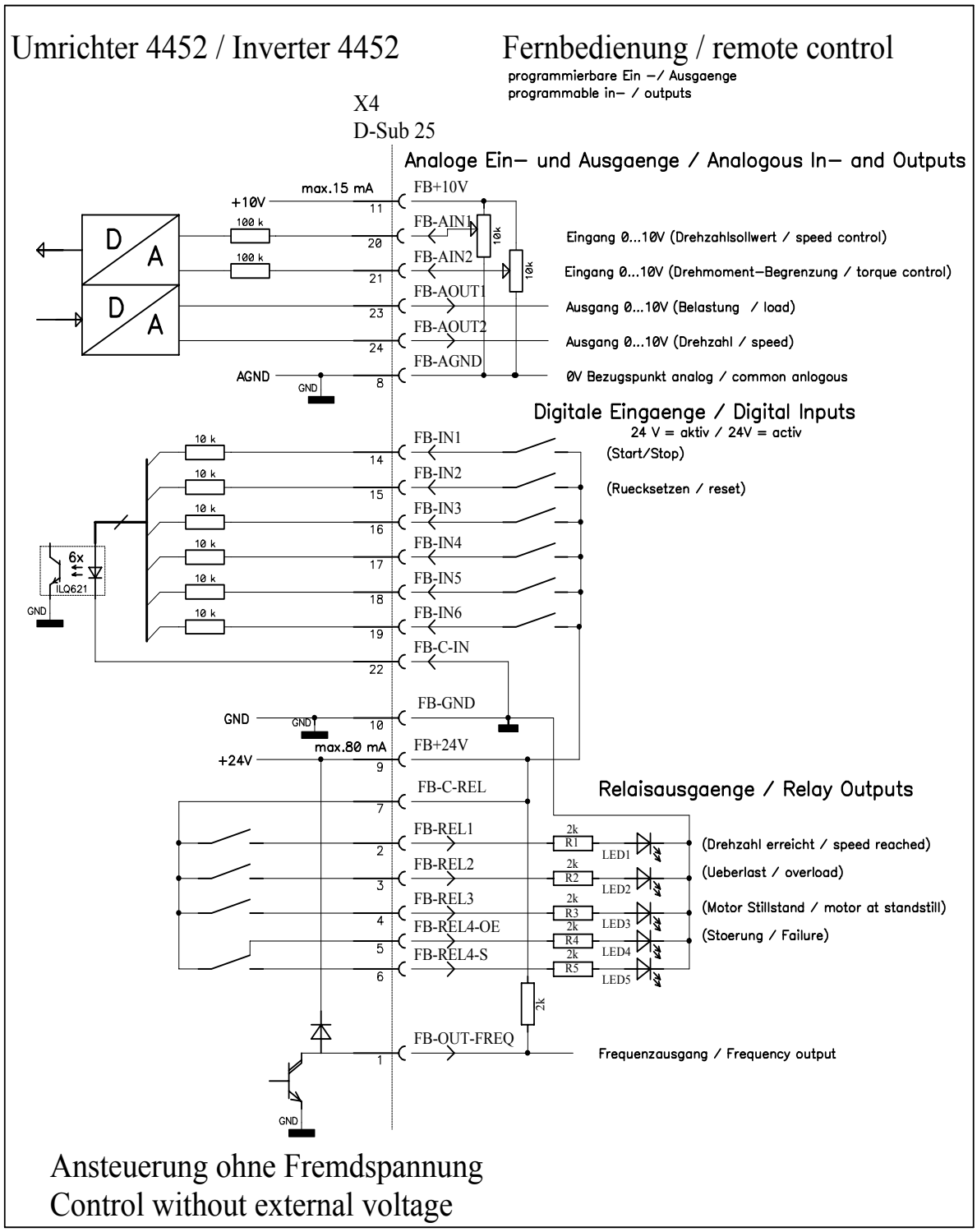
2 analogue inputs
(0 ... 10V) for the functions of speed setpoint default and torque default. The programming is performed with the parameters `P130-analogue-AIN1` and `P131-analogue-AIN2`.(see Section A4.6)

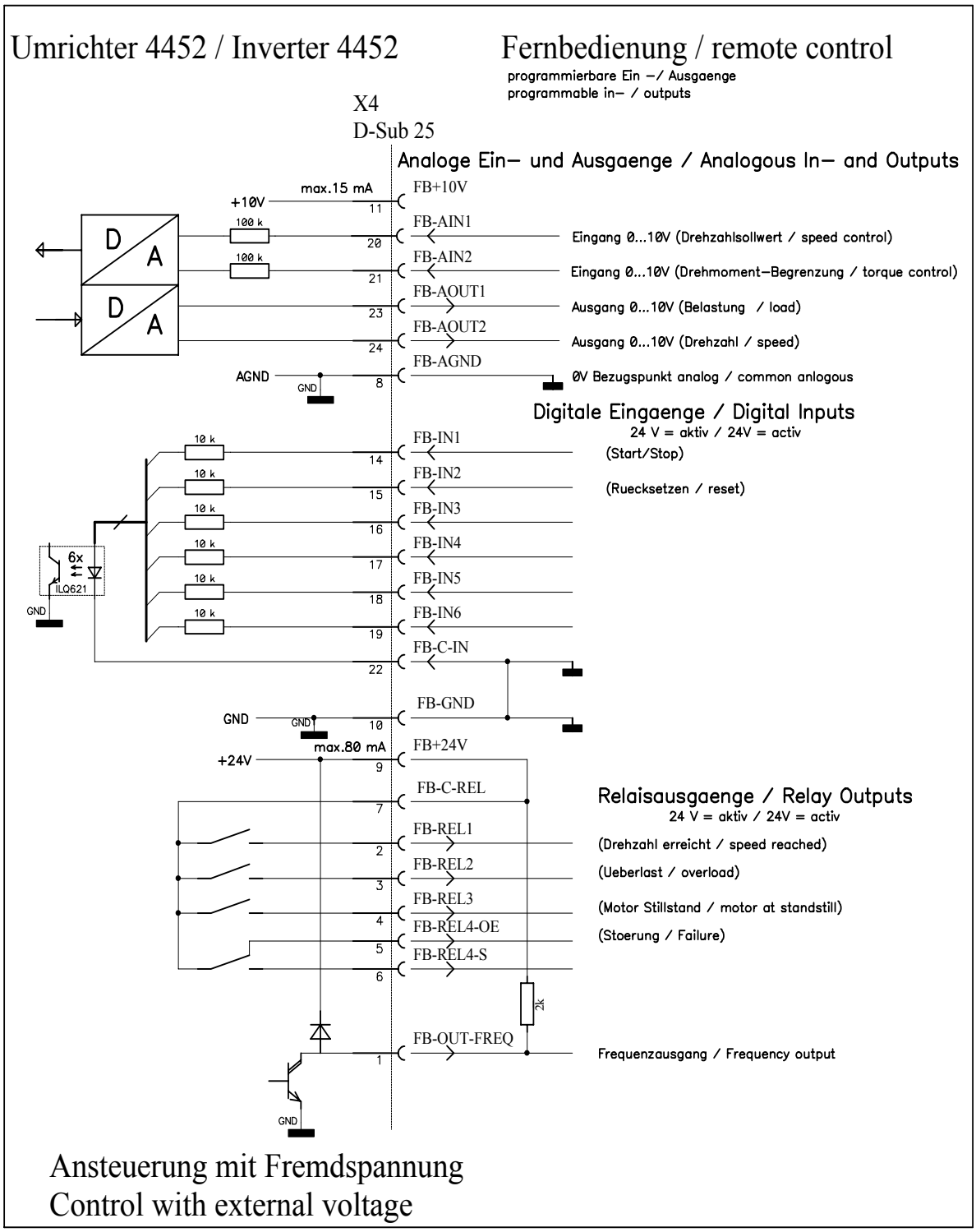
2 analogue outputs
(0 ... 10V) for outputting various analogue signals. The programming is performed with the parameters `P132-analogue-AOU1` and `P133-analogue -AOU2`.

1 frequency output
(open collector, max 24V) with 3 times the inverter output frequency.

2 auxiliary voltages
+24 V (max. 80 mA) for wiring of the digital inputs IN1...IN6 and of the relay outputs REL1...REL4
+10 V (max. 15 mA) as auxiliary supply from external potentiometers to the analogue inputs AIN1 and AIN2

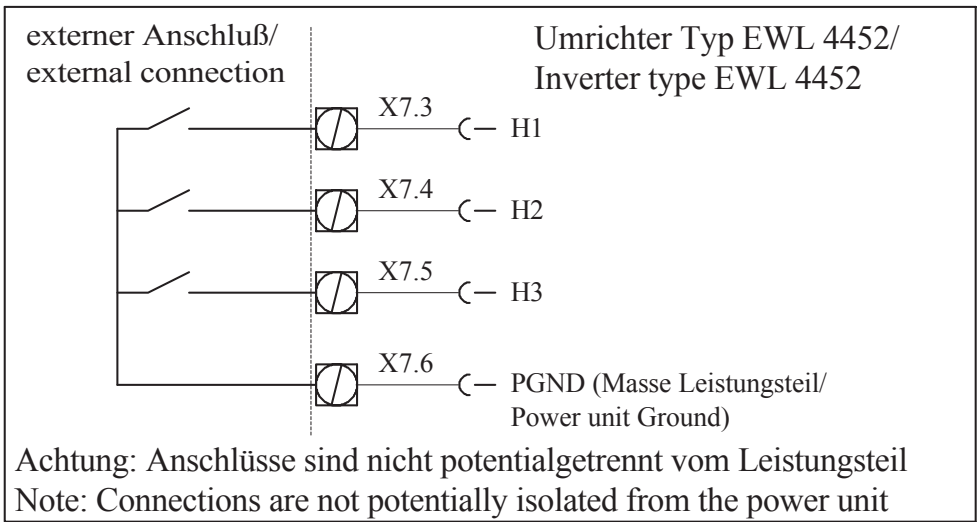
The function of the outputs (4 relay and 2 analogue outputs) is predetermined directly by the corresponding parameters. In order that the inputs perform the function prescribed in the parameters, parameter `P7-select func.` should be set to `remote con.` or `parallel`.




Umrichter 4452 / Inverter 4452
Fernbedienung / remote control
programmierbare Ein –/ Ausgaenge
programmable in– / outputs
X4
D-Sub 25
Analoge Ein– und Ausgaenge / Analogous In– and Outputs
max.15 mA
+10V
11
FB+10V
100 k
20
FB-AIN1
Eingang 0...10V (Drehzahlsollwert / speed control)
100 k
21
FB-AIN2
Eingang 0...10V (Drehmoment–Begrenzung / torque control)
23
FB-AOUT1
Ausgang 0...10V (Belastung / load)
24
FB-AOUT2
Ausgang 0...10V (Drehzahl / speed)
AGND
GND
8
FB-AGND
0V Bezugspunkt analog / common anlogous
Digitale Eingaenge / Digital Inputs
24 V = aktiv / 24V = activ
10 k
14
FB-IN1
(Start/Stop)
15
FB-IN2
(Ruecksetzen / reset)
16
FB-IN3
17
FB-IN4
18
FB-IN5
19
FB-IN6
22
FB-C-IN
6x
ILQ621
GND
GND
10
FB-GND
max.80 mA
+24V
9
FB+24V
Relaisausgaenge / Relay Outputs
24 V = aktiv / 24V = activ
7
FB-C-REL
2
FB-REL1
(Drehzahl erreicht / speed reached)
3
FB-REL2
(Ueberlast / overload)
4
FB-REL3
(Motor Stillstand / motor at standstill)
5
FB-REL4-OE
(Stoerung / Failure)
6
FB-REL4-S
2k
1
FB-OUT-FREQ
Frequenzausgang / Frequency output
GND
Ansteuerung mit Fremdspannung
Control with external voltage

### A 4.5 Motor code

The frequency inverter type 4452 can adapt automatically to up to 8 different motors via three code inputs at X7. The code inputs can be predetermined directly via the motor plug or by a superior control.




⚠ *The code inputs at X7 are based on motor potential, i.e. not isolated from the mains potential. In the case of a PLC control, a relay should be connected between PLC and inverter for the potential isolation.*

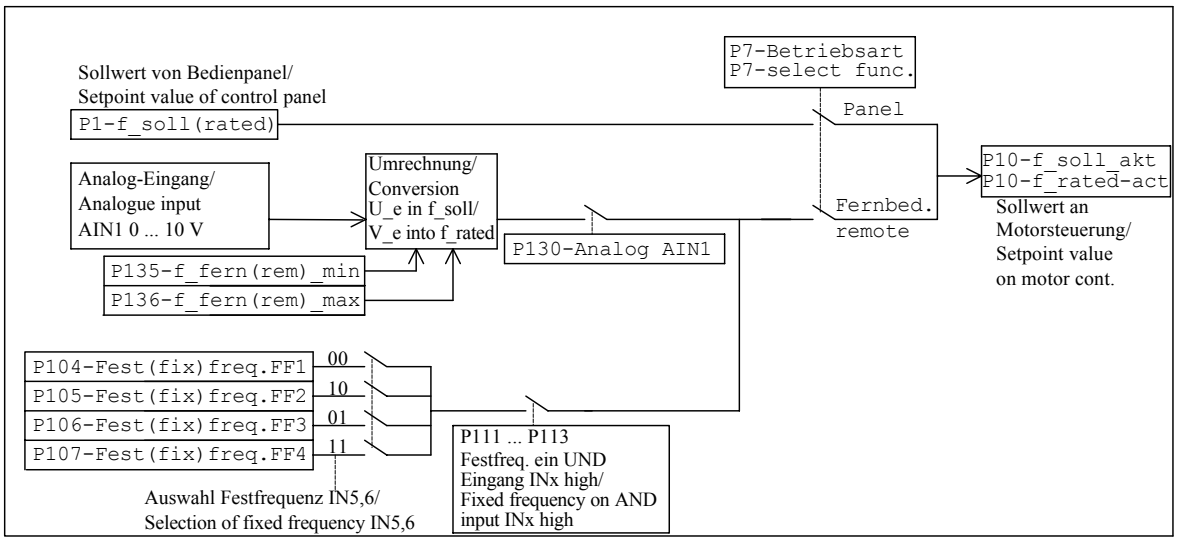
By means of parameter `P102-motor coding`, the coding is switched on and the number of motors used is input. In parameter `P20-motor code`, the current state of the coding inputs and of the assigned motor memory is displayed. If the state of the coding inputs changes, the corresponding motor parameters are loaded from memories M1...M8 (see Section B 3.4 SP1 - store and recall motor parameters).
The motor coding can be changed only when the motor is stationary. Only the coding inputs H1...H3 actually required are evaluated, and inputs not required are ignored.
A motor coding of up to 4 motors can be used in the case of motors with speed sensor; motor coding of up to 8 motors cannot be used simultaneously with a speed sensor since the two functions share the input H1, see `P20-motor code`.

| **Coding input H1 (X7.3)** | **Coding input H2 (X7.4)** | **Coding input H3 (X7.5)** | **Code value in** `P20-motor code` | **Assigned motor parameter memory** |
|---|---|---|---|---|
| H | H | H | C1 | M1 |
| H | L | H | C2 | M2 |
| H | H | L | C3 | M3 |
| H | L | L | C4 | M4 |
| L | H | H | C5 | M5 |
| L | L | H | C6 | M6 |
| L | H | L | C7 | M7 |
| L | L | L | C8 | M8 |

L = low voltage 0..4V (contact closed),
H = high voltage, 8...12V (contact open)

### A 4.6 Setpoint value selection

The frequency setpoint value (speed setpoint value) can be predetermined by various sources, and the mode of operation is shown in the following figure.




If parameter `P7-select func.` is set to `Panel`, the speed setpoint value of `P1-f-rated` is used, and the analogue setpoint value at AIN1 and the fixed frequencies have no function.
If `P7-select func.` is set to `remote control`, the setpoint value is used in the following sequence: fixed frequency, then analogue input. If one of the parameters `P111` ... `P113` is set to `fixfreq.on`, the corresponding input IN2 ... IN4 must be actuated in order that the fixed frequency FF1 ... FF4 selected by IN5 and IN6 is active. Otherwise, the analogue input AIN1 is used, and parameter `P130-analogue AIN1` must be set to `rated frequency.`
If `P7-select func.` is set to `parallel`, the setpoint value selection is performed in the following sequence: fixed frequency, analogue input and control panel.

### A 4.7 Emergency motor stop at mains failure

With parameter `P58-emerg.stop`, the inverter can be set so that a running motor is automatically braked in the event of failure or if the mains voltage falls below the threshold value of approx. 150 V. The inverter supplies itself from the motor voltage still present, and braking is performed with maximum power of the brake resistance. The motor generally cannot be braked to a stop since the motor voltage is no longer sufficient for supplying the inverter.
If an emergency stop occurs as a result of a brief drop in mains voltage, the motor is braked to a stop. In order to start the motor again, the operator must first input a stop command followed by a start command.

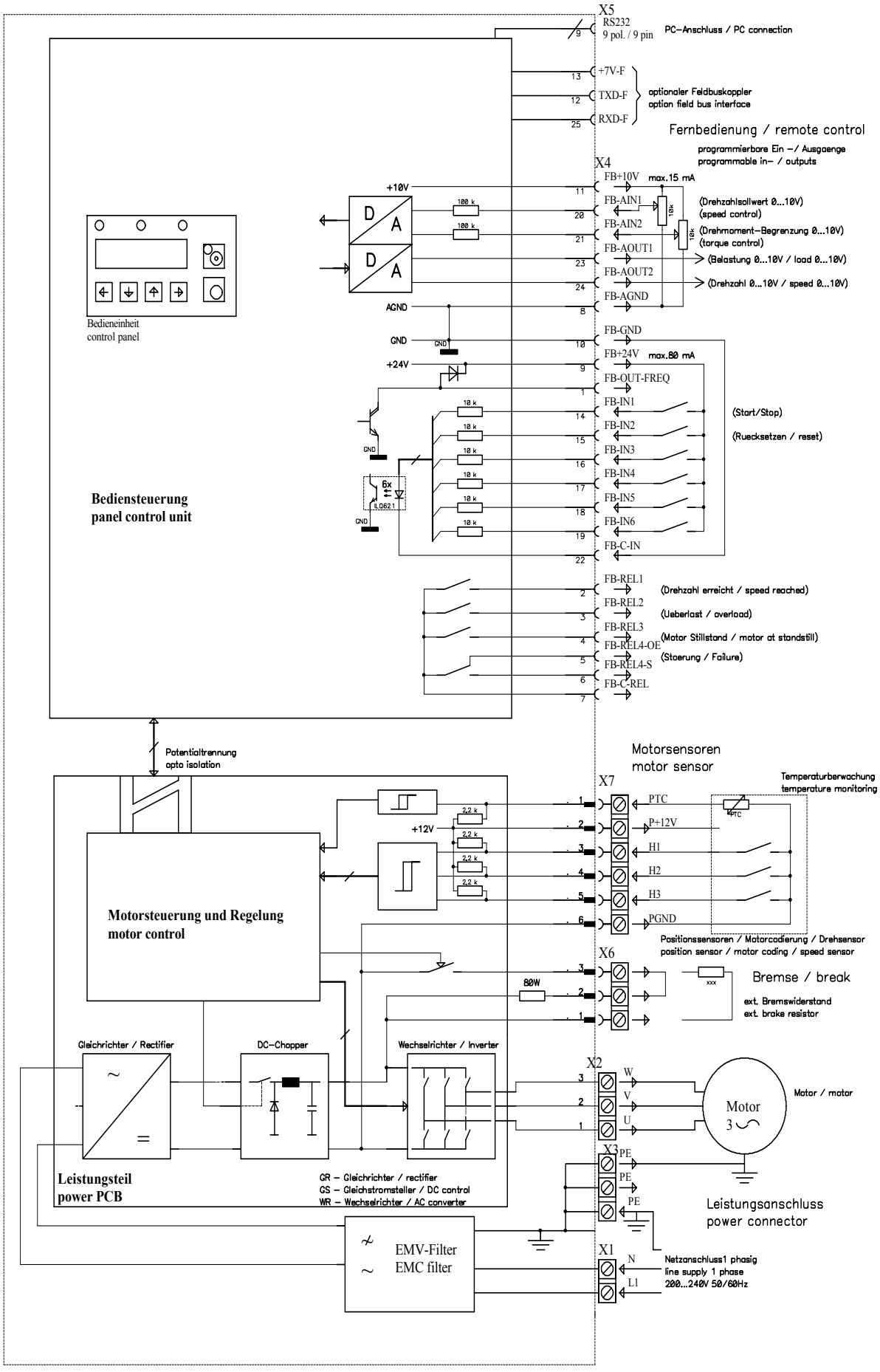
### A 4.8 Speed sensor

For the ASM motor, an external speed sensor can be connected and the number of pulses per revolution can be configured in the range 1...10 with parameter `P59-speedsensor`. The measured actual speed is displayed in `P14-f_motor`. The speed sensor is used for detecting motor stoppage (f < 1Hz, see status signals `P120-RELx...`), for the catch circuit (see `P50-motor start`) and for the speed regulation (see `P70-control`).
The speed sensor and the motor coding for up to 4 motors can be used simultaneously. Motor coding for up to 8 motors cannot be used simultaneously with a speed sensor since both functions share the input H1 (see `P20-motor code`).

### A 4.9 Counterclockwise operation

In standard operation, the inverter operates electrically clockwise. With one of the parameters `P111-input IN2` to `P113-input IN4`, a digital input can be configured for counterclockwise operation. If the corresponding input is supplied with voltage, the direction of rotation changes to `counterclockwise`. If the direction of rotation is switched while the motor is running, the motor is first braked before it is powered up again in the altered direction of rotation.

## A 4.10 Block diagram



## B 1 Assembly and Installation

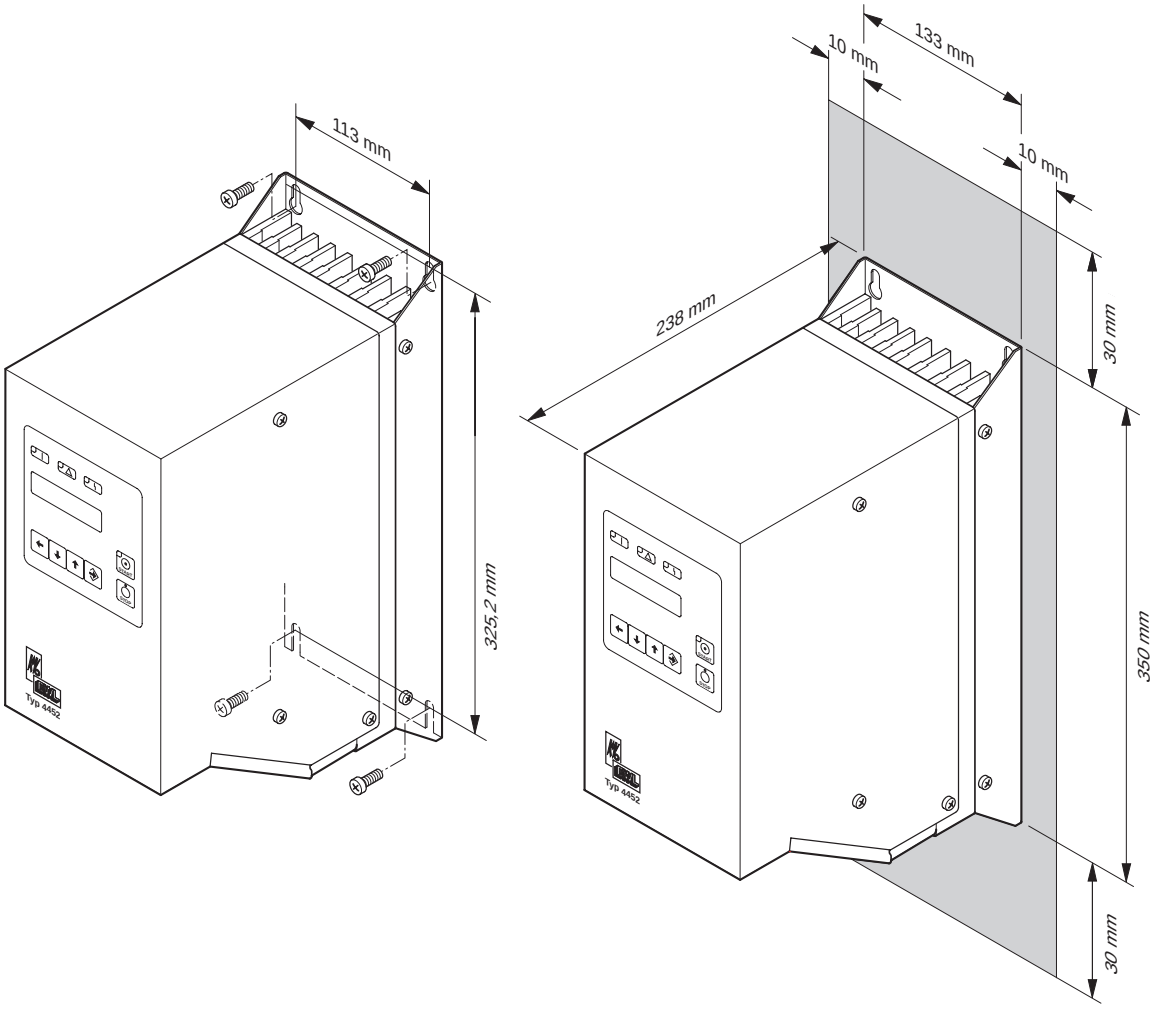
*Before the installation and commissioning of this device, please read the safety and warning information under Section A1 carefully.*

## B 1.1 Assembly

The frequency inverter type 4452 should be mounted as follows in the switch cabinet:
Fasten the mounting plate to the back panel of the switch cabinet by means of four screws.
Ensure good electrical contact with the protective conductor!

### Information on cooling

*The inverter is cooled by an integral fan. To ensure effective cooling, at least the following clearances must be maintained around the inverter:*
*End surfaces: 30 mm*
*Longitudinal surfaces:10 mm*



## B 1.2 Electrical Installation

⚠ *When installing the inverter, the applicable safety regulations must be observed. Cut-out devices for preventing unexpected start-up must be provided. A device for the electrical isolation of the inverter must be provided unless a mains cable with a plug is used. The inverter must be provided with 16 A power cut-outs with tripping characteristic B.*

For connection of the mains and motor connections, unscrew the small sheet metal cover of the connection compartment (2 screws). Disconnect the protective conductor cable.
The connection is performed as described below.
After connection is complete, reconnect the protective conductor cable and screw back the sheet metal cover.

## B 1.3 Wiring guidelines for compliance with the EMC standards

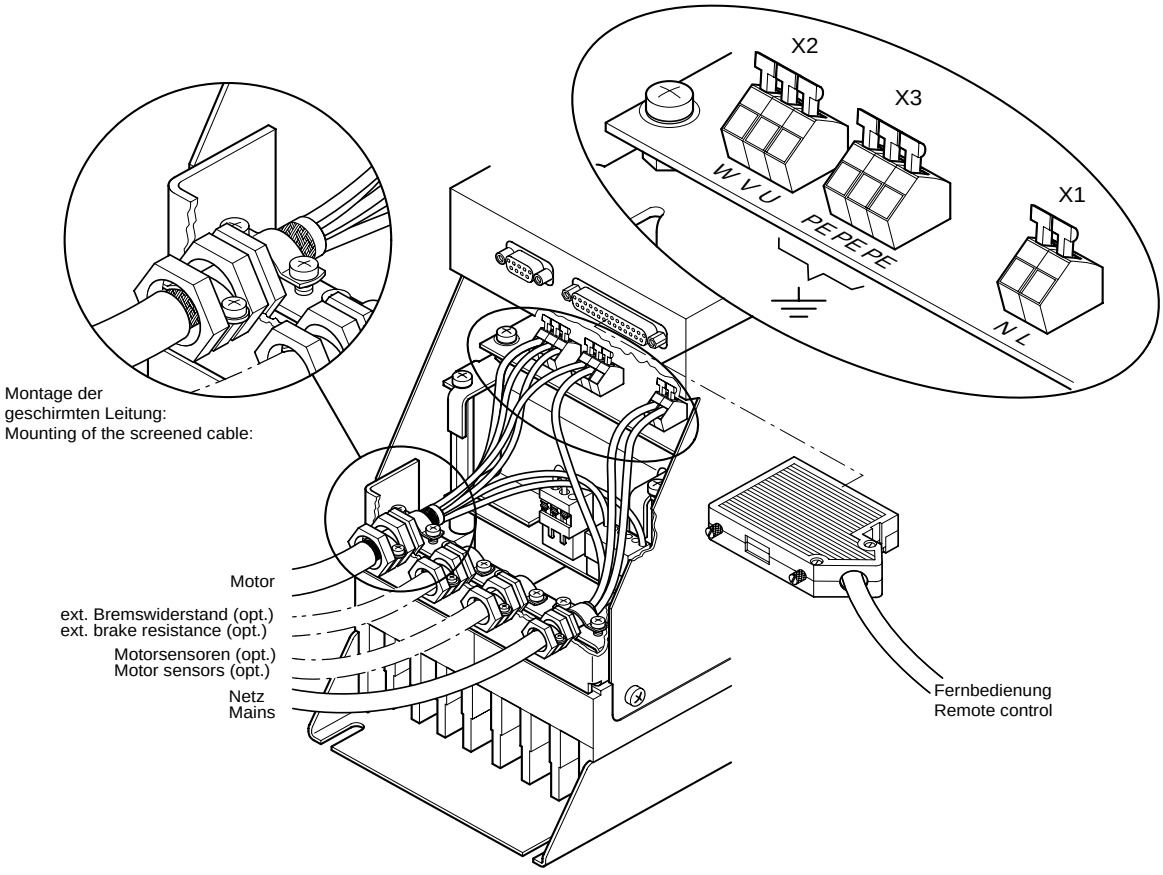
The inverter was tested according to EMC product standard EN 61800-3 (variable-speed electrical drives).

⚠

■ *The above-mentioned EMC product standard can be complied with only by means of shielded motor and control cables. It should be ensured that the cable shields rest over a large area of the inverter housing and are surrounded by the cable clips. A shielded mains cable is not required.*
■ *The control cables must be laid separately from (not parallel with) mains and motor cables. Shielded cables and metallized plug housings should be used.*
■ *All devices in the mounting cabinet should be connected over a large area to a common earthing point via short earthing cables.*
■ *On installation of the inverter, valid safety provisions may on no account be infringed.*

## B 1.4 Electrical connections

### X1, X2, X3: Mains and motor connections



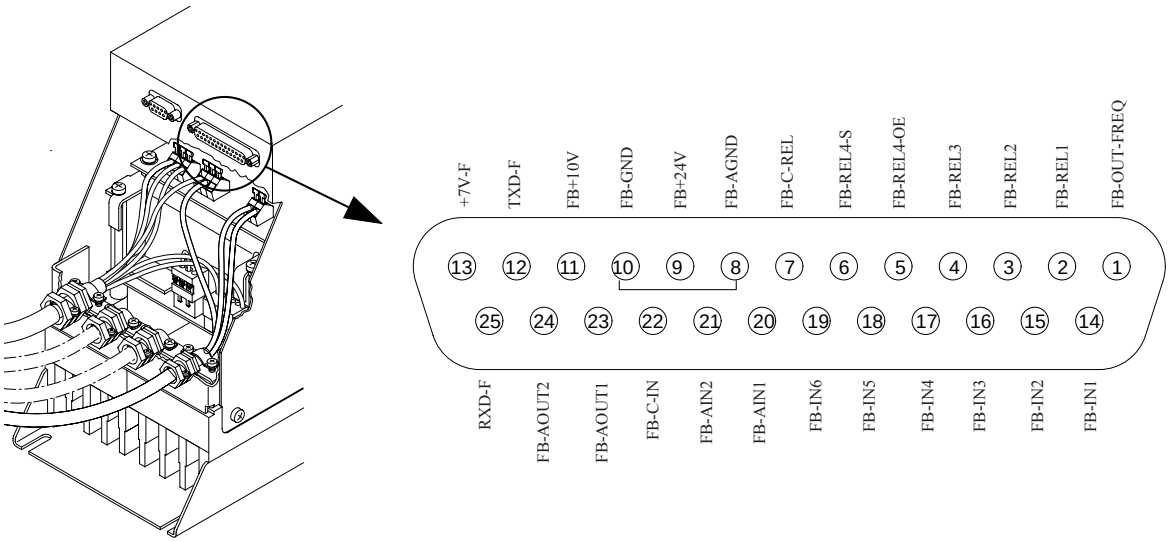

Mains voltage 200...240V~, 50/60 Hz
Plug type: Spring terminal (max 2.5 $mm^2$ / AWG 12)

### Connection of a KaVo spindle

A KaVo spindle is connected according to the following table; on operation for the first time, check the direction of rotation specified on the spindle (arrow).
Compliance with EMC guidelines is ensured only with the use of spindle types EMC 4060 – 4063 with shielded connecting cable.

| Signal | Inverter connection | Shielded cable Type EMV 4060 – 4063 Connection colour | Unshielded cable Type 4060 – 4063 Connection colour |
|---|---|---|---|
| Phase U | X2.1 (U) | 1 – blue | 1 – blue |
| Phase V | X2.2 (V) | 3 –yellow | 3 – violet |
| Phase W | X2.3 (W) | 4 – black | 5 – black |
| PTC (cold conductor) | X7.1 | B – brown | 4 – brown |
| PTC (cold conductor) | X7.6 | C – white/natural | 2 – white |
| Protective conductor | X3 (PE) | 2 – yellow/green | 7 – yellow/green |
| Shield | Pull-relief terminal | Housing - braided | not present |
| --- | Not connected | A – green | 6 – natural |

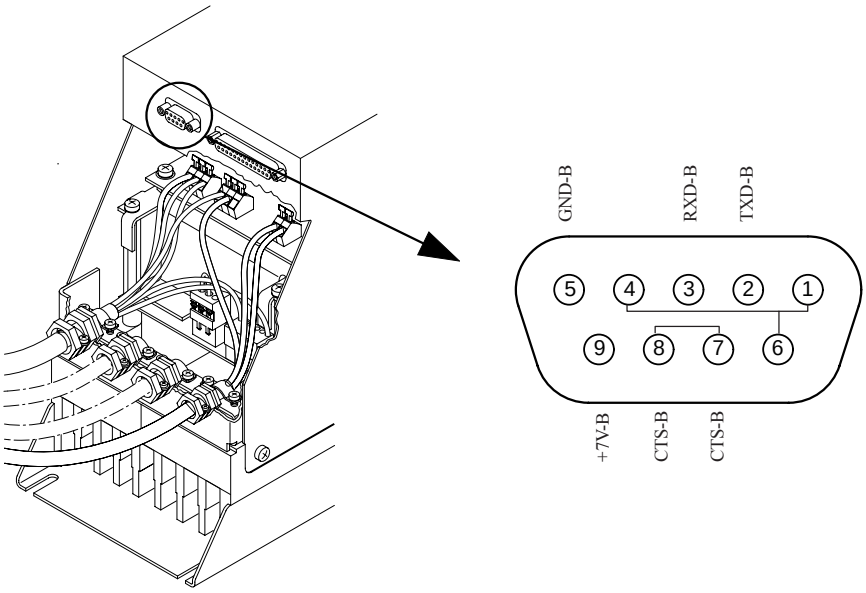
### X4: Remote control connection




Plug type: 25-pole D-Sub jack

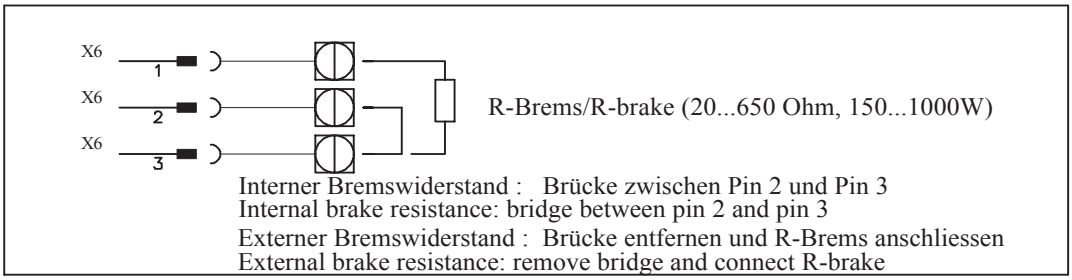
*Note: All connections of the 25-pole jack X4 are potentially isolated from the control and with respect to the conductive earth up to max. 60 V DC or 25V AC.*

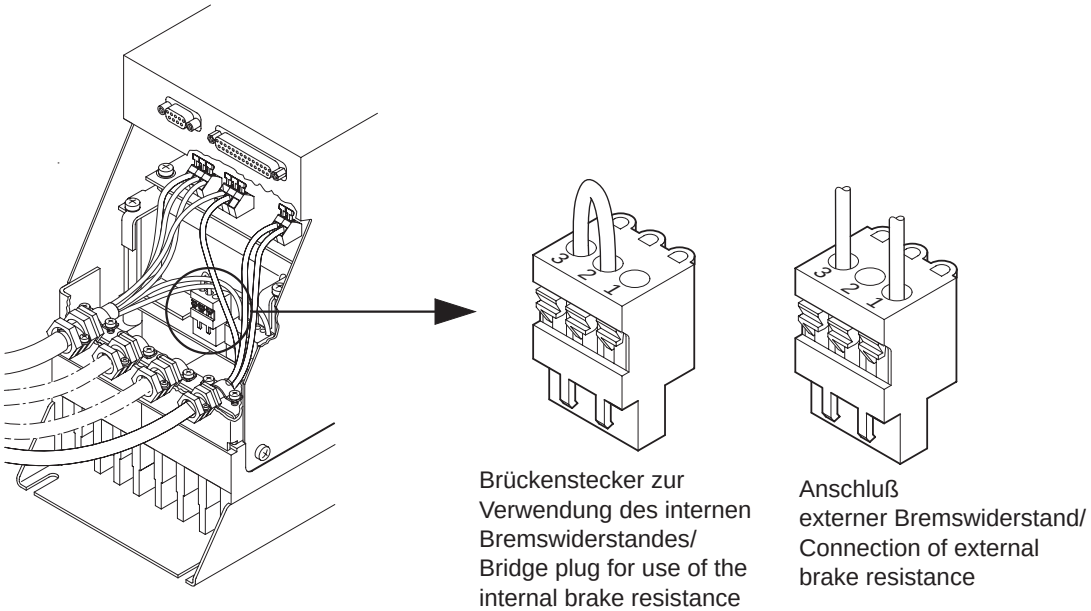
**X5: Connection of external control panel and PC (option)**




Plug type: 9-pole D-Sub jack

**X6: Connection of external brake resistance**



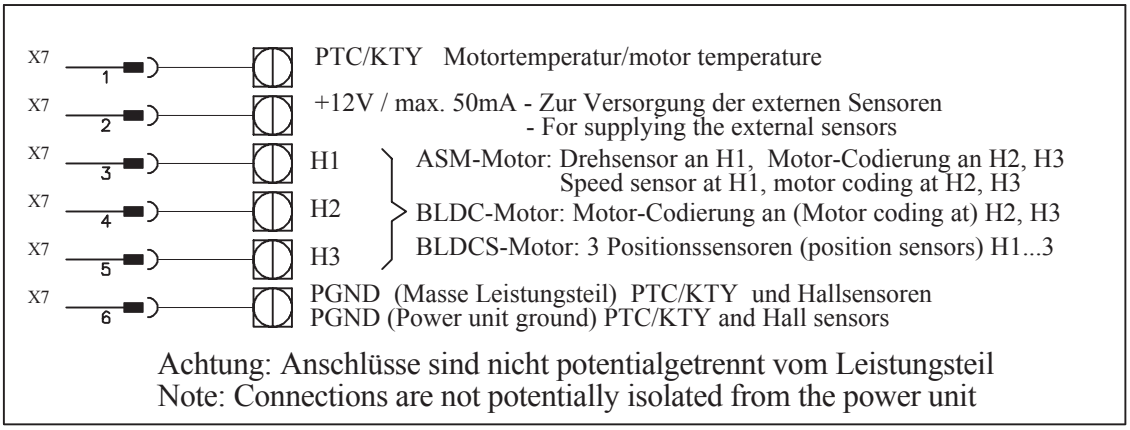

Brückenstecker zur Verwendung des internen Bremswiderstandes/ Bridge plug for use of the internal brake resistance

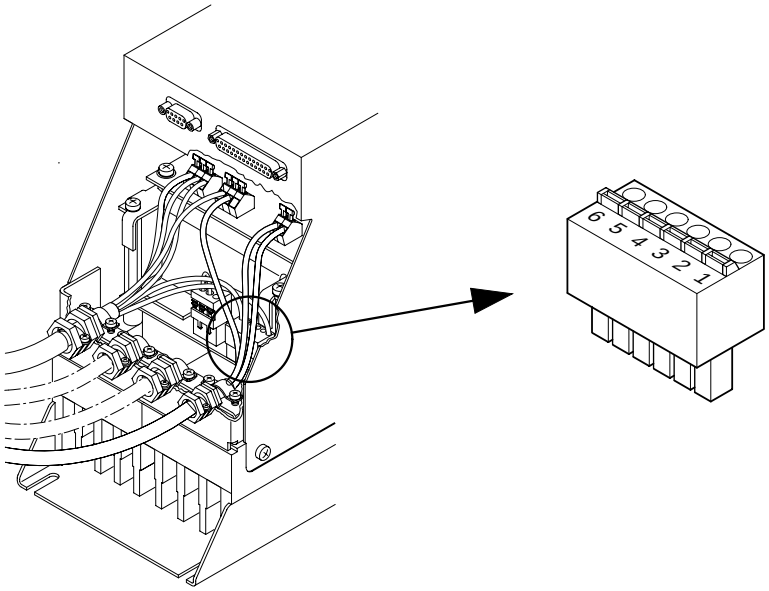
Anschluß externer Bremswiderstand/ Connection of external brake resistance

Plug type: 3-pole pluggable spring terminal (max. 1.5 mm² / AWG 14); from Phoenix, Combicon grid 5.08 mm

### X7: Connection of the motor sensors

This connection is used for the motor temperature sensor, motor coding, speed sensor in the case of the ASM motor and position sensors in the case of the BLDSC motor.




Plug type: 6-pole pluggable spring terminal (max. 1.5 mm² / AWG 16); from Phoenix, Mini-Combicon grid 3.81 mm

⚠ *All connections to the 6-pole terminal X7 are based on the negative potential of the intermediate circuit voltage, i.e. are not isolated from the mains potential.*

## B 2 Fast commissioning, the most important aspects in brief

### B 2.1 Connecting the inverter

First check whether the mains voltage corresponds to the rated voltage of the device.
Connect the inverter to the mains voltage and to the motor, see Section B 1 Assembly and installation.

The LCD display shows the standard display (frequency, voltage and current) and one of the upper three light emitting diodes lights up.

### B 2.2 Establishing factory default

The standard state of the inverter is the factory default state.
The display shows `Warning W 15 undefined motor`. See Section B 2.3.

If the inverter is to be controlled via remote control, see Section B 2.4 Remote control parameters.

If the inverter was already in operation and is to be configured for another application,
first establish the factory default:

Menu: `Special functions` / `SP3- reset parameter / all parameters`

| **Keys** | **Display** |
|---|---|
| 2 x ← | `Special functions` |
| Enter → | `SP1 -` |
| 2 x ↑ | `SP3 - reset parameter` |
| Enter → | `Reset parameter - motor parameter` |
| top ↑ (1) | `Reset parameter - remote control` |
| top ↑ | `Reset parameter - all parameters` |
| Enter → | `P1 - P150 init. YES?` |
| Enter → | Function: All parameters to factory setting |
| ← and ○ Stop simultaneously | Function: reset inverter |

(1) If you wish to bring only the parameters of the motor or the remote control to the factory default, select the corresponding menu option with the keys ↑ and ↓.

For special applications, the inverter can be preconfigured by KaVo before delivery. This is evident from the fact that the parameter sheet (last sheet of these instructions) has been completed and the inverter shows the standard display (`0 Hz  0V  0,0 A`) in the normal state.

### B 2.3 Setting motor parameters

If you wish to set up the inverter for a KaVo spindle, call up the default parameters for the corresponding spindle:

Menu: `Special functions` / `SP1- motor parameter` / `factory setting` / `KAVO Type xxxx`

| **Keys** | **Display** |
|---|---|
| 2 x ← | `Special functions` |
| Enter → | `SP1 -` |
| Enter → | `Motor parameter - recall` |
| 3 x ↑ | `Motor parameter - factory setting` |
| Enter → | `Factory setting - factory default` |
| Select ↑ and ↓ spindle | `Factory setting - KAVO Type xxxx` (e.g. type 4060 for spindles type 4060 – 4063) |
| Enter → | Function: Motor parameters are being recalled |
| ← and ○ Stop simultaneously | Function: Reset inverter |

If you wish to set up the inverter for another motor, or the spindle is not present in the list under factory setting, see Section B 3.1 Commissioning parameters, examples.

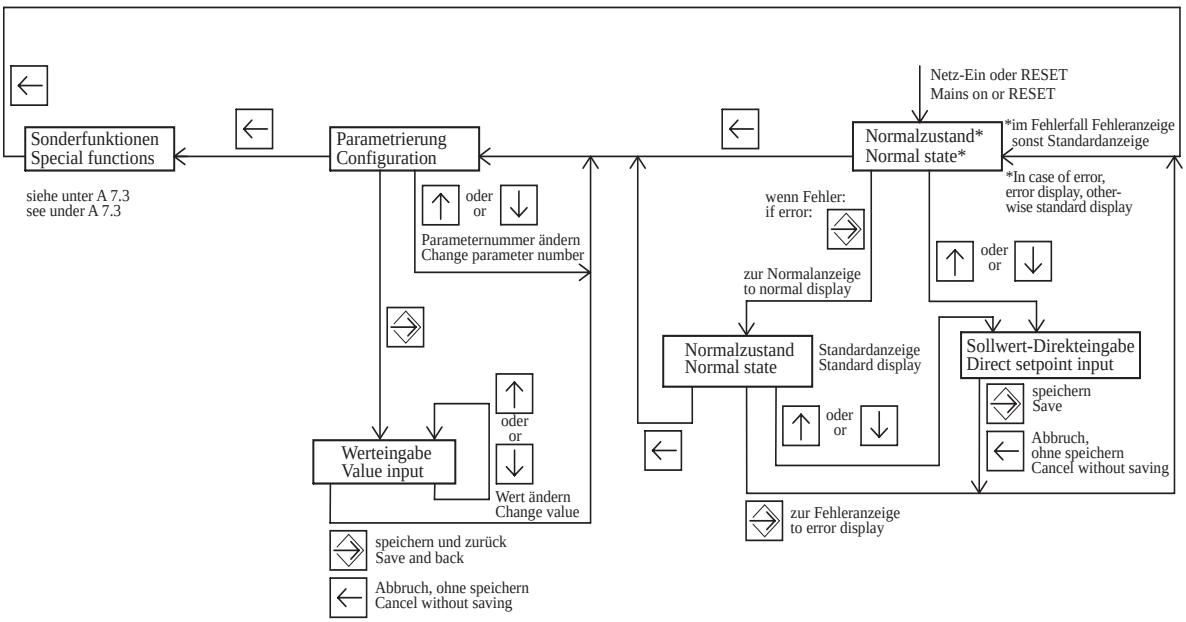
Start the motor with the Start key ⊙ and check the motor running. If necessary, individual parameters should be changed slightly; the individual parameters are described from Section B 3.9. Stop the motor with the Stop key ○.

### B 2.4 Setting remote control parameters

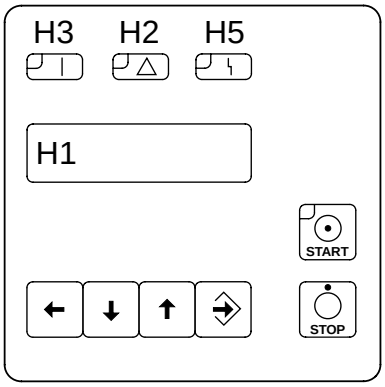
If you wish to control the inverter via the remote control interface X4, additionally set the parameters P104 - P136 and `P7-select func`. See Section B 3.1 Commissioning parameters, examples and from Section B 3.9 Description of the individual parameters.

### B 2.5 Operation

Operation concept for frequency inverter 4452



After the inverter has been switched on (mains on), the device tests various hardware components.
The standard display appears on the LCD display H1, and LED Operation H3 (green) lights up. If an error occurs, LED H5 (red) lights up, see Section B 4 Error messages.




**Meaning of the status displays:**

H3 - LED Operation (green) - The inverter is ready for operation, the motor can be started or is running, no fault is present.

H2 - LED Warning (yellow) - The inverter has detected that a limit has been exceeded (e.g. motor current limit, temperature too high), the motor can be started or is running.

H5 - LED Fault (red) - The inverter has detected an error and is not ready for operation, the motor cannot be started. A fault can be reset only by switching off or reset (see Section B 4 Error messages).

**Only the following functions are available:**
With the ← key (cancel, transfer), you can select between

1. Normal state
(Standard display or error display)
2. Configuration
(Display of parameter P1)
3. Special functions

### B 2.6 Reset

If a serious error occurs (LED H5 Fault lights up red), a reset must be triggered in order to fetch the device from this state.

There are three possibilities for triggering a reset:

**1. Key combination ←** (cancel, transfer), Stop ○
First press the ← key and keep depressed, then press the Stop key ○ and keep both keys depressed for about one second.

**2. Reset via remote control**
Configure digital input with one of the parameters `P111-input IN2 to P113-input IN4` to reset and then trigger a reset via an external voltage pulse (see configuration).

**3. Switch off device**
Wait until the error display (LED H5 red) goes out and then switch on the device again.

With a reset a total initialization is triggered and the inverter is in the normal state and is ready for operation. If the error occurs again, the error display does of course reappear.

## B 3 Configuration

All inverter-relevant data are accessible in the form of parameters P1 ... P150.

The configuration in turn is divided into

**Default parameters**
Superior parameters on which further settings are dependent (P1 .. P9) (speed setpoint value, display settings, operating language, mode...)

**Display values**
Pure display values which cannot be changed (P10 ... P39) (voltage, current and frequency values)

**Motor operating parameters**
Motor-specific parameters for adapting the motor to the inverters (P41 ... P99)

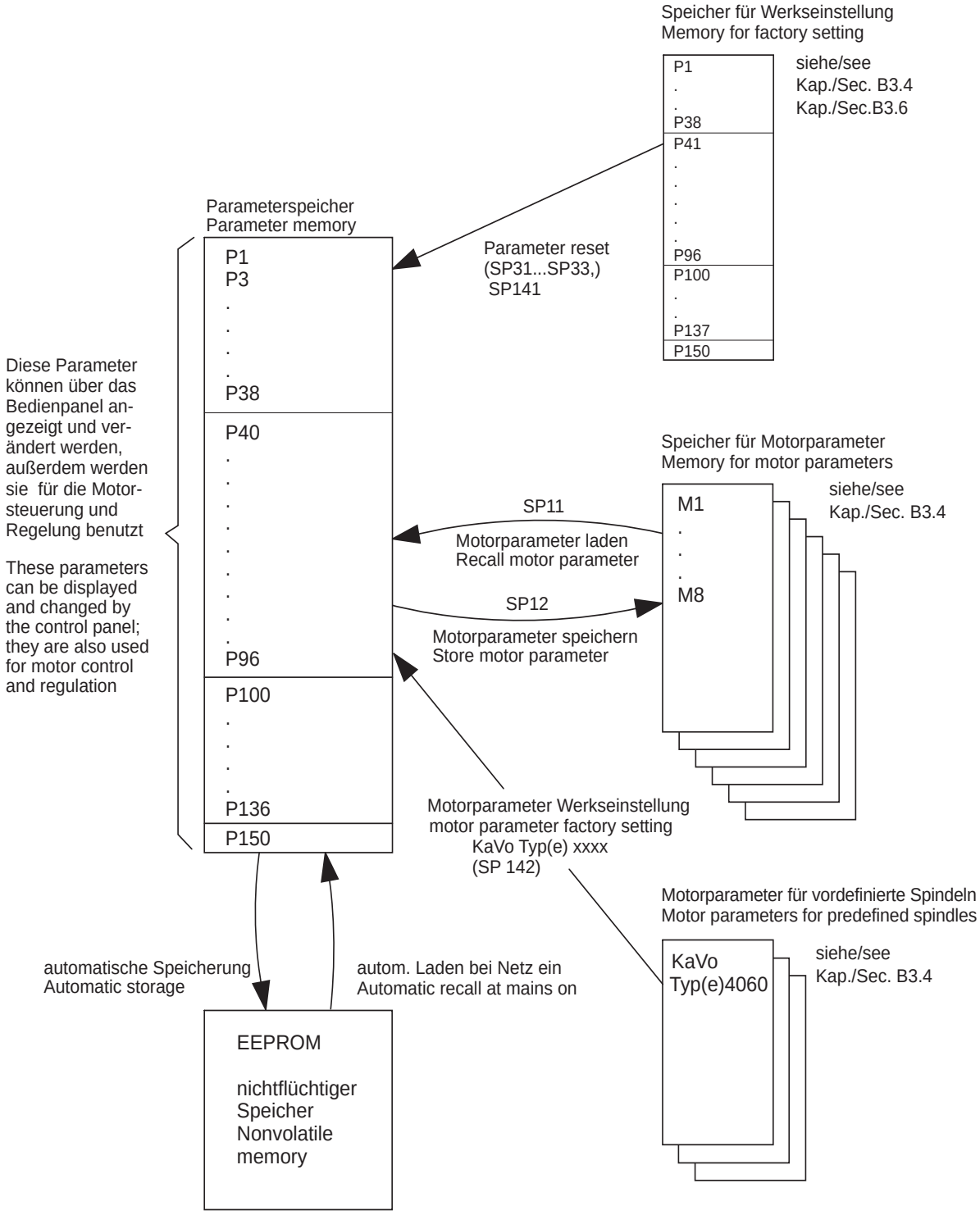
**Device parameters**
Inverter-specific parameters which can be changed (P100 ... P150) (braking resistance, remote control)

The parameter number can be selected with the keys ↓ and ↑. If a parameter is to be changed, the Enter key → is pressed. The value can now be changed within the permissible range. After the Enter key → has been pressed, the value is adopted by the control and is stored. If the old value is to be retained, the ← key (cancel, transfer) is pressed.

If a parameter cannot be changed (e.g. pure display values), an eye symbol (oo) appears in the first position of the second line in the LCD display H1. This also applies to parameters which can be changed only when the motor is stationary.

If a parameter is displayed from the hold memory in the error state, a fault symbol ϟ . appears in the first position of the second line in the LCD display H1. This applies to the standard display (see `P4-display`) and the parameters P10 to P19 (see under Error messages, hold function).

If a parameter is not used, depending on the mode or other parameters, it is faded out. It is thus not displayed and also cannot be changed.




Overview of the various parameter memories
Explanation: SPxx -Special functions, see Section B 3.3

### B 3.1 Commissioning parameters, examples

In order to start from a defined initial state, the factory setting must first be restored, which can be achieved with the following menu option: `Special functions` / `SP3 - Reset parameter / Motor parameter`. The safety inquiry should be confirmed with the Enter key ➔.

For fast commissioning of the inverter, at least the following parameters must be set; for optimization, further parameters can be adapted. [Factory settings in square brackets]

*To ensure that the parameters marked with * are displayed, parameter* `P3-para level` *should be set to* `parameter`*.*

#### Operating language and display preselection

| | |
|---|---|
| `P5-language` | Selection of the operating language [English] |
| `P4-display` | Selection of the standard display |
| `*P8-speed displ` | Selection of the speed display in Hz or $min^{-1}$ |

#### Motor operating parameters

Three-phase asynchronous motors (**ASM**):
Parameters which must be input:

| | |
|---|---|
| `*P90-motortype` | Motor type ASM |
| `*P91-f_mot_nom` | Rated motor frequency according to rating plate |
| `*P92-V_mot_nom` | Rated motor voltage according to rating plate |
| `*P93-I_mot_nom` | Rated motor current according to rating plate |
| `*P94-cos phi` | Cosine phi under nominal load [85%] |
| `*P96-no. of poles` | Number of motor poles [2] |
| `*P85-motor prot.` | Protection of the motor from excess temperature |

Brushless DC motors without position sensors (**BLDC**):
Parameters which must be input:

| | |
|---|---|
| `*P90-motortype` | Motor type BLDC |
| `*P91-f_mot_nom` | Rated motor frequency according to rating plate |
| `*P92-V_mot_nom` | Rated motor voltage according to rating plate |
| `*P93-I_mot_nom` | Rated motor current according to rating plate |
| `*P94-cos phi` | Cosine phi under nominal load [85%] |
| `*P96-no. of poles` | Number of motor poles [2] |
| `*P85-motor prot.` | Protection of the motor from excess temperature |

Brushless DC motors with position sensors (**BLDCS**):
This motor is not supported in the standard version of the inverter.

*For optimization, it may be necessary to set further parameters P41 ... P84. (See Section B3.12)*

#### Device parameters

| | |
|---|---|
| *P100 - P101 | If an external braking resistance is used, P100 and P101 should be set |
| *P104 - P136 | If the remote control interface (X4) is used, the corresponding parameters should be set here |

#### Basic parameters

| | |
|---|---|
| `P1-f_rated` | desired speed setpoint value (operating speed) |
| `*P7-select func.` | Selection of the control on the control panel or remote control [Panel]. |

## B 3.2 Examples of parameters

### ASM motor

Speed range up to 60 000 $min^{-1}$, 230V~, 5A~, cos phi 80 %, motor protection with PTC

| | |
|---|---|
| P90-motortype | ASM |
| P91-f_mot_nom | 1000 Hz |
| P92-V_mot_nom | 230 V |
| P93-I_mot_nom | 5 A |
| P94-cos phi | 80% |
| P96-no. of poles | 2 |
| P85-motor prot. | PTC |

### BLDC motor

Speed range up to 60 000 $min^{-1}$, 220V~ 5 A~ (max 8A~), no centrifugal mass, normal startup

| | |
|---|---|
| P90-motortype | BLDC |
| P91-f_mot_nom | 1000 Hz |
| P92-v_mot_nom | 220 V |
| P93-I_mot_nom | 5 A |
| P96-no. of poles | 2 |
| P44-I_limit | 8 A |
| P85-motor prot. | no sensor |

### BLDC motor

Speed range up to 60 000 $min^{-1}$, 220V~, 5A~, large centrifugal mass (0.004 $kgm^2$), microstep startup with start ramp

| | |
|---|---|
| P90-motortype | BLDC |
| P91-f_mot_nom | 1000 Hz |
| P92-V_mot_nom | 220 V |
| P93-I_mot_nom | 5 A |
| P96-no. of poles | 2 |
| P51-t_start | 4.0 sec |
| P52-I_start | 5 A |
| P53-f_start | 5 Hz |
| P85-motor prot. | no sensor |

### Normal state

In the normal state, the standard display is output to H1 (LCD panel).
During configuration, the standard display can be selected under P4-display if the inverter is in an error state, at this point the error number is displayed in the 1st line and a short text relating to the cause of the error is displayed in the 2nd line. In the event of an error, it is possible to switch back and forth between the error display and the standard display by means of the Enter key ➔.

## B 3.3 Special functions

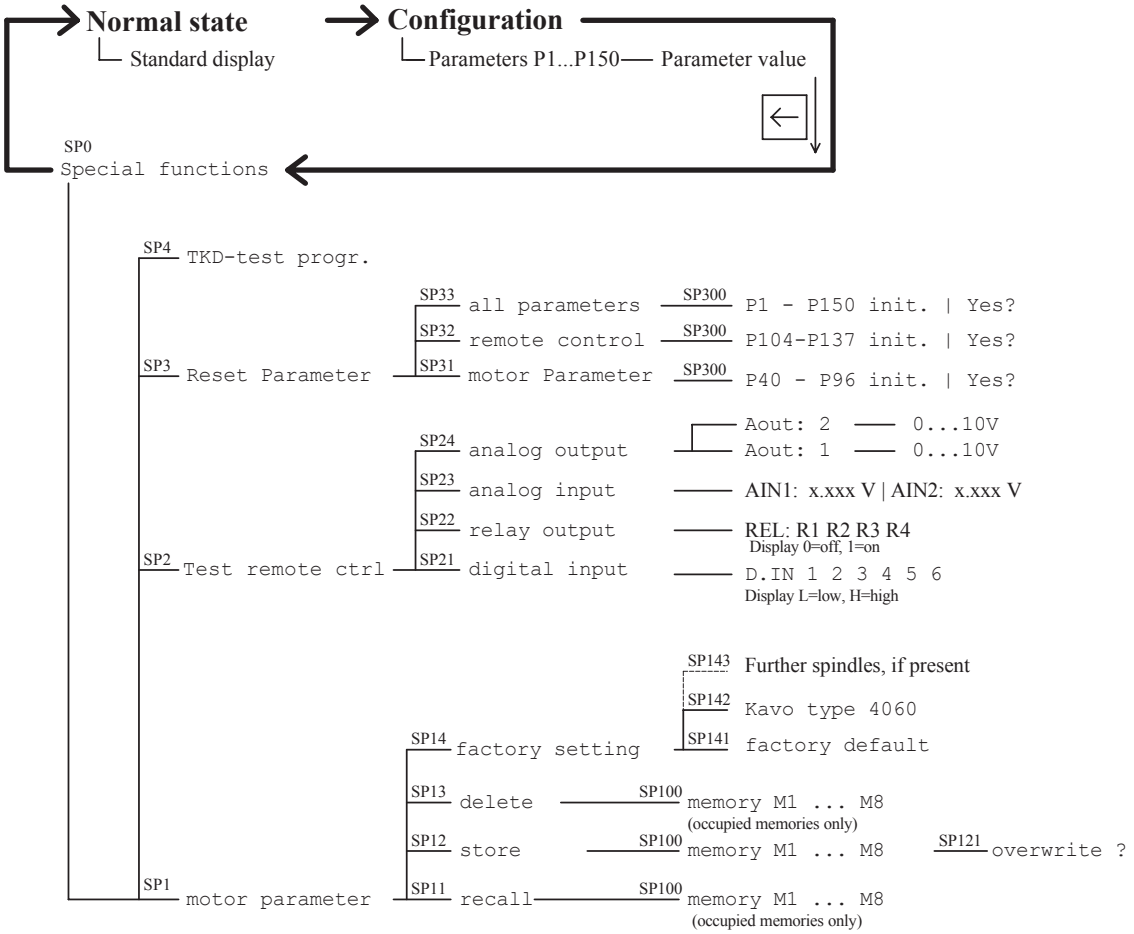
Under special functions, it is possible to establish the default state and to select various utility and test programs which serve as troubleshooting programs and repair aids for the customer and the Technical Customer Service (TKD).

### Contrast setting for LCD display

The contrast of the LCD display H1 can be set as follows:
Menu: Special functions / ↓ and ↑

| Keys | Display | Function |
|---|---|---|
| 1 x ← | P 1-x.. | |
| 1 x ← keep depressed | Special functions | |
| additionally ↕ | Special functions | Increase contrast |
| additionally ↓ | Special functions | Reduce contrast |

**Operation of the special functions:**
First select the menu option “Special functions” with key ← and call up with Enter key →. With the keys ↓ and ↑, select the desired menu entry and call up with the Enter key →. Select further submenus with the keys ↓ and ↑ and call up with Enter key →. Each special program can be exited with the Cancel key ← or you can jump back one level.




**Control keys**

- ENTER, selection, exit with saving
- Cancel, exit without saving
- Up, increase value, exit memory entry
- Down, decrease value, previous memory entry

### B 3.4 SP1 - Storing and recalling motor parameters

All motor-dependent parameters (P41 ... P96) can be stored in separate memories or recalled therefrom, 8 memory locations M1...M8 being available. The corresponding functions are accessible via the menus Special functions - motor parameters. See diagram in Section B 3.
First select the menu option “Special functions” with key ← and call up with Enter key →. Select the menu entry “Motor parameters” with the keys ↓ and ↑ and call up with Enter key →. Each special program can be exited with the Cancel key ←, the system jumping back in each case to the next highest menu level.

SP11 - `Special functions – motor parameter – recall – memory M1...M8`
The selected memory is loaded into the parameters P41 ... P96; these parameters are used for motor control. Only occupied memories can be recalled. If no memory is occupied, the recall function is not available.

SP12 - `Special functions – motor parameter – store – memory M1...M8`
The parameters P41 ... P96 are stored. If a memory is already occupied, you will be asked whether the memory is to be overwritten (SP121); the memory is overwritten using the Enter key → and the function is aborted without storing when the Cancel key ← is used.

SP13 - `Special functions – motor parameter – delete – memory M1...M8`
The memory is deleted. Only occupied memories can be deleted. If no memory is occupied, the delete function is not available.

SP14 - `Special functions – motor parameter – factory setting`
With this menu option, all motor-dependent parameters P41 ... P96 can be set to the factory setting or to various predefined motors.

SP141 - `Special functions – motor parameter – factory setting – factory default`
With this function, motor parameters P41 ... P96 are set to the factory setting. The configuration of the inverter P1 ... P8 and the configuration of the braking resistance and of the remote control P100 ... P150 remain unchanged.

SP142 - `Special functions – motor parameter – factory setting– KaVo type xxxx`
With this function, the motor parameters P41 ... P96 are preset to values for specific KaVo spnidles. Depending on use and operating point, the corresponding parameters must be adapted.

### B 3.5 SP2 - Test remote control

These functions serve for checking the function of the remote control at X4.

SP21 - `Special functions – test remote ctrl – digital input`
The state of the 6 inputs read in by the inverter is displayed, L representing low input voltage (0 V) and H high input voltage (24 V).

SP22 - `Special functions – test remote ctrl – relay output`
With this menu, the switching function of the relays can be checked. First, all 4 relays are switched on. The relay can be selected (Rx flashes) with the keys ↓ and ↑, and the corresponding relay can be switched with the Enter key →. The switching state is displayed as 0 (contact open) and 1 (contact closed).

SP23 - `Special functions – test remote ctrl – analogue input`
The voltages read in by the inverter at the inputs AIN1 and AIN2 are displayed.

SP24 - `Special functions – test remote ctrl – analogue output`
With this menu, the functioning of the outputs AOUT1 and AOUT2 can be checked.
First, the desired output is selected with the keys ↓ and ↑ and confirmed with the Enter key →. Now, the output voltage can be set with the keys ↓ and ↑, confirmation with the Enter key → being unnecessary.

### B 3.6 SP3 - Reset parameter to factory default

SP31 - `Special functions – reset paramter – motor parameter`
With this function, the motor parameters P41 ... P96 are set to the factory setting. After confirmation of the safety inquiry (SP300) with the Enter key ➔, the function is performed. The other parameters remain unchanged.

SP32 - `Special functions – reset parameter – remote control`
With this function, the parameters for the remote control P104 ... P137 are set to the factory setting, rendering the remote control inactive. After confirmation of the safety inquiry (SP300) with the Enter key ➔, the function is performed. The other parameters remain unchanged.

SP33 - `Special functions – reset parameter – all parameters`
With this function, all parameters P1 ... P150 are set to the factory setting. After confirmation of the safety inquiry (SP300) with the Enter key ➔, the function is performed. Stored motor parameters in the memories M1 ... M6 are retained.

### B 3.7 SP4 - TKD test programs

Various test programs for the KaVo Technical Customer Service are included under this menu option.

## B 3.8 Parameter list

This list includes all displayable and alterable parameters.

In the column Change display, the following abbreviations are used:
N = not alterable,
S = alterable only when motor stationary,
I = always alterable, even when motor running
M = display and alterability dependent on P90-motortype,
P = display only if P3-param level is set to parameter
* = display dependent on other parameters

| Par. No. | Indication in display | Description | Value range, physical value | Unit | Factory setting | Change display |
|---|---|---|---|---|---|---|
| | | **Basic parameters:** | | | | |
| P1 | f_rated | Frequency setpoint value control panel | 30... 3000 | Hz | 50 | I |
| P3 | Para level | Parameter level | Operation, configuration | - | Operation | I |
| P4 | Display | Standard display | Combi display, various values | - | Combidisp. | I |
| P5 | Language | Language of the menu texts | numerical, German, English | - | German | I |
| P6 | F_norm | Standardization factor for P24 | 0.01... 500.00 | - | 1.00 | I P |
| P7 | Select func. | Operation local, remote control | panel,remote control,parallel | - | Panel | I P |
| P8 | Speed displ | Selection Speed display | in Hz, in min-1 | - | in Hz | I P |
| | | **Display values** | | | | |
| P10 | f_rated_act | Current frequency setpoint value | 0...3000 | Hz | - | N |
| P11 | I_limit_act | Current current limit | 0.5....12 | A~ | - | N |
| P12 | f_rated_int | Frequency setpoint value after integrator | 0...3000 | Hz | - | N |
| P13 | f_out_act | Actual inverter frequency | 0..3000 | Hz | - | N |
| P14 | f_motor | Actual motor frequency | 0...3000 | Hz | - | N |
| P15 | V_motor | Output voltage | 0..250 | V~ | - | N |
| P16 | V_DC circ | Intermediate circuit voltage | 0..350 | V- | - | N |
| P17 | I_mot_app | Apparent motor current | 0..12 | A~ | - | N |
| P18 | I_mot_real | Real motor power | 0..12 | A~ | - | N |
| P19 | P_real | Real power | 0..2000 | W | - | N |
| P20 | motor code | Motor coding and motor memory | 1..8 | - | - | N |
| P24 | Norm value | Standardized display value | 0...1500000 | - | - | N |
| P25 | t_action | Operating hours counter | 0... 65000 | h | 0 | N |
| P26 | t_reset | Switch-on time from reset | 0... 65000 | min | 0 | N |
| P30 | 1st error | Last error | - | - | 0 | N |
| P31 | 2nd error | Penultimate error | - | - | 0 | N |
| P32 | 3rd error | Third-last error | - | - | 0 | N |
| P33 | 4th error | Fourth-last error | - | - | 0 | N |
| P34 | 5th error | Fifth-last error | - | - | 0 | N |
| P36 | Inverter | Inverter type | - | - | Type 4452 | N |
| P37 | SW panel | Firmware version of panel | - | - | - | N |
| P38 | SW mot cont | Firmware version of motor control | - | - | - | N |
| | | **Motor parameters:** | | | | |
| | | **Motor operating values** | | | | |
| P41 | f_mot_min | Min. motor frequency | 30... 100 | Hz | 50 | S P M |
| P42 | f_mot_max | Max. motor frequency | f_mot_nom, 101 ... 3000 | Hz | f_nom | S P |
| P43 | V_mot_max | Max. motor voltage phase-phase | V_mot_nom, 1 ...250 | V~ | V_nom | S P |
| P44 | I_limit | Current limitation (phase current) | 1.5 * I_mot_nom, 0,5...12 | A~ | 1,5*I_nom | I P |
| P46 | t_rise | Ramp time for run-up | 0.5... 400 | s | 5 | I P |
| P47 | t_fall | Ramp time for fall-down | 0.5... 400 | s | 5 | I P |
| P48 | t_stop | Ramp time for stop | DC brake, t_fall,0.,5..400 | s | t_fall | I P |
| P50 | Motor start | Start option, catch circuit | Normal, catch circuit | - | Normal | I P M |
| P51 | t_start | Start time for microstep operation | without ramp, 0.5 ... 100 | s | without ramp | I P M |
| P52 | I_start | Startup current microstep oper. BLDC | 0.4 ... 12 | A~ | 0.4 | I P M * |
| P53 | f_start | Startup frequency microstep operation | 1 ... 30 | Hz | 5 | S P M |
| P54 | t_off | Inverter switch-off time, startup | 200 ... 1000 | µs | 600 | S P M |
| P55 | t_DC_brake | DC brake time DC brake | off, 0.1... 120 | s | 2 | I P M |
| P56 | I_DC_brake | DC brake current DC brake | 0.1 ... 12 | A- | 1 | I P M * |
| P57 | I_DC_stop | DC stop current (at stop) | off, 0.1 ... 3 | A- | off | I P |
| P58 | emerg. stop | Select emergency stop at mains failure | inactive, on at mains failure | - | inactive | I P |
| P59 | speedsensor | Number of pulses at speed senor | no speed sensor, 1...10 | I/U | no sensor | S P M |

| Par. No. | Indication in display | Description | Value range, physical value | Unit | Factory setting | Change display |
|---|---|---|---|---|---|---|
| | | **U/f characteristic (ASM motor)** | | | | |
| P60 | V_boost | Startup voltage at f=0 | 3%V_nom, 1...50 | V~ | 3%V_nom | I P M |
| P61 | f1 | 1st characteristic point frequency | f_nom, 30... 3000 | Hz | f_nom | I P M |
| P62 | V1 | 1st characteristic point voltage | V_nom , 1... 250 | V~ | V_nom | I P M |
| P63 | f2 | 2nd characteristic point frequency | f_nom, 30... 3000 | Hz | f_nom | I P M |
| P64 | V2 | 2nd characteristic point voltage | V_nom, 1... 250 | V~ | V_nom | I P M |
| P65 | f3 | 3rd characteristic point frequency | f_nom, 30... 3000 | Hz | f_nom | I P M |
| P66 | V3 | 3rd characteristic point voltage | V_nom, 1... 250 | V~ | V_nom | I P M |
| | | **Control** | | | | |
| P70 | control | Control principle speed control | U/f,I*R,slip, speed | - | U/f-Tab. | I P M |
| P71 | I*R factor | I*R compensation gain factor | off, 0.1 ... 30 | V/A | off | I P M * |
| P72 | loadcomp | Load compensation gain factor | off, 0.1 ... 40 | %/A~ | off | I P M * |
| P73 | komp-t_filt | I*R and load compensation. Filter time | 1 ... 1000 | ms | 20 | I P M * |
| P75 | slipkomp | Slip compensation gain factor | off, 0.1 ... 10.0 | %/A~ | off | I P M * |
| P76 | slip-t_filt | Slip compensation filter time | 1... 1000 | ms | 20 | I P M * |
| P77 | I-limtr-KP | Current limitation P-component | 2 ... 200 | % | 40 | I P |
| P78 | I-limtr-t_n | Current limitation I-component reset time | 1 ... 999, without I-part | ms | 10 | I P |
| P79 | V-contr-KP | Voltage control V_WR P-component | 5...100 | % | 20 | I P |
| P80 | V-contr-t_n | Voltage control I-component reset time | 5 ... 999, without I-part | ms | 10 | I P |
| P81 | N-contr-KP | Speed control P-component | 5 ... 500 | % | 50 | I P M * |
| P82 | N-contr-t_n | Speed control I-component reset time | 5 ... 999, without I-part | ms | 250 | I P M * |
| P83 | N-contr-t_v | Speed control D-component derivative time | without D-part, 1...300 | ms | 30 | I P M * |
| P84 | N-contr-t_fil | Speed control T1-element for D-component | 1 ... 300 | ms | 200 | I P M * |
| | | **Monitoring** | | | | |
| P85 | motor prot. | Monitoring motor temperature | off, PTC, KTY | - | PTC | I P |
| P86 | R_protect | Resistance value for sensor KTY | 500...4000 | W | 1200 | I P * |
| | | **Rated motor data (according to rating plate)** | | | | |
| P90 | motortype | Motor design | ASM, BLDC, BLDCS | - | no motor | S P |
| P91 | f_mot_nom | Rated motor frequency | 30 ... 3000 | Hz | 50 | S P |
| P92 | V_mot_nom | Rated motor voltage | 0 ... 250 | V~ | 30 | S P |
| P93 | I_mot_nom | Rated motor current | 0.5 ... 8.0 | A~ | 1.0 | S P |
| P94 | cos phi | Cosine phi at nominal load | 20 ... 100 | % | 85 | S P |
| P96 | no.of poles | Number of poles | 2, 4, 6, 8 | - | 2 | S P |
| | | **Device parameters: ext. brake resistance** | | | | |
| P100 | R_ext_brake | Resistance of external brake resistor | internal, 27 ... 100 | ohm | internal | S P |
| P101 | P_ext_brake | Power of external brake resistor | 150 ... 1000 | W | 150 | S P * |
| | | **Motor coding** | | | | |
| P102 | motorcoding | Motor coding, number of motors | off, 2...4 motors | | off | S P |
| | | **Fixed frequencies** | | | | |
| P104 | fixfreq.FF1 | Fixed frequency FF1 (select with IN5,IN6) | 30 ... 3000 | Hz | 100 | I P |
| P105 | fixfreq.FF2 | Fixed frequency FF2 | 30 ... 3000 | Hz | 100 | I P |
| P106 | fixfreq.FF3 | Fixed frequency FF3 | 30 ... 3000 | Hz | 100 | I P |
| P107 | fixfreq.FF4 | Fixed frequency FF4 | 30 ... 3000 | Hz | 100 | I P |
| | | **Remote control:** | | | | |
| P110 | input IN1 | Function digital input IN1 | off, start/stop, start pulse | - | off | S P |
| P111 | input IN2 | Function digital input IN2 | off, stop, reset, FF, left | - | off | S P |
| P112 | input IN3 | Function digital input IN3 | see input DE2 | - | off | S P |
| P113 | input IN4 | Function digital input IN4 | see input DE2 | - | off | S P |
| P120 | relay REL1 | Function relay output REL1 | off, various status signals | - | f_rated. | I P |
| P121 | relay REL2 | Function relay output REL2 | see relay REL1 | - | overload | I P |
| P122 | relay REL3 | Function relay output REL3 | see relay REL1 | - | standstill | I P |
| P123 | relay REL4 | Function relay output REL4 | see relay REL1 | - | failure | I P |
| P125 | I_warning | var. current limit for relay output | 0.4...12 | A~ | 0.4 | I P |
| P130 | analog AIN1 | Function analogue input AIN1 | off, rated frequency | - | off | S P |
| P131 | analog AIN2 | Function analogue input AIN2 | off, torque | - | off | S P |
| P132 | analog Aou1 | Function analogue output AOUT1 | off, various values | - | I_mot_real | S P |
| P133 | analog Aou2 | Function analogue output AOUT2 | off, various values | - | f_mot | S P |
| P135 | f_rem_min | min. rated freq. of analogue input | 0.. 3000 | Hz | 0 | I P |
| P136 | f_rem_max | max. rated freq. of analogue input | 0.. 3000 | Hz | 3000 | I P |
| P137 | f_stop_ana | Stop via analogue signal | off, 1... 3000 | Hz | off | I P |
| P150 | End | End mark | - | - | - | |

## B 3.9 Description of the individual parameters

The square brackets [ ] behind the entries indicate the numerical value; this is displayed numerically in the operating language (see P5-Language). If a natural language (German, English ...) is chosen, the corresponding text appears instead.

## B 3.10 Basic parameters

P1-f_rated
Rated frequency value (speed preselection) for the motor (input on control panel).
By means of parameter P8-speed displ, this parameter can be changed from frequency display to speed display. The number of motor poles P96-no. of poles is taken into account. Here, only values between the min. frequency P41-f-mot-min and the max. frequency P42-f-mot-max can be set.
Minimum value: 30 Hz
Maximum value: 3000 Hz
Factory setting: 50 Hz

P3-para level
Indicates the operating state
Values: [0] Operation - only basic and display values (P1...P39) are accessible.
[1] Parameter - all parameters P1 to P150 are accessible
Factory setting: [0] Operation

P4-display
Selection of the standard display in the normal state
Values: [0] Combi display - Combination display consisting of actual motor values P14-f_motor, P15-V_motor and P17-i_mot app
[1] f_out_act - Inverter output frequency (P13-f_out_act)
[2] V_motor - Voltage at motor (P15-V_motor)
[3] I_mot_app - Apparent current through motor (P17-I_mot_app)
[4] I_mot_real - Real current through motor (P18-I_mot_real)
[5] V circ - Voltage at intermediate circuit (P16-V_circ)
[6] P_real - Real power (P19-P_real)
[7] Norm_value - Standard factor * output frequency (P6-F_norm * P13-f_off_act)
Factory setting: [0] Combi display

P5-language
Selection of the language which is to be used for operation
Values: [0] numerical - only numerical display without text information
[1] German
[2] English
Factory setting: [1] German

P6-F_norm
Determination of the factor for the standard value display (norm_value = P6-F_norm * P13-f_off_act). This factor is evaluated only if P4-display is set to norm_value. With the standard value display, the output frequency can be converted into a process variable via the standard factor and can be displayed. A display in, e.g. m/s can thus be shown.
Minimum value: 0.01
Maximum value: 500.00
Factory setting: 1.00

P7-Select func
Selection of the source from which the inverter is to be operated with start/stop, setpoint speed value and torque limitation. The digital and analogue output values are always output independently of the setting.

Values: [0] Panel
-Operation is via the control panel. The digital and analogue levels at the remote control X4 are not taken into account.
[1] Remote control.
Start⊙, Stop ○ and P1-f_rated of the control panel are disabled. The parameters P104 ... P136 for remote control should be set accordingly.
[2] Parallel
-Start/Stop can be operated in parallel by the remote control and via the control panel. If Start/Stop is configured via the remote control, the keys Start ⊙ and Stop ○ on the control panel are active only as long as they are kept depressed. Alternatively, the parameter P1-f_rated, the analogue input AIN1 or a fixed frequency is used as the setpoint speed value, depending on figuration. The parameters P104 ... P136 should be set accordingly. (See Section A4.6)
Factory setting: [0] Panel

P8-Speed displ
Selection of the display for rated and actual motor speeds, in Hz or in $min^{-1}$, the conversion of the frequency into the speed is performed by the following formula:
Speed = frequency * 60 / number of poles/2 of the motor (P96-no. of poles).
The parameters of the rated values P1-f_rated, P10-f_rated_act, P12-f_rated_int, the actual motor speed P14-f_motor and the fixed frequencies P104-fixfreq.FF1 ... P107- fixfreq.FF4 of the remote control and the frequency limits for the analogue setpoint value input P135-f_rem_min, P136-f_rem_max are effected.

Values: [1] in Hz - the display is in Hz
[2] in min-1 - the display is in $min^{-1}$ (revolutions per minute)
Factory setting: [1] in Hz

### B 3.11 Display values

P10-f_rated_act (display value)
The valid rated speed value can originate from various sources depending on configuration (panel, remote control analogue input, remote control fixed frequency input). The currently valid value, i.e. the value transmitted to the motor control, is displayed for the user via parameter P10.
By means of parameter P8-speed displ, this parameter can be changed from frequency display to speed display, the number of motor poles P96-no. of poles being taken into account.

P11-I_limit_act (display value)
The valid torque limitation may originate from two sources depending on configuration (panel P48-I_limit or remote control AIN2). The currently valid value, i.e. the value transmitted to the motor control, is displayed for the user via the parameter P11.

P12-f_rated_int (display value)
f_rated_int is the setpoint speed value present after the ramp integrator, and this value may be limited to the maximum output frequency P42-f_mot_max (see error description No.13)
By means of parameter P8-speed displ, this parameter can be changed from frequency to speed display, the number of motor poles P96-no. of poles being taken into account.
The value is updated every 500 ms.

P13-f_out_act (display value)
f_out_ist is the current output frequency of the inverter (inverter frequency).
The value is updated every 500 ms.

P14-f_motor (display value)
f_motor is the current motor frequency and differs from the inverter frequency (P13) only in the case of an ASM motor if the control (P70-control) is set to slip or speed control. In all other cases and for BLDC and BLDCS motors this parameter is the same as the output frequency (P13-f_out_act).
By means of parameter P8-speed displ, this parameter can be changed from frequency display to speed display, the number of motor poles P96-no. of poles being taken into account.
The value is updated every 100 ms.

P15-V_motor (display value)
V_motor is the current motor voltage between two phases and is measured using a real-time converter.
The value is updated every 250 ms.

P16-V_DC_circ (display value)
V_DC_circ is the current intermediate circuit voltage.
The value is updated every 500 ms.

P17-I_mot_app (display value)
I_mot_app is the current apparent motor voltage in phase U and is measured using a real-time converter. The value is updated every 500 ms.

P18-I_mot_real (display value)
I_mot_real is the current real motor current in a phase.
The value is updated every 250 ms.

P19-P_real (display value)
P_real is the current inverter output power, corresponding to the real power consumed by the motor.
The value is updated every 500 ms.

P20-motor code (display value)
Motor code is the current motor coding which is present at X7.4 and X7.5. In addition, the currently used motor parameter memory M1...M6 is displayed. If the parameters from the memory have been changed, the display of the memory is not present.
Example: "C2 – memory M2" motor coding value 2, memory M2 used.
The value is updated every 50 ms.

P24-norm value (display value)
Standard value is P13-f_out_act * P6-F_norm.
The value is updated every 500 ms.

P25-t_action (display value)
t_action shows the total operating hours of the device in hours.
The value is read in from the EEPROM.

P26-t_reset (display value)
t_reset shows the time since the last reset after an error in minutes.
The value is read in from the EEPROM.

P30-1st error (display value)
1st error shows the error number of the last error which occurred.
The value is read in from the EEPROM.

P31-2nd error (display value)
2nd error shows the error number of the penultimate error which occurred.
The value is read in from the EEPROM.

P32-3rd error (display value)
3rd error shows the error number of the third-last error which occurred.
The value is read in from the EEPROM.

P33-4th error (display value)
4th error shows the error number of the fourth-last error which occurred.
The value is read in from the EEPROM.

P34-5th error (display value)
5th error shows the error number of the fifth-last error which occurred.
The value is read in from the EEPROM.

P36-Inverter (display value)
Inverter shows the inverter type (KaVo type 4452).

P37-SW panel (display value)
SW panel shows the software version and the date of the operating software.

P38-SW mot.cont (display value)
SW mot.cont shows the software version and the date of the motor control software.

### B 3.12 Motor operating values

These parameter values are displayed depending on the chosen motor type. The assignment to the individual motor types is shown in square brackets.

P41-f_mot_min [ASM, -, -]
Absolutely minimum inverter frequency, set internally to 0 in the case of BLDC and BLDCS motors. In ASM motor, serves for establishing the lower limit of the inverter frequency.
Minimum value: 30 Hz
Maximum value: 100 Hz
Factory setting: 50 Hz

P42-f_mot_max [ASM, BLDC, BLDCS]
Absolutely maximum inverter frequency. The output frequency of the inverter is limited to this value to protect the motor.
This value is set to the maximum rated frequency in the case of ASM motors; in the case of BLDC and BLDCS motors, this value should be set about 10% higher than the maximum rated frequency. In addition, this parameter must be set larger than P41_f_mot_min
Specific values: [100] f_mot_nom
-f_mot_max is taken from the nominal motor frequency P91-f_mot_nom
Minimum value: 101 Hz
Maximum value: 3000 Hz
Factory setting: [100] f_mot_nom (see P91)

P43-V_mot_max [ASM, BLDC, BLDCS]
Maximum motor voltage between two phases, serves for protecting the motor from excessively high voltages. The inverter output voltage is limited to this value.
Specific values: [0] V_mot_nom
- V_mot_max is taken from the nominal motor voltage P92-V_mot_nom
Minimum value: 1 V
Maximum value: 250 V
Factory setting: [0] V_mot_nom (see P92)

P44-I_limit [ASM, BLDC, BLDCS]
Limitation of phase current for normal motor running. The inverter limits the output current to I_limit.
The stop current (P57-I_DC_stop) and, in the case of the BLDC motor, the startup current (P52-I_start) are unaffected by this.
Specific values: [0.4] 1.5*I_nom - I_limit is set to 1.5 times the nominal motor current from P93-I_mot_nom.
Minimum value: 0.5 A
Maximum value: 12 A
Factory setting: [0.4] 1.5*I_nom (see P93-I_mot_nom)

P46-t_rise [ASM, BLDC, BLDCS]
Rise time of frequency 0 to P42-f_mot_max
The rise time is effective at motor start and in the case of changes of nominal frequency. If the rise time is set too small, the motor current increases up to the current limit P44-I_limit, thus automatically increasing the rise time.
Minimum value: 0.5 sec
Maximum value: 400 sec
Factory setting: 5 sec

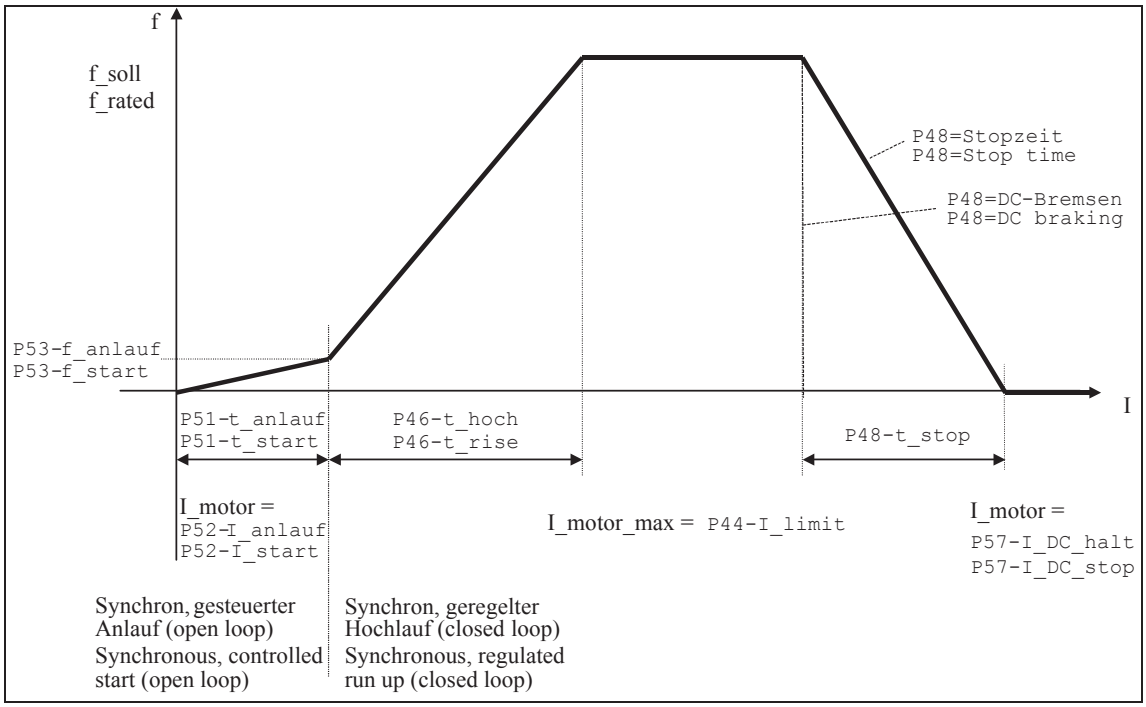
P47-t_fall [ASM, BLDC, BLDCS]
Delay from P42-f_mot_max to frequency 0.
The delay is effective in the case of changes of nominal frequency and in the case of a motor stop only if P48-t_stop is set to t_fall.
Minimum value: 0.5 sec
Maximum value: 400 sec
Factory setting: 5 sec

P48-t_stop [ASM, BLDC, BLDCS]
Stop delay time from P42-f_mot_max to frequency 0. The inverter reduces its frequency after the specified ramp, and the motor operates as a generator. The rotational energy is converted into heat in the brake resistance. The stop time is effective only at a motor stop, after which DC braking is also performed (see P55-t_DC_brake and P56-I_DC_brake).
If t_stop is set too short, the inverter limits the generator current to the value of P44-I_limit and the actual stop time of the motor automatically increases but vibrations may occur during the braking process.
Specific values: [0,3] DC-brake
- At stop, the system switches directly to DC brake, there is no generator braking and the total rotational energy is converted into heat in the rotor.
[0.4] t_fall
- t_stop is set internally as the delay (P47-t_fall).
Minimum value: 0.5 sec
Maximum value: 400 sec
Factory settting: [0.4] t_fall (see P47-t_fall)

P50-motor start [ASM]
Motor start influences the start behaviour of the ASM motors. The catch circuit prevents an overcurrent if the inverter is switched to the running motor. The inverter starts at the maximum motor frequency P42-f_mot_max and reduces its frequency until the inverter frequency has adapted to the motor frequency. This process takes not more than 1 second.
Values: [0] Normal
-Normal motor start from the frequency P41-f_mot_min, no catch circuit.
[1] Catch power on
- The catch circuit is active only when the inverter knows **nothing** about the actual motor speed, for example after power on and reset, unless a speed sensor is used. If the motor was braked via the generator brake, the next motor start takes place without a catch circuit. If the motor is braked only via the DC brake (P48-t_stop = DC-brake), the catch circuit is active at every motor start.
[2] Catch always
- Catch circuit active at every motor start
Factory setting: [0] Normal

P51-t_start [-, BLDC, -]
Startup time for microstep startup in BLDC motor from 0 Hz to P53-f_start.
With t_start > 0.5 sec sind, P52-I_start and P53-f_start must also be input.
In the case of the microstep startup, the BLDC motor is operated as a synchronous motor with constant current (P52-I_start) . The output frequency is slowly increased from 0 to the start frequency (P53-f_start), after which the system switches to controlled motor running with e.m.f. measurement. In the case of small centrifugal masses, the start ramp can be switched off or shorter times set. In the case of larger centrifugal masses, longer times should be set.
Specific values: [0.4] without ramp - microstep startup ramp switched off
Minimum value: 0.5 sec - start up with microstep startup ramp

Maximum value: 100 sec
Factory setting: [0.4] without ramp

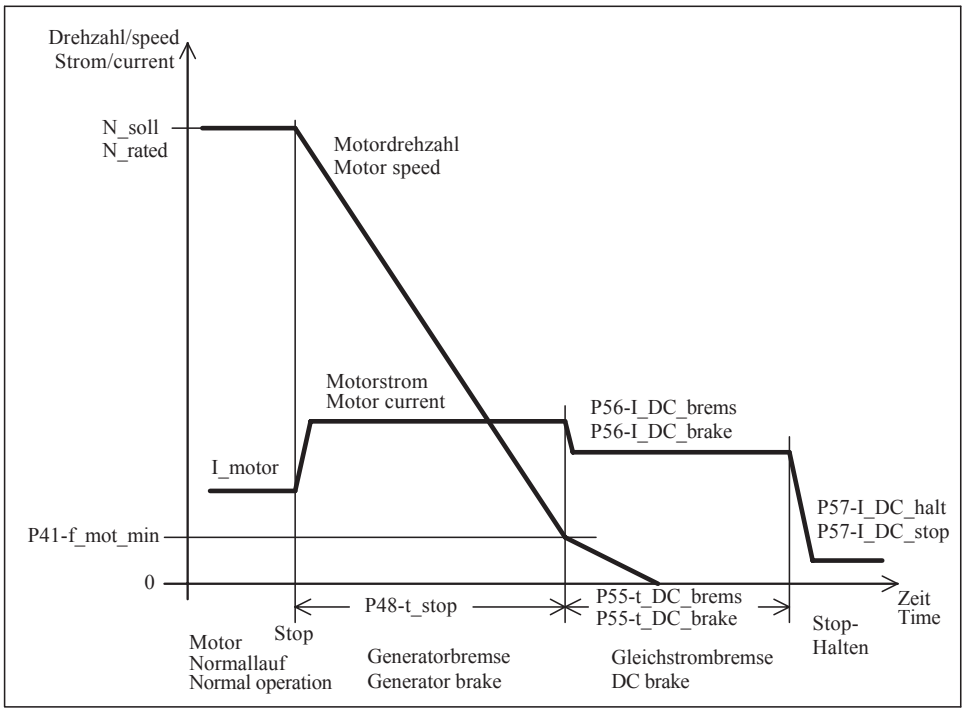



P52-I_start [-, BLDC, -]
Startup current for microstep startup, can be selected only if P51-t_start > 0. Low currents should be set for a soft and quiet start and higher currents for fast start and larger centrifugal masses.
Minimum value: 0.4 A
Maximum value: 12 A
Factory setting: 0.4 A

P53-f_start [-, BLDC, -]
Startup frequency for microstep startup. If P51-t_start is set to [0.4] without ramp, the motor start begins at the frequency f_start; if a ramp time is set in P51-t_start, the startup begins at frequency 0 and is slowly increased up to f_start. On reaching the start frequency, the microstep startup is terminated. If the motor does not start up reliably, f_start should be increased.
Minimum value: 1 Hz
Maximum value: 30 Hz
Factory setting: 5 Hz

P54-t_off [-, BLDC, -]
Switch-off time of the inverter.
In the microstep startup, the inverter is repeatedly switched off briefly in a cyclic manner in order to measure the e.m.f. voltage of the BLDC motor; this is used for detecting the position of the rotor at low speeds. In the case of larger inductances of the motor winding, longer times should be set.
**Setting rule:** If the BLDC motor starts up poorly or synchronizes poorly with the motor, longer times should be set; it may also be necessary to increase the startup frequency in P53-f_start.
Minimum value: 200 µs
Maximum value: 1000 µs
Factory setting: 600 µs

P55-t_DC_brake [ASM, -, -]
Time for DC brake in ASM motor,
0 = no DC brake. If this parameter is set to values > 0, P56-I_DC_brake should also be set.
Specific values: [0] DC-brake off - There is no DC braking
Minimum value: 0.1 sec
Maximum value: 120 sec
Factory setting: 2 sec




Bremsvorgang ASM-Motor
Braking process for ASM motor

P56-I_DC_brake [ASM, -, -]
Current for DC brake in ASM motor, displayed only if P55-t_DC_brake is not set to off.
Minimum value: 0.1 A
Maximum value: 12 A
Factory setting: 1 A

P57-I_DC_stop [ASM, BLDC, BLDCS]
Stop current, this current flows in the stopped motor through 2 phases; the 3rd motor phase is currentless and the motor is thus braked (ASM motor) or is kept in a defined position (BLDC or BLDCS motor).
Specific values: [0] Off - With stopped motor, no stop current is output
Minimum value: 0.1 A
Maximum value: 3 A
Factory setting: [0] Off

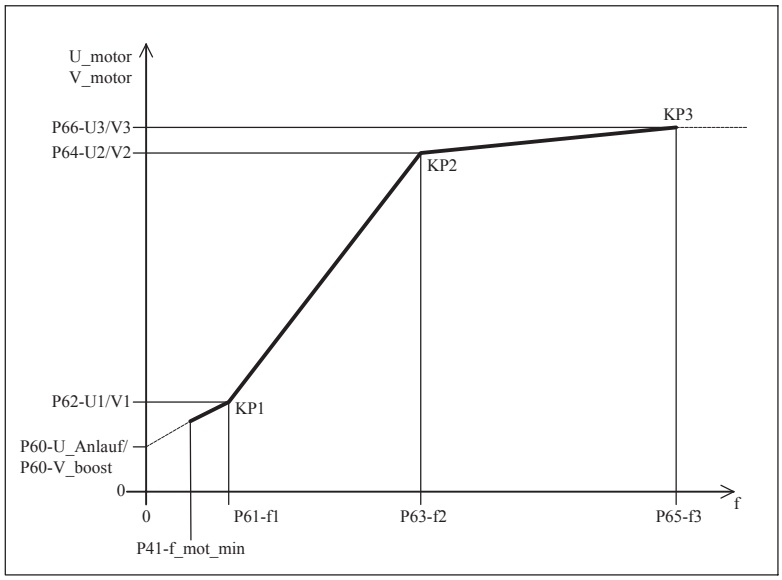
P58-emerg. stop [ASM, BLDC, BLDCS]
Parameter influences the behaviour on mains failure.
Values: [0] off
- At mains failure, the motor runs out freely and there is no braking.
[1] On
- The motor is braked with maximum power of the brake resistance as long as the inverter can still supply itself from the motor voltage.
Factory setting: [0] off

P59-speedsensor [ASM, - , -]
Number of pulses of the speed sensor for the ASM motor.
Specific values: [0] No sensor
- The speed sensor input at X7.3 is inactive. If P70-control is set to speed control, the speed sensor cannot be switched off since it is required for speed control. If P102-motorcoding is set to more than 4 motors, no speed sensor can be used since both functions share the input H1 (X7.3) and setting of P102 is then not possible. Motor coding for up to 4 motors and speed sensors can be used simultaneously.
Minimum value: 1 pulse / revolution
Maximum value: 10 pulses / revolution
Factory setting: [0] No sensor

**Motor U/f-characteristic [ASM, -, -]**
The voltage/frequency table describes the key points of the motor voltage at specific frequencies for the ASM motor.
With the factory setting, characteristic points KP1... KP3 are set to the nominal frequency and the nominal voltage of the motor.

⚠

*With input from the table, the following must be noted:*
■ *The frequencies must be equal or must increase in the sequence f1, f2 and f3.*
*(*P61-f1 <= P63-f2 <= P65-f3*)*
■ *For identical frequencies, the voltage too must be identical (if e.g.* P61-f1 = P63-f2, P62-U1 *must also be equal to* P64-U2*)*
■ *If one of the above-mentioned conditions is infringed, a brief warning message is obtained and the value input continues and can be terminated with the ← key.*
■ *In the case of nominal frequencies which are higher than the highest frequency in the table,* P66-U3 *is assumed as the voltage.*
■ *In the event of input difficulties, make the input in the sequence P66...P60.*



P60-V_start [ASM, - -]
U/F-characteristic: Startup voltage at frequency zero.
The minimum frequency to be output by the inverter is specified in P41-f_mot_min, and the output voltage at this frequency is calculated using the U/F characteristics.
Specific values [0] 3%_V_nom
- the startup voltage at f=0 is set internally to the value of 3% of the rated motor voltage from P92-V_mot_nom.
Minimum value: 1 V
Maximum value: 50 V
Factory setting: [0] 3%_V_nom

P61-f1 [ASM, - -]
U/f-characteristic: Frequency of characteristic point KP1
Specific values: [29] f_nom
- the value of the nominal motor frequency from P91-f_mot_nom is used
Minimum value: 30 Hz
Maximum value: 3000 Hz
Factory setting: [29] f_nom

P62-U1 [ASM, - -]
U/f-characteristic: Voltage of characteristic point 1
Specific values: [0] V_nom
- the value fo the rated motor voltage from P92-V_mot_nom is used
Minimum value: 1 V
Maximum value: 250 V
Factory setting: [0] V_nom

P63-f2 [ASM, - -]
U/f-characteristic: Frequency of characteristic point KP2
Specific values: [29] f_nom
- the value of the nominal motor frequency from P91-f_mot_nom is used
Minimum value: 30 Hz
Maximum value: 3000 Hz
Factory setting: [29] f_nom

P64-V2 [ASM, - -]
Specific values: [0] V_nom
- the value of the rated motor voltage from P92-V_mot_nom is used
Minimum value: 1 V
Maximum value: 250 V
Factory setting: [0] V_nom

P65-f3 [ASM, - -]
U/f-characteristic: Frequency of characteristic point KP3
Specific values: [29] f_nom
- the value of the rated motor frequency from P91-f_mot_nom is used
Minimum value: 30 Hz
Maximum value: 3000 Hz
Factory setting: [29] f_nom

P66-V3 [ASM, - -]
U/f-characterstic: Voltage of characteristic point KP3
Specific values: [0] V_nom
- the value of the rated motor voltage from P92-V_mot_nom is used
Minimum value: 1 V
Maximum value: 250 V
Factory setting: [0] V_nom

### B 3.13 Control

P70-control [ASM, -, -]
Selection of the speed control for ASM motors
Values: [0] U/f table
- Voltage control via U/f table, no rise
[1] -I*R-load-comp.
- I*R and load compensation, the motor voltage is adapted as a function of the load. The parameters P71-I*R-factor, P72-loadcomp and P73-comp-t_filt should be set.
[2] -Slip + I*R
- Slip compensation with I*R and load compensation, the output frequency of the inverter is increased with increasing load and the motor voltage is also adapted as a function of the load. The parameters P71-I*R-factor, P72-Loadkomp, P73-Komp-t_filt, P75-slipkomp and P76-slip-t_filt should be set.
[3] N-control + I*R
- The ASM motor is controlled via a speed control; a speed sensor must be connected at X7 for this purpose and the parameter P59-speedsensor must be set appropriately beforehand. An I*R and load compensation is applied to the speed control. The parameters P71-I*R-factor, P72-Loadkomp, P73-Komp-t_filt, P81-N-contr-KP , P82-N-contr-t_n , P83-N-contr-t_v and P84-N-con-t_fil should be set.
Factory setting: [0] U/f table

P71-I*R-factor [ASM, -, -]
Factor of the I*R compensation, the inverter output voltage is adapted as a function of the motor load.
The aim of the I*R compensation is to keep the magnetic flux in the motor constant. The I*R compensation is effective in particular at low speeds or low voltages, and the speeds decrease less sharply under load. The I*R factor corresponds to the ohmic resistance of the motor, measured between two motor cables.
ΔU = P71-I*R-factor * (P18-I_mot_real - (P93-I_mot_nom * P94-cos phi)
V_mot = U_table + ΔU
U_table corresponds to the U/f table voltage, calculated from the values P60...P66
Specific values: [0] off - I*R compensation switched off
Minimum value: 0.1 V/A (slight rise)
Maximum value: 30 V/A
Factory setting: [0] off

P72-Loadkomp [ASM, -, -]
Factor of the load compensation, the inverter output voltage is adapted as a function of the motor load.
With the load compensation, it is possible to ensure that the motor consumes only little current during idling (little heating up) but that the magnetization current is appropriately increased under load. This makes it possible to reduce the heating up of the motor, and the speed decrease in the load is smaller. The load compensation is applied in particular at medium and high speeds or voltages and supplements the I*R compensation.
ΔU = U_table * P72-Loadkomp * (P18-I_mot real - (P93-I_mot_nom * P94-cos phi)
V_mot = U table + ΔU
U_table corresponds to the U/f table voltage, calculated from the values P60...P66
Specific values: [0] off - Load compensation switched off
Minimum value: 0.1 %/A (slight rise)
Maximum value: 40 %/A (very sharp rise)
Factory setting: [0] off

P73-komp-t_filt [ASM, -, -]
Filter time of the I*R and load compensation
This makes it possible to influence the rapidity of the I*R and load compensation. If the motor tends to vibrate under load, higher values should be set.
Minimum value: 1 ms
Maximum value: 1000 ms
Factory setting: 20 ms

P75-slipkomp [ASM, -, -]
In the case of asynchronous motors, the fact that the actual speed deviates from the nominal speed under load is disadvantageous and is caused by the motor slip. Depending on the dimensioning of the motor, the slip is up to 10% at nominal load.
As a result of the slip compensation, the inverter increases the output frequency as a function of real motor current according to the following formula:
Δf = P75-slipkomp * (P18-I_mot_real - (P93-I_mot_nom * P94-cos phi)
f_off = P10-f_nom_int + Δf
Specific values: [0] off - slip compensation switched off
Minimum value: 0.1 %/A
Maximum value: 10.0 %/A
Factory setting: [0] off

P76-slip-t_filter [ASM, -, -]
Filter time of the slip compensation.
This makes it possible to influence the rapidity of the slip compensation.
If the motor tends to vibrate, higher values should be set.
Minimum value: 1 ms
Maximum value: 1000 ms
Factory setting: 20 ms

P77-I-limtr-KP [ASM, BLDC, BLDCS]
Only in special cases should this parameter be changed from the factory setting.
P77-I-limtr-KP influences the control (PI) for the motor current limitation, it being possible to set the gain (proportional part) here.
Minimum value: 2 %
Maximum value: 200 %
Factory setting: 40 %

P78-I-limtr-t_n [ASM, BLDC, BLDCS]
Only in special cases should this parameter be changed from the factory setting.
P78-I-limtr-t_n influences the control (PI) for the motor current limitation, it being possible to set the reset time (I-part) here. Longer times make the control slower. If the times are too short, the current control tends to oscillate.
Specific values: [1000] without I-part - I-part is switched off
Minimum value: 1 ms
Maximum value: 999 ms
Factory setting: 10 ms

P79-V-contr-KP [ASM, BLDC, BLDCS]
Only in special cases should this parameter be changed from the factory setting.
P79-V-contr-KP influences the control (PI) for the internal intermediate circuit voltage, it being possible to set the gain (proportional part) here. The motor voltage is generated from the intermediate circuit voltage by the inverter.
Minimum value: 5 %
Maximum value: 100 %
Factory setting: 20 %

P80-V-contr-t_n [ASM, BLDC, BLDCS]
Only in special cases should this parameter be changed from the factory setting.
P80-V-contr-t_n influences the control (PI) for the internal intermediate circuit voltage, it being possible to set the reset time (integral part) here. Longer times make the control slower.
Specific values: [1000] without I-part - I-part is switched off
Minimum value: 5 ms
Maximum value: 999 ms
Factory setting: 10 ms

P81-N-contr-KP [ASM, BLDC, BLDCS]
This parameter influences the control (PID) for the motor speed, it being possible to set the gain (proportional part) here.
Minimum value: 5 %
Maximum value: 500 %
Factory setting: 50 %

P82-N-contr-t_n [ASM, BLDC, BLDCS]
This parameter influences the control (PID) for the motor speed, it being possible to set the reset time (integral part) here. Shorter times make the control faster and longer times make it slower.
Specific values: [1000] without I-part - I-part is switched off
Minimum value: 5 ms
Maximum value: 999 ms
Factory setting: 250 ms

P83-N-contr-t_v [ASM, BLDC, BLDCS]
This parameter influences the control (PID) for the motor speed, it being possible to set the derivative time (D-part) here. Longer times make the control faster and shorter times make it slower.
Specific values: [0] without D-part - D-part switched off
Minimum value: 1 ms
Maximum value: 300 ms
Factory setting: 30 ms

P84-N-contr-t_fil [ASM, BLDC, BLDCS]
This parameter influences the control (PID) for the motor speed, it being possible to set the filter before the D-part here. The filter makes the D-part smoother and slightly slower. In the case of longer times, the tendency of the D-part to oscillate is damped.
Minimum value: 1 ms
Maximum value: 300 ms
Factory setting: 200 ms

### B 3.14 Monitoring

P85- motor prot. [ASM, BLDC, BLDCS]
The temperature of the motor can be monitored with various sensors, and the sensor type should be set here.
Values: [0] no sensor
- there is no temperature monitoring of the motors
[1] PTC
- Positive temperature coefficient sensor (according to DIN 44081) with fixed switching thresholds, the cut-out temperature is determined by the sensor itself.
[2] KTY
- Analogue semiconductor sensor, the swiching threshold can be set with P86-R_protect
Factory setting: [0] no sensor

P86-R_protect [ASM, BLDC, BLDCS]
Resistance value of the KTY sensor at the cut-out point, selectable only if P85-motor prot. is set to KTY.
Minimum value: 500 Ω
Maximum value: 4000 Ω
Factory setting: 1200 Ω

### B 3.15 Nominal motor values

In this section, the nominal data of the connected motor should be input.
The nominal data are shown on the rating plate or the data sheet.

P90-motortype [ASM, BLDC, BLDCS]
Input of motor design.
Values: [0] no motor - no motor defined
[1] ASM - three-phase asynchronous motor
[2] BLDC - brushless DC motor without sensors
[3] BLDCS - brushless DC motor with sensors (not in series version)
Factory setting: [0] no motor

P91-f_mot_nom [ASM, BLDC, BLDCS]
Nominal motor frequency according to rating plate in Hertz.
Minimum value: 30 Hz
Maximum value: 3000 Hz
Factory setting: 50 Hz

P92-V_mot_nom [ASM, BLDC, BLDCS]
Rated motor voltage according to rating plate.
Minimum value: 0 V
Maximum value: 250 V
Factory setting: 30 V

P93-I_mot_nom [ASM, BLDC, BLDCS]
Rated motor current (apparent current in one phase) according to rating plate.
Minimum value: 0.5 A
Maximum value: 8.0 A
Factory setting: 1.0 A

P94-cos phi [ASM, BLDC, BLDCS]
Motor power factor cosine phi according to rating plate.
Minimum value: 20 %
Maximum value: 100 %
Factory setting: 85 %

P96-no. of poles [ASM, BLDC, BLDCS]
Number of poles in the motor. This parameter is used for speed display in $min^{-1}$.

*Note that the number of poles and not the number of pole pairs should be input here.*

Minimum value: [2] 2 poles
Maximum value: [8] 8 poles
Factory setting: [2] 2 poles

### B 3.16 Device parameters, remote control

P100-R_ext_brake

Resistance value of the external brake resistance at X6.
The value of the external brake resistance must be in the range from 27 to 100 W, and P101-P_ext_brake should also be set for this purpose. The resistor should be connected to terminal X6.1-3 and the bridge at X6.2-3 should be removed.
If P100 is set to internal, the internal brake resistance (80W) is active, and a bridge should be connected at X6.2-3.
Parallel operation of internal and external brake resistances is not possible.
Specific values: [26] internal - the internal brake resistance is used
Minimum value: 27 Ω
Maximum value: 100 Ω
Factory setting: [26] internal

P101-P_ext_brake

Power of the external brake resistance at X6,
can be selected only if P100-R_ext_brake is not set to internal.
Minimum value: 150 W
Maximum value: 1000 W
Factory setting: 150 W

P102-motorcoding

By means of this parameter, the motor coding is switched on and the number of motors used is input (see Section A4.5 Motor coding). A setting to 5...8 motors is possible only if no speed sensor is used, since both functions share the input H1 (X7.3) (see P59-speedsensor).
Only the coding inputs H1...H3 actually required are evaluated.

| Value | Display | Function | Coding inputs used H1(X7.3) | H2(X7.4) | H3(X7.5) |
|---|---|---|---|---|---|
| [1] | Motorcode OFF | - Motor code switched off | - | - | - |
| [2] | 2 motors M1-M2 | - Coding with 2 motors | - | x | - |
| [3] | 3 motors M1-M3 | - Coding with 3 motors | - | x | x |
| [4] | 4 Motors M1-M4 | - Coding with 4 motors | - | x | x |
| [5] | 5 Motors M1-M5 | - Coding with 5 motors | x | x | x |
| [6] | 6 Motors M1-M6 | - Coding with 6 motors | x | x | x |
| [7] | 7 Motors M1-M7 | - Coding with 7 motors | x | x | x |
| [8] | 8 Motors M1-M8 | - Coding with 8 motors | x | x | x |

P104-fixfreq.FF1

Value of the fixed frequency FF1 which can be selected via the remote control.
By means of parameter P8-speed disp, this parameter can be changed from frequency display to speed display, the number of motor poles P96-no. of poles being taken into account.
Minimum value: 30 Hz
Maximum value: 3000 Hz
Factory setting: 100 Hz

P105-fixfreq.FF2

Value of fixed frequency FF 2
Minimum value: 30 Hz
Maximum value: 3000 Hz
Factory setting: 100 Hz

P106-fixfreq.FF3

Value of fixed frequency FF3
Minimum value: 30 Hz
Maximum value: 3000 Hz
Factory setting: 100 Hz

P107-fixfreq.FF4

Value of fixed frequency FF4
Minimum value: 30 Hz
Maximum value: 3000 Hz
Factory setting: 100 Hz

P110-input IN1
Function of the digital input IN1
Values: [0] off
- Input has no function
[1] run/stop
- U_high = run, U_low = stop
[2] run
- Pulse at U_high = run, after which the input can return to U_low, the inverter remaining in the started state. The pulse must be at least 60 ms long. For stopping, an input (P111-input IN2 ... P113-input IN4) should be configured for stop.
Factory setting: [0] off

P111- input IN2
Function of the digital input IN2
Values: [0] off
- Input has no function
[1] stop
- Motor stop (V_high = stop, V_low = run enable)
[2] Reset
- Reset (pulse at V_high = trigger reset)
[3] fixfreq. on
- Current nominal speed value is a fixed frequency, and the input must be high for this purpose. This selection of the fixed frequency FF1...FF4 is performed by inputs IN5 and IN6. The fixed frequencies themselves should be set with P104...P107.
[4] CCW rotation
- CCW motor operation (U_high = CCW)
Factory setting: [0] off

P112- input IN3
Function of the digital input IN3
Values: - see under parameters P111-input IN2
Factory setting: [0] off

P113- input IN4
Function of the digital input IN4
Values: - see under parameter P111-input IN2
Factory setting: [0] off

P120-relay REL1
Output value of relay REL1
Values: [0] off :
- no function, relay is in opened state.
[1] operation:
- The inverter is ready for operation, the motor can be started.
[2] failure:
- The inverter is in the error state, the motor cannot be started and a reset is required.
[3] overload:
- The motor current has reached the current limit.
(P17-I_mot_app >= P44-I_limit, -10% hysteresis)
[4] N_rated reached:
- The actual speed of the motor has reached the rated speed
(P14-f_motor = P10-f_rated_act, ±10% hysteresis).
[5] current limit
- The real motor current is higher than the current warning threshold
(P18-I_mot_real >= P125-I_warning, 10% hysteresis).
[6] motortemp:
- The temperature sensor in the motor indicates that the temperature is too high
(see P85-motor prot. and P86-R_protect).
[7] motor stands:
- The motor is stationary, depending on motor type. The ASM motor: if a speed sensor is present, this signal becomes active after the end of the braking process, consisting of generator brake and DC brake (see P48-t_stop and P55-t_DC_brake). After the inverter has been switched on or after a reset, the motor stands signal is inactive. If a speed sensor is configured with P59-speedsensor, this signal becomes active at an actual motor stoppage (f<1Hz). BLDC motor: The signal becomes active if the actual motor stoppage is detected from the e.m.f. voltage.
[8] motor runs:
- This is the inverted motor stands signal.
Factory setting: [4] n_rated reached

P121- relay REL2
Output value of relay REL2.
Values: - see under parameter P120-relay REL1
Factory setting: [3] overload

P122- relay REL3
Output value of relay REL3.
Values: - see under parameter P120-relay REL1
Factory setting: [7] motor stands

P123- relay REL4
Output value of relay .
Values: - see under parameter P120-relay REL1
Factory setting: [2] failure

P125-I_warning
Value of the variable current limit for the relay output, this can be used for detecting a specific motor load, a relay output (P120- relay REL1 ... P123- relay REL4) must be configured with the current limit function for this purpose. The value has no effect on the current limitation.
Minimum value: 0.4 A
Maximum value: 12 A
Factory setting: 0.4 A

P130-analogue AIN1
Function of the analogue input 1 (AIN1)
Werte: [0] off
- Input has no function
[1] f_rated
- The voltage present at AIN1 is used as the rated speed value. The frequency limit should be set for the input voltage V_e = 0V in P135-f_rem_min and for V_e = 10V in P136-f_rem_max.
Factory setting: [0] off

P131- analogue AIN2
Function of the analogue input 2 (AIN2)
Values: [0] off
- Input has no function
[1] torque
- The voltage present at AIN2 is used as a value for the current limitation (torque limitation). An input voltage of V_e = 0V corresponds to a current value of 0 A, V_e = 10V corresponds to the full current limit as specified in P44-I_limit.
Factory setting: [0] off

P132-analogue AOU1
Function of the programmable analogue output 1 (AOUT1).
Werte: [0] off
- The output has no function, output voltage 0V
[1] I_mot_real
- Real motor current (P18-i_mot_real), 10V = P44-I_limit
[2] f_motor 3000Hz
- Motor frequency (P14-f_motor), 0V=0Hz, 10V = 3000Hz
[3] f_motor 1000Hz
- Motor frequency (P14-f_motor), 10V = 1000Hz
[4] f_out 3000Hz
- Inverter output frequency (P13-f_out_act), 10V=3000Hz
[5] f_out 1000Hz
- Inverter output frequency (P13-f_out_act), 10V=1000Hz
[6] P_out 3000W
- Inverter output power (P19-P_real), 10V = 3000W
[7] P_out 1000W
- Inverter output power (P19-P_real), 10V = 1000W
[8] V_link circ
- Intermediate circuit voltage (P16V_link_circ) 10V = 400V
[9] f_rated_act
- Current rated frequency (P10-f_rated_act) 10V = 1000Hz
Factory setting: [1] I_mot_real

P133-analogue AOU2
Function of the programmable analogue output 2 (AOUT2).
Values: - see P132-analogue AOU1
Factory setting: [3] f_motor 1000Hz

P135-f_rem_min
Minimum rated frequency for analogue rated frequency default AIN1 at V_e = 0V. This parameter is evaluated only if P130-analogue AIN1 is configured for rated frequency.
By means of parameter P8-speed displ, this parameter can be changed from frequency display to speed display, the number of poles of the motor P96-no. of poles being taken into account.
Minimum value: 0 Hz
Maximum value: 3000 Hz
Factory setting: 0 Hz

P136-f_rem_max
Maximum rated frequency for analogue rated frequency default AIN1 at V_e = 10V. This parameter is evaluated only if P130-analogue AIN1 is configured for rated frequency.
By means of parameter P8-speed displ, this parameter can be changed from frequency display to speed display, the number of poles of the motor P96-no. of poles being taken into account.
Minimum value: 0 Hz
Maximum value: 3000 Hz
Factory setting: 3000 Hz

P137-f_stop_ana
Stop frequency from analogue rated frequency signal; this makes it possible to achieve an automatic motor stop with counterclockwise rotation of the nominal value potentiometer or analogue voltage 0 V.
The motor is automatically stopped if the rated frequency default at analogue input AIN1 falls below the value of this parameter. By means of parameter P8-speed displ, this parameter can be changed from frequency display to speed display, the number of poles of the motor P8-no. of poles being taken into account.
In this context, also see the parameter P135-f_rem_min and P136-f_rem_max.
Values: [0] off - no automatic stop
[1] f_mot_min - the value from P41-f_mot_min is used
Minimum value: 2 Hz
Maximum value: 3000 Hz
Factory setting: off

P150-end (display value)
Last parameter number; serves as end mark.

## B 4 Error messages

If a warning occurs, the warning LED H2 (yellow) lights up and the motor can continue running. If an error is detected, the fault LED H5 (red) lights up and the motor is stopped.
The following is applicable for both types of error:
If the configuration mode or the special functions mode is active, the error number is shown in the LCD display only on entry into the normal state. In the normal state, it is possible to change between the standard display and the error display using the Enter key ➔.
If the reason for a warning disappears, the message too is deleted from the display.
In order to be able to exit an error state, a reset must be triggered (either through the key combination ←/○ or through a remote control reset). With a reset, a total initialization of the device is triggered. If the error persists, the error display immediately appears again.

The last 5 error messages are stored in the parameter `P30-1st error` to `P34-5th error`, warning messages not being taken into account here. This makes it possible to trace the error history.

## B 4.1 Hold function

At the time the error occurs, all display values are stored.
As long as the error state is present, the values are displayed from the hold memory.
The LCD display H1 shows an error symbol ϟ . The standard display (see `P4-display`) and the parameters P10 to P19 are effected.

With the Hold function, it is possible to determine retrospectively the operating point which triggered the error state.

If a reset is triggered, the hold display and the values in the hold memory are deleted.

### B 4.2 Errors on motor control, can be influenced by operator

1 Current limitation active - warning
2 Motor temperature too high
3 Inverter cooler temperature too high
4 Motor current too high, inverter limit exceeded
5 Motor current in generator mode too high, inverter limit exceeded
6 Inverter intermediate circuit voltage V_WR too high
7 Mains input voltage too low
8 Mains input voltage too high
9 Overcurrent error in inverter
10 Overcurrent error in direct current chopper
11 Bridge at X6.2-3 for internal brake resistance missing
12 Bridge at X2 for internal brake resistance connected but external brake resistance configured
13 Nominal speed limitation active
14 Motor emergency stop active because mains voltage too low
15 No motor in parameter `P90-motortype`
16 Earth fault in motor or supply cable
17 Motor connection broken

### B 4.3 Errors on control panel, can be influenced by operator

20 Remote control analogue input AIN1, voltage greater than 11V
21 Remote control analogue input AIN2, voltage greater than 11V
22 Remote control voltage output FB-+24V short-circuit (voltage less than 18V)
23 Remote control voltage output FB-+7V short-circuit (voltage less than 5.5V)
24 Inadmissible code for motor coding
25 Motor coding changed with running motor
26 Unused motor parameter memory for motor coding
27 Motor coding, more than 4 motors and speed sensor used (conflict at input H1)

### B 4.4 Electronics errors on motor control

40 Communication of motor control to control panel broken
41 EEPROM on power circuit board faulty during self-test (data memory)
42 Flash program memory on motor control circuit board faulty
43 EEPROM on motor control circuit board faulty in self-test (data memory)
44 ID in memory incorrect
45 Watchdog reset on motor control
47 Motor type from `P90-motortype` (still) not supported - (prototype)
49 Error in real-time converter V_motor in self-test
50 Error in real-time converter I_motor in self-test
51 Error in converter (WR) in self-test
52 Error in DC chopper (GS) in self-test
53 Short-circuit or earth fault in DC chopper (GS)
54 Brake chopper faulty or brake resistance broken in self-test
55 Offset in current measuring circuit (I_wr) too large in self-test
56 Offset in current measuring circuit (I_wr_neg) too large in self-test
57 Actual motor speed too high
58 BLDC motor does not start

### B 4.5 Electronics errors on control panel

60 Communication of control panel to motor control broken
61 Flash program memory on control circuit board faulty
62 EEPROM on control circuit board faulty in self-test (data memory)
63 Error while loading a parameter from the EEPROM data memory
64 Error while loading a calibration value from EEPROM data memory
65 Flash program memory on motor control empty
66 Software of control panel and motor control do not correspond.
67 Watchdog reset on control panel

## B 4.6 Description of all errors and warnings

W = Warning message, inverter still ready for operation
E= Error message, serious fault, inverter not ready for operation, a reset must be triggered

| No. | Description | Cause | Rectification |
|---|---|---|---|
| 1 W | Warning. Motor current has reached the current limit (P44-I_limit) | Motor too highly loaded, rise time P46-t_rise too short, startup current P52-I_start too large | Reduce load, adapt parameter |
| 2 E | Temperature monitoring Motor | Motor too hot, possibly sensor cable break | Cool motor reduce load, test sensor and check P85-motor prot. and P86-R_protect. |
| 3 E | Temperature monitoring Inverter cooler | Inverter overloaded, cooler too hot | Reduce load, check output currents |
| 4 E | Inverter output current too large (15A) | Motor current too high, overload | Reduce load, check parameter P44-I_limit |
| 5 E | Inverter overcurrent protection Generator operation (15A) | Generator current too high | Increase ramp times P47-t_fall or P48-t_stop, if necessary activate catch circuit (P50-motor start) |
| 6 E | Voltage monitoring Intermediate circuit voltage (380V) | ASM motor fall time too short | Adapt parameter P47-t_fall |
| 7 E | Monitoring Mains undervoltage | Mains voltage too low | Test mains voltage, test mains connection |
| 8 E | Monitoring Mains overvoltage | Mains voltage too high | Test mains voltage, test mains connection |
| 9 E | Overcurrent protection in inverter (peak current) | Inverter overloaded, motor short-circuit or earth fault | Reduce load, check motor and supply cable for short-circuit and earth fault |
| 10 E | Overcurrent protection DC chopper | Device error in inverter | Inverter reset, if fault occurs repeatedly send inverter for repair. |
| 11 W | Monitoring Brake resistance | Bridge at X6.2-3 for internal brake resistance missing | Connect bridge or set P100-R_ext_brake for external resistance. |
| 12 E | Monitoring brake resistance | Bridge at X6.2-3 for internal brake resistance connected but external brake resistance configured | Remove bridge or set P100-R_ext_brake for internal brake resistance. |
| 13 W | Nominal speed limit active. The internal nominal speed of the motor control (P12-f_rated_int) is limited to the maximum inverter frequency P42-f_mot_max. | P1-f_rated or rated value of analogue input too high | Check rated parameter value P1-f_rated, frequency limits for rated value for remote control P135-f_rem_min and P136-f_rem_max and fixed frequencies P104 ... P107, for checking the current rated value P10-f_rated_act. |
| 14 W | Motor emergency stop is activated. | Mains voltage interruption or mains input voltage too low. | Stop motor and start again on control panel, check parameter P58-emerg. stop, check mains voltage. |

| No. | Description | Cause | Rectification |
|---|---|---|---|
| 15 W | No motor defined. | Parameter P90-motortype set to “no motor”. | Set parameter P90-motortype, presumably the inverter is still not configured, see Section B 2 Fast commissioning. |
| 16 E | Motor earth fault detected | Earth fault in motor or in supply cable | Check motor and supply cable. |
| 17 W | Motor connection broken | No KL motor connected or a motor phase is interrupted | Check motor connection, adapt parameter P90-motortype |
| 20 W | Input voltage at AIN1 (X4.20) is higher than 11 volt. | Input voltage too high | Reduce voltage, check wiring |
| 21 W | Input voltage at AIN2 (X4.21) is higher than 11 volt. | Input voltage too high | Reduce voltage, check wiring |
| 22 W | Remote control voltage output FB-+24V (voltage less than 18V) | Voltage too highly loaded or short-circuit | Check wiring to X4 |
| 23 W | Remote control voltage output FB-+7V (voltage less than 5.5V) | Voltage too highly loaded or short-circuit | Check wiring to X4 |
| 24 W | Inadmissible code for motor coding | Motor coding input set to a higher code number than motors configured in P102-motorcoding, e.g. coding input is C4 and only 3 motors configured in P102 | Check signal values at X7 (also see P20-motor code) or parameter P102-Motorcoding. |
| 25 W | Motor coding changed while motor running. | Motor coding input at X7 changed while motor running. | Check signal values at X7, they may not change while the motor is running (also see P20-motor code). |
| 26 W | Unused motor parameter memory for motor coding. | The value at motor coding input X7 indicates an empty parameter memory M1...M8. | Check signal values at X7 (also see P20-motor code) or store parameter for corresponding motor (see Section B3.4 SP1 Storing and recalling motor parameters). |
| 27 W | Motor coding for more than 4 motors and speed sensor used (conflict at input H1) | P102-motorcoding contains more than 4 motors and a speed sensor is configured in P59-speedsensor. Both functions share the input H1 (X7.3). Loading of the motor parameter memory M1...M8 is not possible. | Check signal values at X7, adapt parameter P59-speedsensor or P102-motorcoding, also see P20-motor code. |
| 40 E | Communication of motor control to control panel broken | Hardware or software interruption of communication | If the error persists in spite of repeatedly switching on and off or resetting, a hardware error is present and the inverter should be sent for repair. |
| 41 W | Automatic test on switching on, data memory of power circuit board | EEPROM on power circuit board faulty | If the error persists in spite of repeatedly switching on and off or resetting, a hardware error is present and the inverter should be sent for repair. |
| 42 E | Automatic test on switching on, program memory | Flash memory on motor control circuit board faulty | If the error persists in spite of repeatedly switching on and off or resetting, a hardware error is present and the inverter should be sent for repair. |

| No. | Description | Cause | Rectification |
|---|---|---|---|
| 43 W | Automatic test on switching on, data memory of motor circuit board | EEPROM on motor control circuit board faulty | If the error persists in spite of repeatedly switching on and off, a hardware error is present and the inverter should be sent for repair. |
| 44 E | Automatic test on switching on, circuit ID | Motor control circuit board faulty | If the error persists in spite of repeatedly switching on and off or resetting, a hardware error is present and the inverter should be sent for repair. |
| 45 W | Watchdog reset on motor control | Strong EMC interference on motor control circuit board | Warning indication is automatically reset after 10 seconds and motor continues to run. |
| 47 E | Motor type not supported (prototype) | Motor control does not support the configured motor. | Check parameter `P90-motortype`, bring firmware in motor control to new status (TKD). |
| 49 W | Error in real-time converter V_motor in self-test | Electronics for measuring the effective motor voltage are faulty | If the error persists in spite of repeated resetting, a hardware error is present and the inverter should be sent for repair. |
| 50 W | Error in real-time converter I_motor in self-test | Electronics for measuring the effective motor current are faulty | If the error persists in spite of repeated resetting, a hardware error is present and the inverter should be sent for repair. |
| 51 E | Error in inverter (WR) in self-test | Inverter electronics faulty | If the error persists in spite of repeated resetting, a hardware error is present and the inverter should be sent for repair. |
| 52 E | Error in DC chopper (GS) in self-test | DC chopper electronics faulty | If the error persists in spite of repeated resetting, a hardware error is present and the inverter should be sent for repair. |
| 53 E | Short-circuit in DC chopper (GS) | DC chopper electronics faulty, possibly earth fault in motor | Check motor for short-circuit or fault. If the error persists in spite of repeated resetting, a hardware error is present and the inverter should be sent for repair. |
| 54 W | Brake chopper faulty or brake resistance interrupted in self-test | Brake chopper electronics faulty or brake resistance interrupted | If the error persists in spite of repeated resetting, a hardware error is present and the inverter should be sent for repair. |

| No. | Description | Cause | Rectification |
|---|---|---|---|
| 55 W | Offset in current measuring circuit (I_wr) too large in self-test | Electronics for measuring the intermediate circuit voltage are faulty | If the error persists in spite of repeated resetting, a hardware error is present and the inverter should be sent for repair. |
| 56 W | Offset in current measuring circuit (I_wr_neg) too large in self-test | Electronics for measuring the intermediate circuit voltage are faulty | If the error persists in spite of repeated resetting, a hardware error is present and the inverter should be sent for repair. |
| 57 W | Actual speed of motor too high | Actual motor speed is 10% above the nominal speed. Motor cannot follow the nominal speed, motor driven externally. | Decrease nominal speed more slowly or increase power of brake resistance. |
| 58 E | BLDC motor does not start. The inverter attempts to start the motor depending on `P51-t_start`; after 3 unsuccessful start attempts or after 15 seconds, the start procedure is terminated. | Motor blocked or incorrect start parameters. | Check motor, check parameters P51 ... P54. |
| 60 E | Communication of the control panel to the motor control broken | Hardware or software interruption of communication | If the error persists in spite of repeatedly switching on and off or resetting, a hardware error is present and the inverter should be sent for repair. |
| 61 E | Automatic test on switching on, program memory | Flash memory on control circuit board faulty | If the error persists in spite of repeatedly switching on and off or resetting, a hardware error is present and the inverter should be sent for repair |
| 62 E | Automatic test on switching on, data memory of control circuit board | EEPROM on control circuit board faulty | If the error persists in spite of repeatedly switching on and off or resetting, a hardware error is present and the inverter should be sent for repair |
| 63 W | Error while loading a parameter from the EEPROM data memory | Loss of data, EEPROM on control circuit board faulty | Input the corresponding parameters again; if the error occurs repeatedly, the inverter should be sent for repair. |
| 64 W | Error while loading a calibration value from the EEPROM data memory | Loss of data, EEPROM on control circuit board faulty | The inverter is still ready for operation in the uncalibrated state; if the error persists in spite of repeated resetting, the inverter should be sent for repair. |
| 65 E | No program in flash memory of motor control circuit board | Loss of data, flash on motor control circuit board faulty | Send inverter for repair or request the flash programming software from KaVo. |
| 66 E | Software versions of control circuit board and of motor control circuit board do not correspond | Internal communication of control circuit board to motor control circuit board broken since protocols do not match one another. | Send inverter for repair or request the flash programming software from KaVo |
| 67 W | Watchdog reset on control circuit board | Strong EMC interference on control circuit board | Warning display is automatically reset after 10 seconds, motor continues to run. |

We,

KaVo ELEKTROTECHNISCHES WERK
Vertriebsgesellschaft m.b.H.
Wangener Str. 78
D-88299 Leutkirch im Allgäu

declare that the product

**frequency inverter type 4452**

-to which this declaration relates complies with the essential safety requirements in accordance with the provisions of the Directive(s)

89/336/EEC (EMC Directive)
73/23/EEC (low-voltage directive).

The following standards or normative documents were used for assessing the product:

EN 50178 Equipping of power current installations with electronic operating materials
EN 61800-3 Variable-speed electric drives

Leutkirch, 11.09.2000

M.Mohr
Managing Director

# Index

### Inverter 4452 motor parameters

**Customer:** **Date:**

**Motor/spindle:** **Official responsible:**

**Remark :**

| Sett.-Prio. | P | Description | Display | Use ASM | Use BLDC | Use BLDCS | Unit | Factory setting | Customer setting |
|---|---|---|---|---|---|---|---|---|---|
| | | **Special settings** | | | | | | | |
| O | 41 | Min. motor frequency | f_mot_min | x | x | x | Hz | 50 | |
| B | 42 | Max. motor frequency | f_mot_max | x | x | x | Hz | f_mot_nom | |
| O | 43 | Max. motor voltage | V_mot_max | x | x | x | V | U_mot_nom | |
| B | 44 | Current limit | I_limit | x | x | x | A~ | 1.5 * I_nom | |
| O2 | 46 | Rise time | t_rise | x | x | x | s | 5.0 | |
| O2 | 47 | Delay time | t_fall | x | x | x | s | 5.0 | |
| O2 | 48 | Delay time at stop | t_stop | x | x | x | s | t_fall | |
| O2 | 50 | Start option (catch) | Motorstart | x | - | - | - | Normal | |
| O2 | 51 | Start time | t_start | - | x | - | s | without ramp | |
| O2 | 52 | Start current | I_start | - | x | - | A~ | 0.4 | |
| O2 | 53 | Start frequency | f_start | - | x | - | Hz | 5 | |
| O2 | 54 | Switch-off time WR | t_off | - | x | - | µs | 600 | |
| O2 | 55 | DC brake time | t_DC_brake | x | - | - | s | 2 | |
| O2 | 56 | DC brake current | I_DC_brake | x | - | - | A- | 1.0 | |
| O2 | 57 | Stop current | I_DC_stop | x | x | x | A- | OFF | |
| O2 | 58 | Flag emergency stop at mains failure | emerg.stop | x | x | x | - | off | |
| B | 59 | Speed sensor pulse count | emerg.stop | x | x | x | - | no sensor | |
| | | **U/f Table** | | | | | | | |
| O | 60 | Startup voltage | V_start | x | - | - | V~ | 3% U_nom | |
| O | 61 | Frequency 1 | f1 | x | - | - | Hz | f_mot_nom | |
| O | 62 | Voltage 1 | V1 | x | - | - | V~ | U_mot_nom | |
| O | 63 | Frequency 2 | f2 | x | - | - | Hz | f_mot_nom | |
| O | 64 | Voltage 2 | V2 | x | - | - | V~ | U_mot_nom | |
| O | 65 | Frequency 3 | f3 | x | - | - | Hz | f_mot_nom | |
| O | 66 | Voltage 3 | V3 | x | - | - | V~ | U_mot_nom | |
| | | **Control** | | | | | | | |
| O | 70 | Control (U/f. I*R, slip, N) | Control | x | - | - | - | U/f table | |
| O2 | 71 | I*R comp. rise factor | I*R-factor | x | - | - | V/A | off | |
| O2 | 72 | Load comp. rise factor | Loadkomp. | x | - | - | % | off | |
| O2 | 73 | I*R and load comp. filter time | comp-T-filt | x | - | - | ms | 20 | |
| O2 | 75 | Slip comp. P-factor | Slipkomp | x | - | - | Hz/A | off | |
| O2 | 76 | Slip comp filter time | slip-T_filt | x | - | - | Hz/A | 20 | |
| W | 77 | Current limitation | I-limtr-KP | x | x | x | % | 40 | |
| W | 78 | Current limitation | I-limtr-Tn | x | x | x | ms | 10 | |
| W | 79 | Voltage control | V-contr-KP | x | x | x | % | 20 | |
| W | 80 | Voltage control | V_contr-Tn | x | x | x | ms | 10 | |
| O3 | 81 | Speed control | N-contr-KP | x | x | x | % | 50 | |
| O3 | 82 | Speed control | N-contr-Tn | x | x | x | ms | 250 | |
| O3 | 83 | Speed control | N-contr-Tv | x | x | x | ms | 30 | |
| O3 | 84 | Speed control | N-con-T_fil | x | x | x | ms | 200 | |
| | | **Monitoring**: | | | | | | | |
| B | 85 | Sensor type | Motor_prot | x | x | x | - | off | |
| O | 86 | Resistance | R_protect | x | x | x | ohm | 1200 | |
| | | **Nominal motor data: (according to rating plate)** | | | | | | | |
| E | 90 | Motor design | motortype | x | x | x | - | no motor | |
| E | 91 | Nominal frequency | f_mot_nom | x | x | x | Hz | 50 | |
| E | 92 | Nominal voltage | V_mot_nom | x | x | x | V | 30 | |
| E | 93 | Nominal current | I_mot_nom | x | x | x | A | 1.0 | |
| E | 94 | cos. phi | cos phi | x | x | x | % | 85 | |
| E | 96 | Number of poles | no.of poles | x | x | x | - | 2 | |

**Setting priority:**
E = Necessary, minimum input,
B = required according to mode,
O =set for optimization (opt level)
W = best left at factory setting