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# Operating Instructions

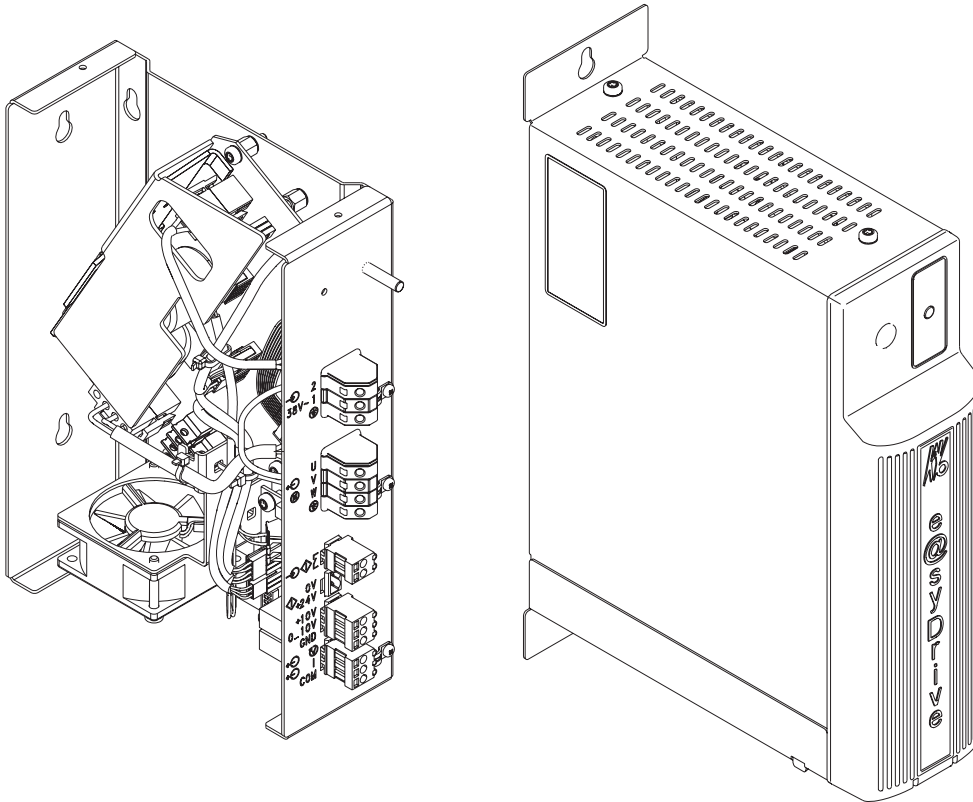
## e@syDrive® 4424

*With Compliments*



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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.*

### A 1.2 Important information



*The Operating Instruction 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 Operating Instruction (OI) 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.

Modifications 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 cannot be held responsible 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 is not configurable. Only those spindles must be connected that are named in the summary table on page 10 (A5 Inverter Types).*

## 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:

- Industrial safety regulations
- 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 e@sy drive4424 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.).

**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.

**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.

**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.

**PLC** Programmable Logic Controller, controller of a superior level machine.

## A 1.4 Purpose and potential applications

KaVo EWL frequency inverters, type e@sy drive4424, have been specially designed 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) (standard)                | EWL 4025, 4026, 4029 |
| - Brushless DC motors without sensors (BLDC) (option) | EWL 4015             |

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

On stop command, the connected motor is decelerated down to zero speed.

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


The inverter can either be controlled via the PLC-compatible remote control or manually.


The inverter is cooled by an integrated fan.

## A 1.5 Technical data

### Frequency inverter

Operation	via the PLC-compatible remote control or manual
Display	LED for Ready (green) // Fault (red)
Dimensions	75 mm width, 310 mm height, 215 mm depth for installation in cabinet
Operating temperature	5 ... 40°C
Humidity of the air:	lower than 90 % relative humidity, non-condensing
Weight	approx. 3 kg
Tests and standards	VDE tested according to EN 50178 EMV according to 61800-3
Ingress protection	IP20 acc DIN 40050 for open version IP00 acc DIN 40050 for enclosed version

 *All inverter types in open version (IP00) must only be installed as rack-mounted models. This means that protections against accidental contact, isolating switch as well as Standards and tests according to EN 50178 (VDE) and EN 61800-3 (EMC) have to be provided by the installer.*

 *The frequency inverter 4424 has been designed for variable speed control of KaVo-Spindles (see section A5). Pulse Amplitude Modulation (PAM) with 120°-blocks is used to set the output voltage.*

### Power unit

Electrical connection	single-phase max. 38V~, 50/60 Hz or max. 53V
Input power	max. 300 VA
Output voltage	max. 3 * 33 V~
Output current	max. 6 A~ per phase at 16V motor voltage max. 5 A~ per phase at 22 V motor voltage max. 4 A~ per phase at 28 V motor voltage
Output frequency	83 ... 1666 Hz for ASM motors 83 ... 1666 Hz for BLDC motors
Output power	max. 180 W continuous operation
Braking resistance	internal
Efficiency	93 % (at 250 VA, cos phi motor 86 %)

## Remote control

### Start signal Inputs

- Start signal with external contact
- Start with external voltage + 24 V (level 15...30 V)  
0 V (ground)

**i** For faultless detection of the start signal the inverter 4424 needs to see a clear signal edge from "low" to "high". A re-start signal is needed after power-off. Only one of the two start inputs must be used. Start input terminals must not be bridged or bypassed.

### Relay Outputs

- Relay No 1 NO contact, max. 48 V~, 1 A, max. 30 V=, 1 A  
min. current 1 mA at 24V (10mA at 10V)  
Function: Up-to-speed
- Relay 2 NO contact, max. 48 V~, 1 A, max. 30 V=, 1 A  
min. current 1 mA at 24V (10mA at 10V)  
Function: Up-to-speed

**i** Relay outputs are potential free (galvanic isolation).

### Analogue Inputs

- 0...10V Ue = 0...10 V, Re = 100 kΩ, Ie = 0,1 mA at 10 V,  
w/o connection 0V, input protected up to max. ± 40 V  
Function: Analogue speed set value
- +10 V- Potentiometer-output:
- +10 V Voltage supply Uo = 10 V, Io = max.2 mA,

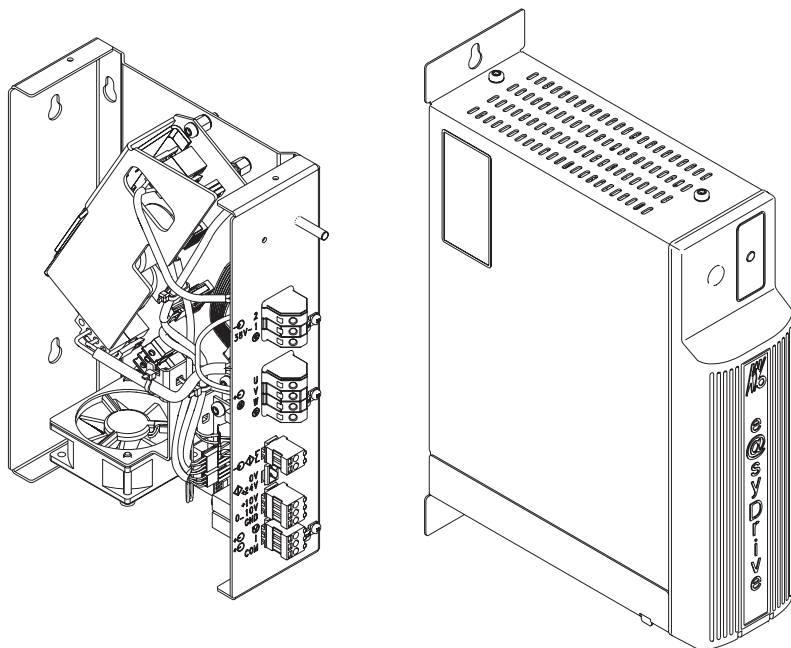
**i** FB-voltage outputs reference is ground "FB-Masse".

## A 2 Scope of delivery - Accessories

### A 2.1 Scope of delivery

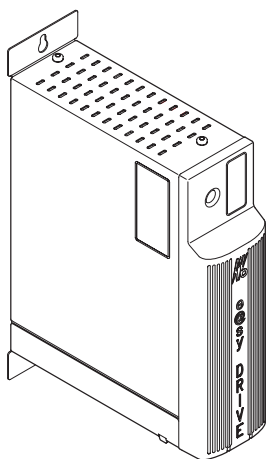
Frequency inverter type 4424  
 Technical manual Mat.-No. 1.001.0224

Frequency inverter type 4424  
 Technical manual Mat.-No. 1.001.0224



### A 2.2 Accessories

Power module for inverter type 4424 Mat.-Nr. 1.002.0061 (available as enclosed version only)

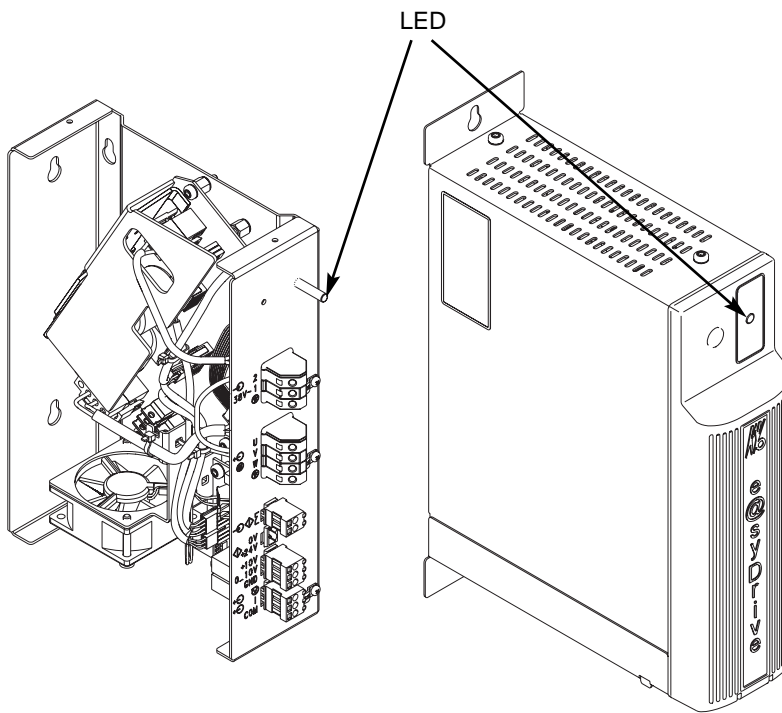




### A 3 LED/Operation

LED Ready/Fault	Green:	Operating
	Green flashing:	Software identification after power-on
	Red:	Fault
	Red flashing:	Number of flashing cycles refers to fault code

Please refer to Fault Codes in section B 2 for further information.

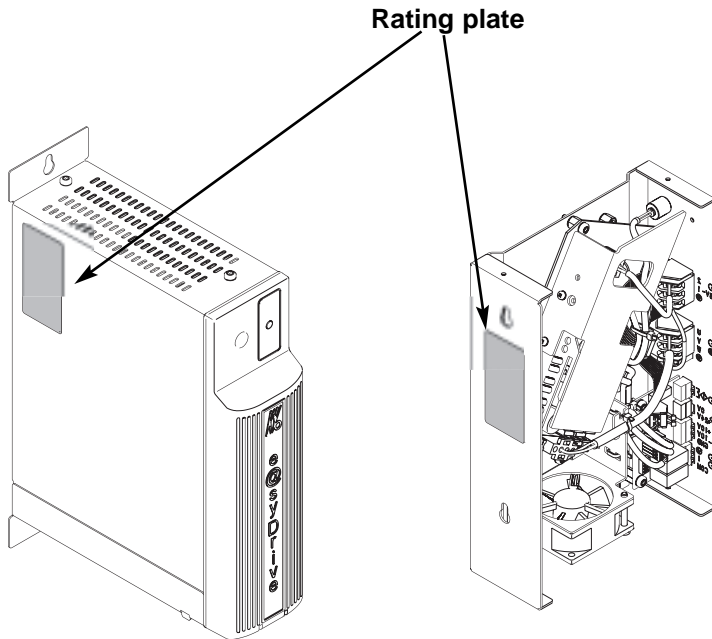


#### Control:

Usually the PLC compatible remote control is used to operate the device.

### A 4 Rating plate

The device has been tested according requirements of the European Standard EN 50178



### Rating plate for enclosed types

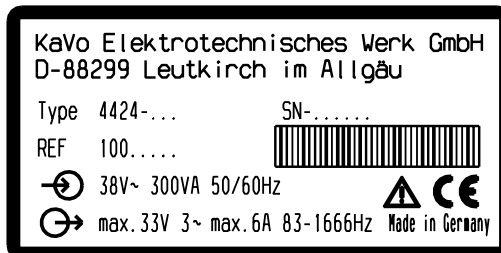
inverter type  
Mat.no.  
  
input power  
output power



serial no.  
test label

### Typenschild für offene Version

inverter type  
Mat.no.  
  
input power  
output power



serial no.  
test label


**A 5 Inverter types and matching KaVo-Spindle types**


Each inverter type of the e@syDrive® 4424 series is adjusted to a certain KaVo-Spindle type and can only be used for this type. Please refer to below table for matching pairs:

**Combination of inverters/inverter versions with matching power modules und spindles**

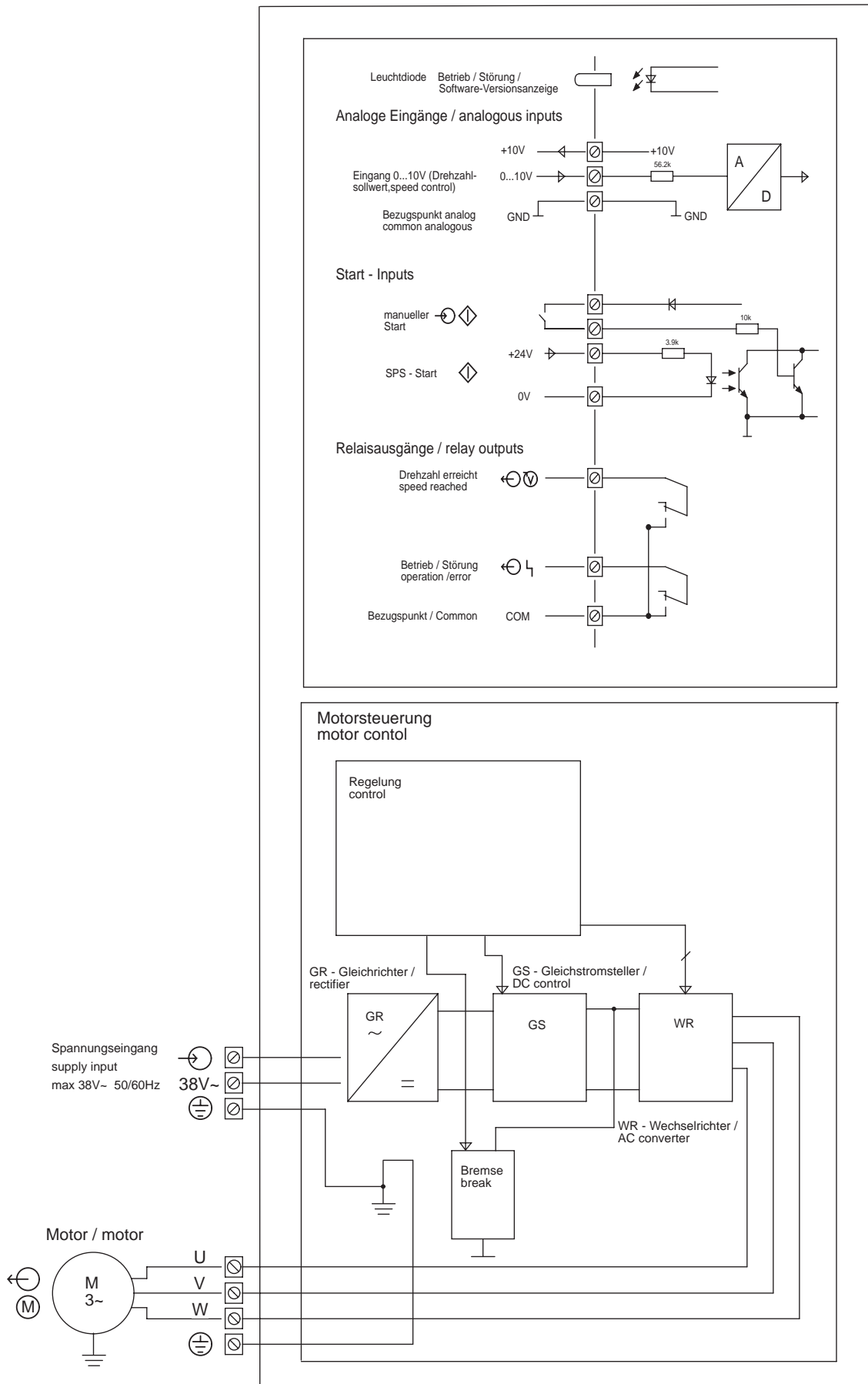
Inverter types	4424-D25	4424-D33R+	4424-D33T+	4424-A33
Enclosed version (IP20)	REF 10019109	REF 10019110	REF 10020752	REF 10019291
Open version (IP00)	REF 10020294	REF 10020690	REF 10020753	REF 10020751
Matching Power Modul (IP20)	4424-NT (REF 10020061)			
Matching Spindel type	D25 <sup>1)</sup>	D33R+ <sup>2)</sup>	D33T+ <sup>3)</sup>	A33 <sup>4)</sup>

- 1) D25: Micro-Spindle with housing diameter 25,4mm (1 inch) and BLDC-motor, e.g. spindle type 4015
- 2) D33R+: HF-Spindle series with housing diameter 33 mm and BLDC-motor, high speed version
- 3) D33T+: HF-Spindle series with housing diameter 33 mm and BLDC-motor, high torque version
- 4) A33: HF-Spindle series with housing diameter 33 mm and ASM-motor, e.g. spindle type 4025

 *On first operation ensure that spindle rotates in correct direction! (Please refer to rotation direction arrow on spindle!)*

 *Compliance with EMC-Standards is only ensured if spindles with shielded motor cable are used!*

**A 6 Block diagram motor control**



**B 1 Assembly and Installation, for cabinet mounting**

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

**B 1.1 Assembly**

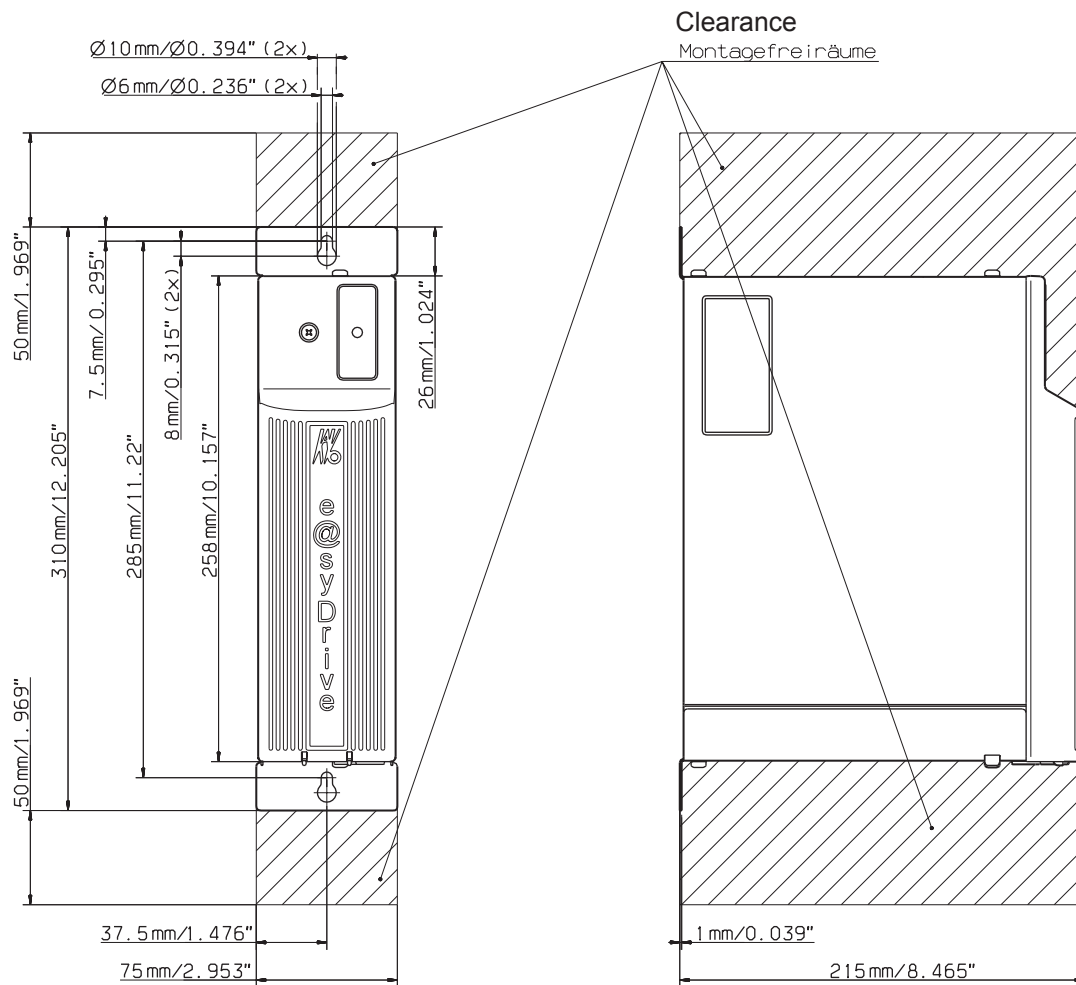
Frequenz inverter type e@sy drive 4424 designed for mounting in cabinet:  
 Use 2 screws for mounting on switch board  
 Ensure proper electrical connection to protective conductor.

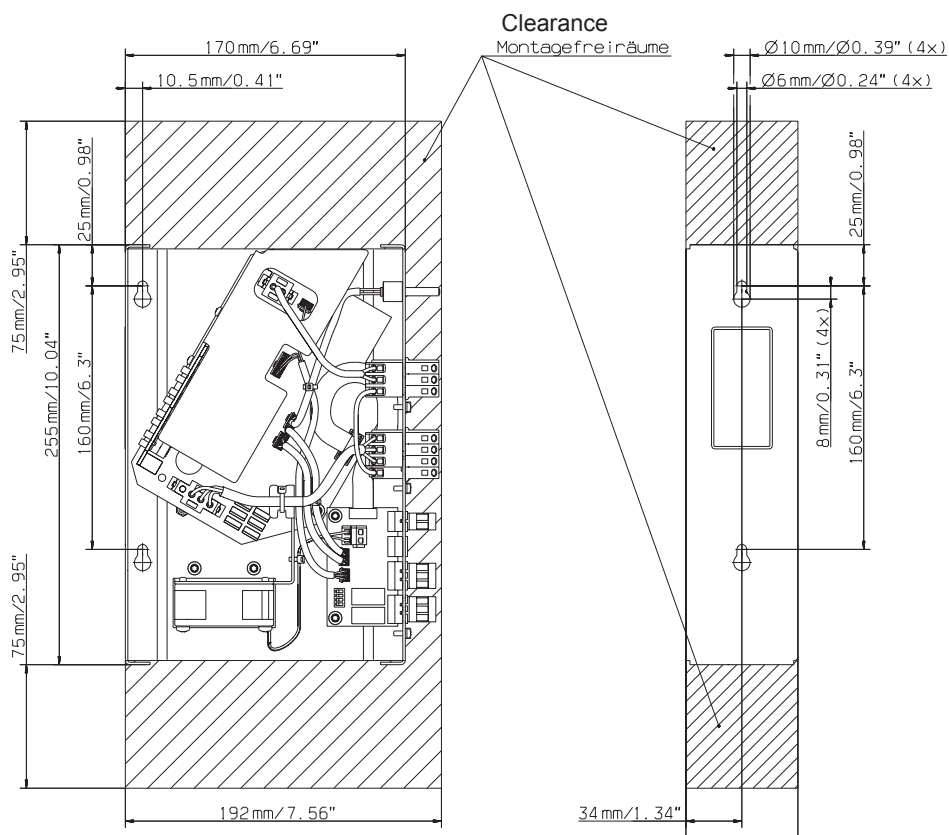
**Information on cooling**

**⚠** 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: 50 mm  
 Longitudinal surfaces: 10 mm

**Assembly of inverter type 4424, enclose version**



**Assembly of inverter type 4424, open version**


For assembly of power module please refer to manual 1.002.0313

**B 1.2 Electrical Installation**

**!** When installing the inverter, the applicable safety regulations must be observed. A device for the electrical isolation of the inverter and the connected power module must be provided. The power module must be protected by fuses or circuit breakers with tripping characteristic B.

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

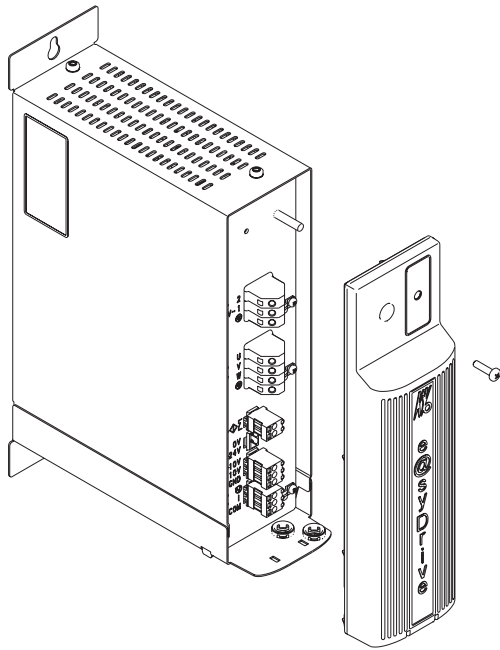
The inverter was tested according to EMC product standard EN 61800-3 (variable-speed electrical drives).



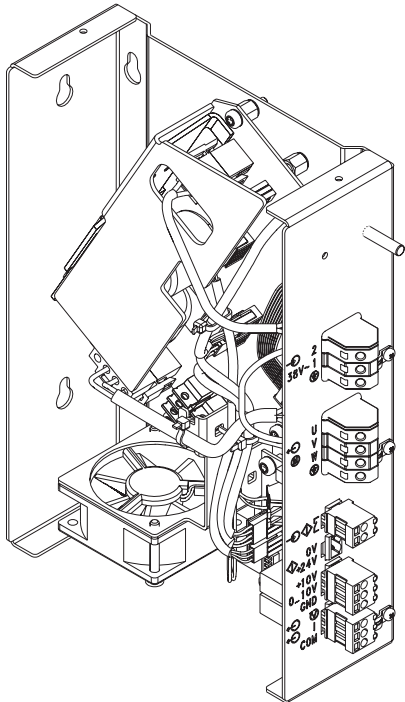
- The above-mentioned EMC product standard can be accomplished with use of shielded motor and control cables.
- The control cables must be laid separately from (not parallel with) mains and motor cables. Shielded cables and metallized plug housings should be used.
- All devices in the mounting cabinet 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 Access to electrical connections

Connections terminals of e@syDrive 4424

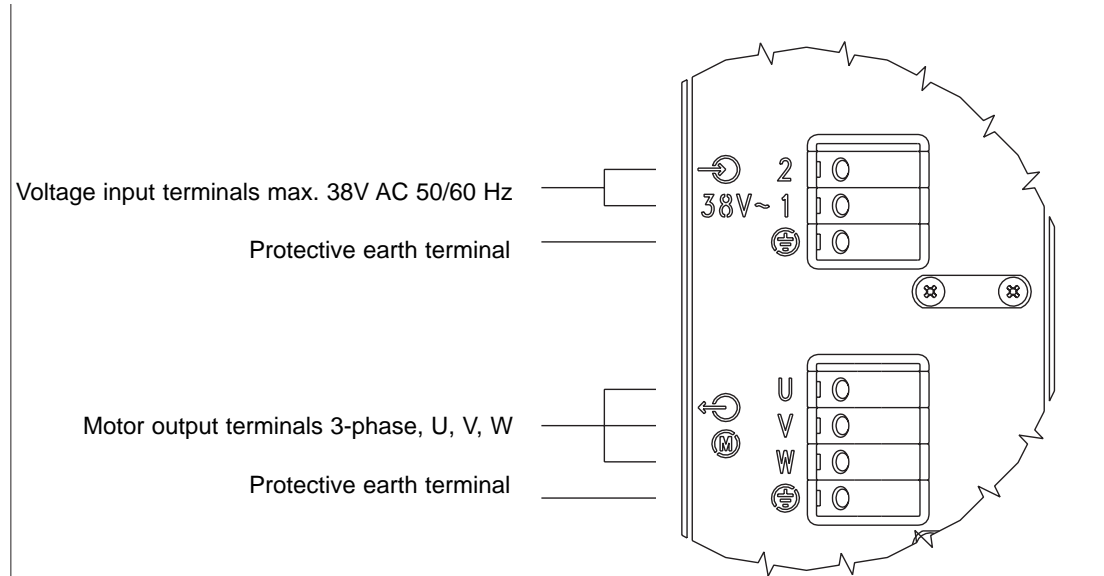


Connection terminals e@syDrive® 4424 in enclosed version



### B 1.5 Motoranschluss / Spannungseingang

**i** The inverter 4424 is to be wired to the voltage supply at the input voltage terminals and the PE (Protective Earth) terminal. Make sure the cable shield is properly surrounded by the cable clip. If the enclosed inverter version is installed together with the power module 4424-NT (REF 1.002.0061) it must be ensured that the enclosures are electrically well connected (connect either via mounting over large switch board area or additional cables).

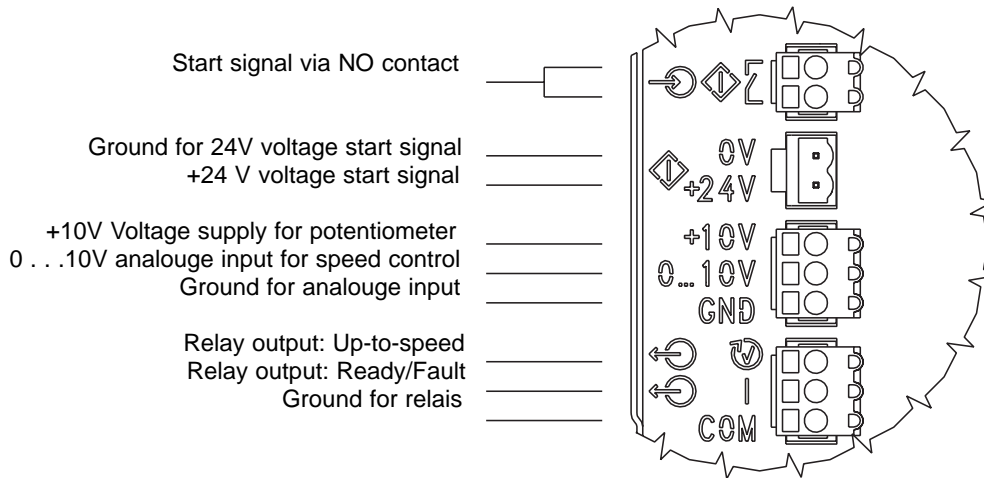


**i** The spring loaded terminals for the motor cable, voltage supply and protective earth connection allow a max. wire size of 2,5 mm<sup>2</sup> (AWG 12) and should be stripped over a length of 8-10 mm. Spring loaded terminals are suitable for solid and flexible wires.



### B 1.6 Connection of remote control

Connection of inputs and outputs



**i** Alle Anschlüsse werden an Federklemmen angeschlossen. Die Federklemmen sind geeignet für einen Leitungsquerschnitt von 0,2 bis 1,5 mm<sup>2</sup> (AWG 24 - AWG 14) und müssen 10 - 12 mm abisoliert werden. Die Federklemmen sind sowohl für Massivdraht als auch für Litzen geeignet

## B 2 Fault indications

If inverter indicates a warning the Ready // Fault LED flashes red but motor can continue operation.

If inverter indicates a fault the Ready // Fault LED flashes red and motor is stopped.

The number of flashing cycles refers to the warning or fault code. To clear a fault the inverter needs to be reset (power off and power on). The reset starts a re-initialization of the unit. In case the fault remains the fault indication starts again immediately.

### B 2.1 Description of all warnings and faults

F1

Description Motor has reached current limit

Cause Motor overload, motor current above 4 A for 7 sec

Elimination Reduce motor load, stop and start

F2

Description Motor stalled or does not accelerate

Cause Motor stalled for longer than three seconds

Elimination Clear stall, stop and start

F3

Description Motor not recognized

Cause Motor not connected

Elimination Connect motor, start

F4

Description Motor phase disconnection

Cause Broken motor winding or motor lead

Elimination Check motor lead and winding

F6

Description Motor speed too high

Cause Broken motor phase or control board damaged

Elimination Send motor or inverter for repair

F9

Description Potentiometer for speed control defect

Cause Broken wire to potentiometer

Elimination Check wire to potentiometer

## F13

Description Short circuit in power electronics

Cause Transistor(s) faulty

Elimination Send inverter for repair

## F14

Description Power electronics or measurement equipment defect

Cause Transistor(s) faulty.

Elimination Send inverter for repair

## F17

Description Overtemperature inverter

Cause Temperature at heat sink too high (> 90 °C)

Elimination Let inverter cool down

## F18

Description Temperature sensor defect

Cause Short circuit in Temperature sensor

Elimination Send inverter for repair

**Konformitätserklärung;  
Déclaration de conformité;  
CE-Dichiarazione di conformità;**

**Declaration of conformity;  
Declaración de conformidad;**

Wir, We, Nous, Nosotros, Noi,

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Wangener Str. 78  
D-88299 Leutkirch im Allgäu

**erklären, dass das Produkt  
declare that the product  
déclarons que le produit  
declaramos que el producto  
dichiariamo che il nostro prodotto**

**Frequenzumrichter Typ EWL 4424  
frequency inverter type EWL 4424**

auf das sich diese Erklärung bezieht, mit den wesentlichen Schutzanforderungen gemäß den Bestimmungen der Richtlinie(n) übereinstimmt.  
to which this declaration relates conforms to the essential safety requirements according to the provisions of Directive(s)  
auquel se réfère cette déclaration, est conforme aux exigences essentielles de protection conformément aux dispositions de la/ des Directive(s)  
al lo cual se refiere esta declaración, coincide con las esenciales exigencias de protección según las determinaciones de la(s) norma(s)  
a cui si fa riferimento in questa dichiarazione, è conforme alle misure di sicurezza secondo le direttive delle norm

89/336/EWG (EMV-Richtlinie)  
73/23/EWG (Niederspannungsrichtlinien)

Zur Beurteilung des Erzeugnisses wurden folgende Normen oder normativen Dokumente angewandt:  
The following standards or normative documents were used for assessing the product:  
Les normes ou autres documents normatifs suivants sont utilisés pour le jugement de ce produit :  
Para la evaluación del producto se aplicaron las siguientes normas o documentos norma:  
Per la valutazione del prodotto sono state applicate le seguenti normative o altri documenti normat:

EN 50178 Ausrüstung von Starkstromanlagen mit elektronischen Betriebsmitteln  
EN 61800-3 Drehzahlveränderbare, elektrische Antriebe

Leutkirch, 25.10.2002

M.Mohr  
-Managing Director-