

## **Additional Installation, Operating and Maintenance Instructions**

### **Permanent magnet synchronous motors for inverter operation**

**Series**

**PE1R/PE1F/PE1W**

**P21R/P21F/P21W**

**P22R/P22F/P22W**

**PE0R/PE0F/PE0W**

**P20R/P20F/P20W**



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D-38855 Wernigerode

VEM motors Thurm GmbH  
Äußere Dresdener Str. 35  
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## EG-Konformitätserklärung

Die elektrischen Betriebsmittel

Permanentmagnet erregte Synchronmotoren für Umrichterbetrieb

der Baureihen	PE1R/PE1F/PE1W P21R/P21F/P21W P22R/P22F/P22W	PE0R/PE0F/PE0W P20R/P20F/P20W
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stimmen mit den Vorschriften folgender Europäischer Richtlinien überein:

2006/95/EG

Richtlinie des Europäischen Parlaments und des Rates vom 12. Dezember 2006  
zur Angleichung der Rechtsvorschriften der Mitgliedstaaten betreffend elektrische Betriebsmittel zur  
Verwendung innerhalb bestimmter Spannungsgrenzen

2004/108/EG

Richtlinie des Rates zur Rechtsangleichung der Rechtsvorschriften der Mitgliedstaaten über  
die elektromagnetische Verträglichkeit

Die Übereinstimmung mit den Vorschriften dieser Richtlinien wird durch die Einhaltung nachstehender  
Normen nachgewiesen:

Europäische Norm / Deutsche Norm

EN 61000-6-1, EN 61000-6-2, EN 61000-6-3, EN 61000-6-4

EN 55014-1, EN 55014-2

EN 61000-3-2, EN 61000-3-3

EN 60034-1, EN 60034-2-1, EN 60034-5, EN 60034-6, EN 60034-9, EN 60034-17, EN 60034-30

IEC/TS 60034-25

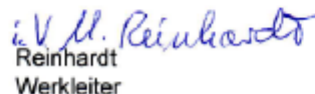
IEC 60038,

EN 60204-1

Das bezeichnete Produkt ist zum Einbau in eine andere Maschine gedacht. Die Inbetriebnahme ist solange  
untersagt, bis die Konformität des Endprodukts mit der Richtlinie 2006/42/EG festgestellt ist.

Wernigerode, 01.12.2009

  
Sander  
Geschäftsführer

  
i.V. M. Reinhardt  
Werkleiter

Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, ist jedoch keine  
Zusicherung von Eigenschaften im Sinne der Produkthaftung.

Bei elektronischer Übermittlung des Dokumentes erscheint keine Unterschrift.

## General



**Attention! Read installation, operation and maintenance instructions, connection diagram, additional connection diagram and safety regulations before transportation, installation, start-up, maintenance and repair. Mind the information!**

The existing additional operation and maintenance manual is valid together with the already mentioned documents and the operation and maintenance manual for standard motors, where the basic specifications for connection, installation, operation and maintenance as well as the spare parts lists are included.

This manual shall help the user to ease the secure and proper transportation, installation, start-up and maintenance of the electric machine.

The compliance of this manual and the conditions and methods for installation, operation, usage and maintenance of the electric motor can not be controlled by the manufacturer. An incorrect installation can result in damage to property and thus can lead to risks for persons. Therefore we do not assume responsibility and warranty for losses, damages or costs resulting directly or indirectly from incorrect installation, faulty operation or usage and maintenance.

Technical drawings and pictures are simplified illustrations. Due to improvements and changes it might happen that they do not correspond in detail with the supplied electric machine. Our policy is one of constant product improvement. Therefore we reserve the right to change the product, technical data or installation, operating and maintenance instructions without prior notice. Designs, technical data and illustrations are not binding until confirmed in writing by the supplier's works.

## Symbols

In this manual symbols will be used, that indicate important passages:



**Security and warranty advices, possible damage to persons included.**



**Warning against electric voltage, danger of life. Advice that damages to the electrical machine and/or the auxiliary devices can happen.**



**Warning against magnetic fields. Advice that electronic data storage media can be destroyed next to the rotors.**



**Warning** against damage of hands, risks of crushing



**Warning about dangerous voltages**



**Prohibition sign for persons with pace makers. Due to magnetic fields there is an acute danger for persons with pace makers near the rotor when the machine is open.**

## Security regulations

The security regulations, accident prevention regulations, standards and approved rules of technique must be observed unconditionally!

The non-observance of the security advices can result in endangering people and/or damaging of the machine.

### Intended use

These **installation, operating and maintenance instructions** are only valid for electric equipment with permanent magnet rotors. That means it is valid for permanent magnet synchronous motors which can not be operated at the mains. To operate these motors it is mandatory to use a frequency inverter. In principle a difference is made between operation as motor or as generator.



#### Operation as generator

By driving the motor shaft a voltage is induced that is proportional to the speed and can be picked off from the motor terminals. The load can be connected directly and thus operating in an isolated network or connected with a load control according to the required application. For supply to a public network please use suitable inverters that comply with the local prescriptions.



#### Operation as motor

For operation as motor a suitable inverter for permanent magnet motors is required. It should obey the principles for field oriented control (FOR). For devices with other control principles we do not guarantee that the permissible temperature rise and name plate data is kept. This can result in a lifetime reduction.

### Motor connection

**The connection has to be done by qualified personnel according to the valid security regulations.**

**Outside of Germany the required national standards must be applied.**

**Name plate designations have to be observed under all circumstances!**

**Before opening the terminal box, please make sure that the shaft is blocked so that it can not move.**

**Shaft rotation induces a voltage related to the speed of the motor shaft.**



Compare current type, mains voltage and frequency!

Mind connection type!

Mind rated current for motor protection switch setting!

Connect the motor according to the connection diagram in the terminal box!

Earthing shall be done with the earthing clip that can be found at the enclosure or at the end shield depending on the type of construction. In addition all motors are equipped with a ground conductor clamp inside of the terminal box. Unused cable glands of the terminal box have to be closed for protection against dust and humidity. For electrical connection the standard security and starting instructions are valid. The installation torques, sealing areas and clamp ranges of the cable clamps given by the manufacturer have to be observed unconditionally.

Supply cables have to be selected according to DIN VDE 0100 taking into account rated current and operational conditions (i.e. ambient temperature, method of cable installation etc. complying with DIN VDE 0298 and IEC / EN 60204-1). Take extra care when connecting the supply cables in the terminal box of the motor. The nuts of the connection screws have to be fastened without force (according to terminal box overview).

Please follow the Safety Regulations closely. All work is to be carried out only when there is no voltage on the motor. The installation must be carried out according to the valid regulations by qualified skilled personnel. Initially the mains conditions (voltage and frequency) must be compared with the data on the rating plate of the motor. The dimensions of the connecting cables must be adjusted in line with the rated currents of the motor. The connection points of the motor are marked in accordance with EN 60034-8 (VDE 0530 Part 8). At the end of this instructions the most common circuit diagrams for three phase motors in basic design are provided, according to which the connection will be implemented. For all other versions, the special circuit diagrams are glued to the inside of the terminal box cover or placed in the terminal box. An additional terminal box can be provided for the connection of auxiliary and protection devices (e.g. anti-condensation heaters); the same regulations apply as for the main terminal box.

The motors must be taken into operation with an inverter. The parameters of the inverter must be selected corresponding with the nominal data of the motor. Otherwise warranty claims with respect to damaged windings become void. Before the motor is connected for the first time it is recommended to check the insulation resistances between winding and earth and between phases (see Section about insulation check). After prolonged storage it is absolutely essential that the insulation resistance is measured. Before coupling the motor to the driven machine, check the direction of rotation of the motor to prevent possible damage being caused to the driven machine. If the power lines are connected with the phase sequence L1, L2, L3 to U, V, W, the direction of rotation is clockwise (view to shaft end on drive side DS). If two terminals are changed, the direction of rotation is counter clockwise (i.e. L1, L2, L3 to V, U, W).

**Terminal box overview**

Terminal box type	Terminal board	Rated current [A]	Connecting thread	Tightening torque [Nm]
KA 05	K1M4	30	M4	1,8 ± 0,2
KA 05-13	K1M4	30	M4	1,8 ± 0,2
KA 05-13	K1M5	30	M5	2,4 ± 0,2
KA 25 A	SB 5	25	M5	2,5 ± 0,5
K 63/25 A	SB 5	25	M5	2,5 ± 0,5
KK 63 A	SB 6	63	M6	4 ± 1
KK 100 A	SB 8	100	M8	7,5 ± 1,5
KK 200/100 A	SB 8	100	M8	7,5 ± 1,5
KK 200 A	SB 10	200	M10	12,5 ± 2,5
KK 400 A	SB 12	400	M12	20 ± 4
KK 400 B	KM 16	630	M16	30 ± 4
KK 630 A	KLP 630-20	630	M20	30 ± 4
KK 1000 A	KLSO 1000	1000	current bar	-

When inserting the feed line in the terminal box it has to be secured that no tensile loading acts on the cables. The inside of the terminal box must be kept clean. The seals must be undamaged and have to be fitting. The terminal box must always be closed when the motor is in operation.

Before closing the terminal box make absolutely sure that:

- the connection has been made in accordance with the wiring diagram
- all terminal box connections are tightened
- all minimum values of air paths are maintained (larger than 8 mm up to 500 V, larger than 10 mm up to 750 V, larger than 14 mm up to 1000 V)
- the interior of the terminal box is clean and free from foreign particles  
unused cable entries are blanked off and the threaded plugs with seals are tightened
- the seal in the terminal box cover is clean and tightly glued and all sealing surfaces are in the correct state to ensure that the relevant degree of protection is maintained.

Tightening torques for bolts (terminal box, end shield, bearing cover)  
Series P.1R/F 63 to 132T, P.0R/F 56 to 100 (manufacturer VEM motors Thurm GmbH)

Type		Type of construction	End shield		Fixed bearing cover		Terminal box	
P.1R/F	P.0R/F		DS	NS	DS	NS	or adapter	cover
Bolts/tightening torque for bolts M <sub>A</sub>								
63...	56...	all	M 4 2,0 Nm	M 4 2,0 Nm	M 4 1,5 Nm (for KPER/O 100 L M 5 2,0 Nm)	M 4 1,5 Nm	M 4 2,5 Nm	M 5 1,0 Nm
71...	63...		M 5 4,0 Nm	M 5 4,0 Nm				
80...	71...		M 6 7,0 Nm	M 6 7,0 Nm				
90...	80...							
100 L	90...							
100 LX,112...	100...	B3	M 8 10,0 Nm	M 8 10,0 Nm	M 5 2,0 Nm	M 5 2,0 Nm	M 4 2,5 Nm	M 4 2,0 Nm
		B5, B14	M 8 15,0 Nm					
132 S...T	-	B3, B14-FT130	M 8 10,0 Nm					
		B5, B14	M 8 15,0 Nm					

Tightening torques for bolts (terminal box, end shield, bearing cover)  
Series PE1R 132M to 355 (manufacturer VEM motors GmbH, Wernigerode)

Thread Ø	M5	M6	M8	M10	M12	M16	M20
End shield	-	-	25	45	75	170	275
Bearing cover	5	8	15	20	20	-	-
Terminal box	-	4	7,5	12,5	-	20	-

### Commissioning

Before starting up the motor check that all safety regulations are strictly adhered to, that the machine is correctly installed and aligned, that all fixing parts and earthing connections are tightened, that the auxiliary and additional devices are functionally and correctly connected and if a second shaft end is fitted that the key is secured against being thrown aside.

If possible the motor is to be connected without load. If the motor is running smoothly and without any abnormal noises, the load of the driven machine is to be applied onto the motor. When the motor is started up it is recommended to monitor the current consumption if the motor is loaded with its driven machine so that any possible overloads and asymmetries occurring in the mains can be recognised immediately.



Synchronous motors with permanent magnet rotor are not suitable for direct connection with the mains. When using inverter feeding please check carefully if the inverter is suitable for operation with this kind of synchronous motors before start of operation. If you are not sure, please ask the manufacturer of both components.



Synchronous motors with permanent magnet rotor emit magnetic stray fields during assembly or disassembly. The rotors of such motors can disturb or damage electric or electronic devices or equipments. This is especially valid for pace makers, mobile electronic devices and credit cards.



Additional safety regulations are valid for these synchronous motors, especially as they are operated in connection with an inverter. That means even after complete separation of the terminals from the mains dangerous voltages can exist. That means a rotation of the shaft must be prevented under all conditions before opening of the terminal box.



When working on the cables it is possible that inverse voltages arise. When using inverter feeding it is possible that the terminals are energized even at standstill of the motor. Overloading of synchronous motors with permanent magnet rotor can result in demagnetization processes and damage of the windings.



The disassembly of the rotor is only permitted when using tools specially designed for this application. Non observance of this regulation will result in serious personal and property damage. When assembling the permanent magnet rotor please take care that no metallic residues remain in the stator drilling.



**Near a disassembled rotor people with pace makers are in danger!**

### Insulation Check

When the motor is first commissioned and especially after extended storage, the insulation resistance of the winding is to be measured to earth and between phases. The check must take place using the rated voltage, but at least 500 V. In addition the rotation of the shaft must be avoided by suitable measures. Otherwise dangerous voltages are induced.

During and immediately after the measurements dangerous voltages are present at the terminals. Therefore never touch the terminals and follow the operating instructions of the insulation resistance meter closely! After testing the windings must be discharged immediately!

Depending on the rated voltage UN, the following minimum values must be maintained with a winding temperature of 25 °C:

Rated Power $P_N$ in kW	Insulation Resistance referred to Rated Voltage in $k\Omega/V$
$1 < P_N \leq 10$	6,3
$10 < P_N \leq 100$	4
$100 < P_N$	2,5

If the minimum values are lower, the winding must be dried properly until the insulation resistance corresponds to the required value.

### Maintenance



**You are once again referred to the Safety Regulations, in particular to isolation, to securing against reconnection, to checking whether all components connected to a voltage source are in dead state. If it is necessary to disconnect the motor from the mains for maintenance work particular care must be taken to ensure that any possibly existing auxiliary circuits (e.g. anti-condensation heaters, forced ventilators, brakes) are also disconnected from the mains.**

If the motor is to be dismantled during maintenance work, the sealing compound on the centering shoulders is to be removed. When re-assembling the motor, these need to be re-sealed using a suitable motor sealing compound (for example surface sealing compound Drei Bond Universal type FD 1110). Existing copper sealing washers must always be refitted.

### Series PE1R 132 to 355 (Manufacturer VEM motors GmbH, Wernigerode)

If bearings are changed this must be done in a way so that the rotor is not removed from the stator. Before disassembly of the end shields the rotor must be fixed in the drilling with non-magnetic retaining strip (approx. 0.8 mm thick, width 10 mm) by using the maintenance access in the end shield on N-side (closed with screw plugs). After that the end shields can be removed for maintenance. After assembly of the end shields the retaining strips must be removed again and the screw plugs for the maintenance access must be attached.

### Auxiliary devices

As option the motors can be equipped with auxiliary devices.

### Motors with Thermal Winding Protection

For monitoring the stator winding temperature it is possible to have thermo couples installed in the motor (PTC thermistors, KTY or PT100). For their connection suitable auxiliary clamps for auxiliary circuits are available in the main terminal box or in additional terminal boxes. The connection is done according to the attached connection diagram.

A continuity test of the thermistor sensor circuit using a test lamp, a hand generator and such like is strictly prohibited because this would destroy the sensors immediately. If it becomes necessary to verify the cold resistance of the sensor circuit (at approx. 20°C) then the measuring voltage must never exceed 2.5 V DC. It is recommended to carry out the measurement using a Wheatstone bridge with a 4.5 V DC supply voltage. The cold resistance of the sensor circuit must never exceed 810 Ohms; a measurement of the hot resistance is not necessary.

With motors that are fitted with thermal winding protection, care must be taken that when the thermal winding protection responds and after the cooling down of the motor, no hazards can occur due to spurious automatic reconnection.

### Anti-condensation heating

The input supply voltage is indicated on the name plate of the motor. For their connection either in the main terminal box or in the auxiliary terminal boxes suitable clamps for auxiliary circuits are provided. The connection is done according to the attached connection diagram. The anti-condensation heating has to be switched on only after disconnection of the motor. It shall not be switched on while the motor is in operation.

### Forced ventilation unit

The forced ventilation unit is dissipating the lost heat at operation of the main motor. During operation of the main motor the motor of the forced ventilation unit has to be switched on. After disconnection of the main motor the forced ventilation has to continue depending on the temperature. For motors with forced ventilation units that are dependent of the sense of rotation, the sense of rotation has to be observed unconditionally



(see rotation mark). Only manufacturer approved forced ventilation units shall be used. The forced ventilation unit has to be connected according to the connection diagram that is supplied inside of the terminal box.

**Electromagnetic Compatibility**

The motors, as non-independently working unit, have been checked with regard to their conformity with the EMC Standards. It is the responsibility of the equipment operator to ensure by suitable measures that the apparatus or plant in their entirety comply with the relevant electromagnetic compatibility standards.

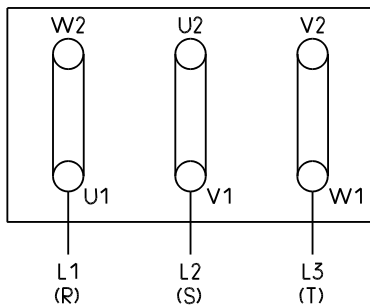
**Trouble Shooting**

General mechanical and electrical faults are to be rectified according to the Schedule given in this manual. . All Safety Regulations must be strictly observed when rectifying faults.

**Terminal board circuits**

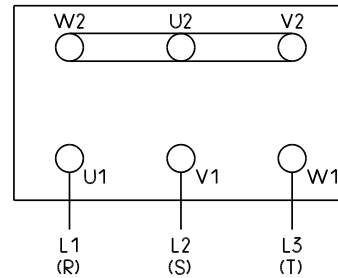
**Single speed squirrel-cage motors:**

Δ low voltage



**Single speed squirrel-cage motors:**

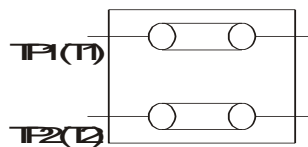
Y high voltage



**Motor with thermal winding protection**

Terminal board connection as above

from motor



Connection of tripping device

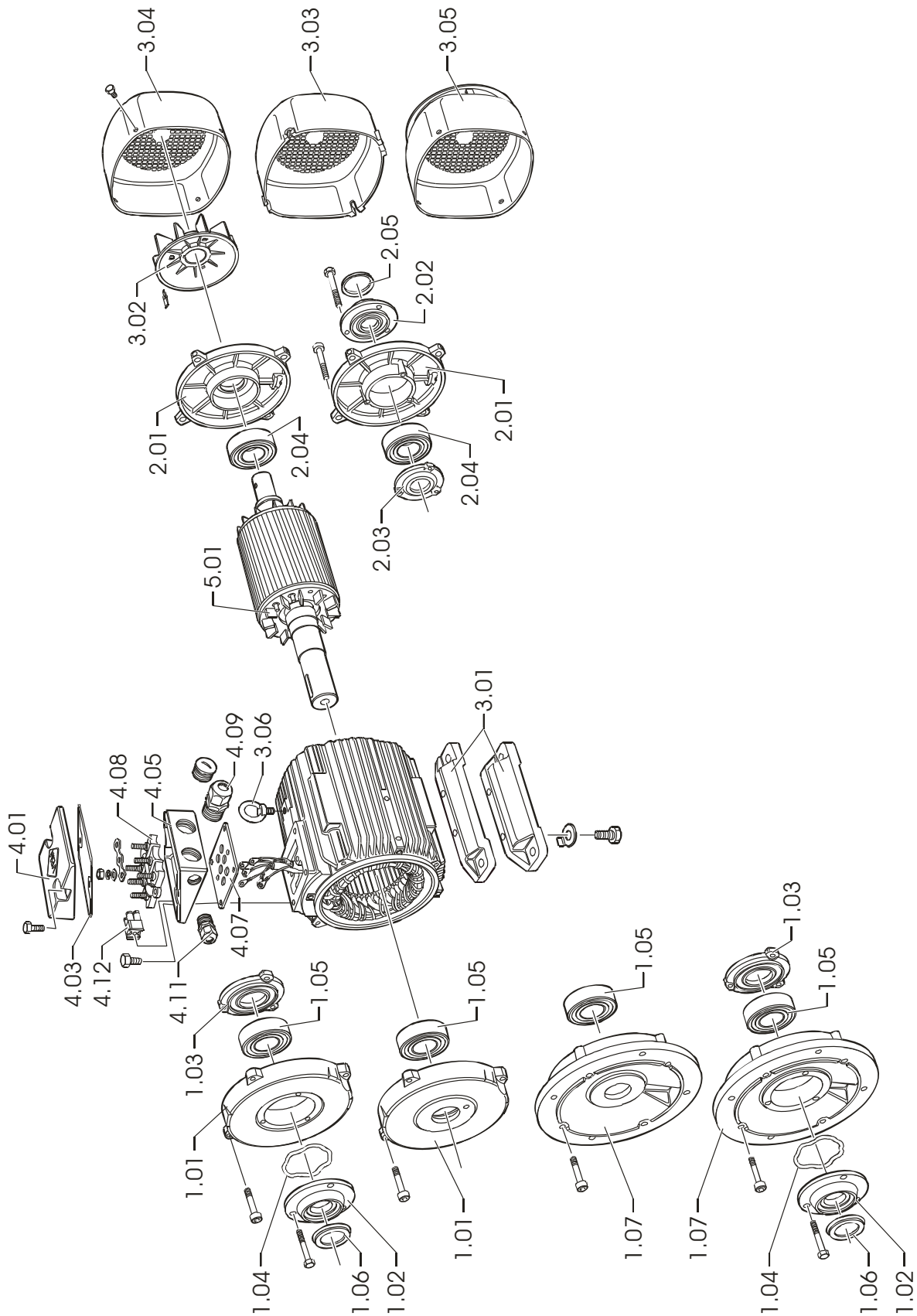
The connection will be implemented according to the connecting diagram of the tripping device



**Construction of the motor**

<b>Item No.</b>	<b>Bezeichnung</b>	<b>Designation</b>
1.01	Lagerschild D-Seite	End shield Drive-end
1.02	Lagerdeckel, D-Seite, außen	Bearing cover, Drive-end, external
1.03	Lagerdeckel, D-Seite, innen	Bearing cover, Drive-end, internal
1.04	Tellerfeder / Wellfeder, D-Seite, nicht bei Rollenlagern	Disc spring / wave washer, Drive-end, not for roller bearings
1.05	Wälzlager D-Seite	Antifriction bearing, Drive-end
1.06	V-Ring D-Seite	V-type rotary seal, Drive-end
1.07	Flanschlagerschild	Flange end shield
1.08	Filzring D-Seite	Felt ring, Drive-end
2.01	Lagerschild N-Seite	End shield Non-drive end
2.02	Lagerdeckel, N-Seite, außen	Bearing cover, Non-drive end, external
2.03	Lagerdeckel, N-Seite, innen	Bearing cover, Non-drive end, internal
2.04	Wälzlager N-Seite	Antifriction bearing, Non-drive end
2.05	V-Ring N-Seite	V-type rotary seal, Non-drive end
2.06	Wellfeder N-Seite (oder D-Seite)	Wave washer, Non-drive end (or Drive-end)
2.08	Filzring N-Seite	Felt ring, Non-drive end
3.01	1 Paar Motorfüße	1 pair of motor feet
3.02	Lüfter	Fan
3.03	Lüfterhaube, Kunststoff	Fan cowl, plastic
3.04	Lüfterhaube, Stahlblech	Fan cowl, sheet steel
3.05	Lüfterhaube mit Schutzdach	Fan cowl with canopy
3.06	Ringschraube	Lifting eye bolt
4.01/4.02	Klemmenkastendeckel	Terminal box cover
4.03/4.04	Dichtung Klemmenkastendeckel	Terminal box cover gasket
4.05/4.06	Klemmenkastenunterteil	Terminal box base
4.07	Dichtung Klemmenkastenunterteil	Terminal box base gasket
4.08	Klemmenplatte	Terminal plate
4.09	Kabeleinführung	Cable gland
4.10	Verschlusschraube	Screw plug for gland opening
4.11	Kabeleinführung für thermischen Wicklungsschutz	Cable gland for thermal winding protection
4.12	Anschluss für therm. Wicklungsschutz	Terminal for thermal winding protection
4.13	Schelle	Clamp
4.14	Verschlussstücken	Sealing components
4.15	Zwischenplatte	Adapter plate
4.16	Flacher Anschlusskasten	Flat terminal box
4.17	Normalienbeutel	Standard parts bag
5.01	Läufer, komplett mit Permanentmagneten	Rotor, complete with permanent magnets
6.01	Schleuderscheibe, D-Seite	Grease thrower ring, Drive-end
6.02	Schleuderscheibe, N-Seite	Grease thrower ring, Non-drive end
6.03	Labyrinthbuchse, D- u. N-Seite	Labyrinth gland, Drive- and Non-drive end
6.04	Leitscheibe, D-Seite	Guide disc, Drive-end
6.05	Leitscheibe, N-Seite	Guide disc, Non-drive end

**Inverter fed synchronous motor with permanent magnet rotor**  
**Basic design PE.R 71 – 355/P2.R 71 to 355**  
**(example, delivered version may differ in details)**



**Trouble shooting**  
**Electrical Faults**

	Motor doesn't start	
	Motor runs up heavily	
	Humming noise during start	
	Humming noise during operation	
	Hum in time of the double slip frequency	
	Excessive warming up at no-load operation	
	Excessive warming up at rated output	
	Excessive warming up of individual winding sections	
	<b>Possible cause of fault</b>	<b>Remedial measure</b>
● ● ●	Overload	Decrease the load
●	Interruption of a phase in the supply conductor	check the switch and the supply conductor
● ● ●	Interruption of a phase in the supply conductor after switching-on	check the switch and the supply conductor
●	Mains voltage too low, frequency too high	check the mains conditions
●	Mains voltage too high, frequency too low	check the mains conditions
● ● ● ●	Stator winding misconnected	check the winding connections
● ● ●	Turn-to-turn fault	check the winding and the insulation resistance, repair in authorized service workshop
● ● ●	Phase-to-phase short circuit	check the winding and the insulation resistance, repair in authorized service workshop
●	Interruption in the squirrel cage winding	repair in authorized service workshop

## Mechanical Faults

	Dragging noise	
	Excessive warming up	
	Strong vibrations	
	Bearing warming up excessively	
	Bearing noises	
	<b>Possible cause of fault</b>	<b>Remedial measure</b>
● ● ●	Rotary parts are dragging	Determine the cause, re-align parts
●	Air supply reduced	Check the ventilation passages
●	Unbalance of the rotor	Take rotor off, re-balance it
●	Rotor not circular, shaft deformed	Take rotor off, co-ordinate further measures with the manufacturer
●	Imperfect alignment	Align motor & driven machine, check the coupling
●	Unbalance of the coupled machine	Re-balance coupled machine
●	Shocks from the coupled machine	Check the coupled machine
●	Irregularities from the gear	Check and repair the gear
●	Resonance with the foundation	Stiffen the foundation after consultation
●	Changes in the foundation	Determine the cause, eliminate it and re-align the machine
●	Too much grease in the bearing	Remove excess grease
●	Coolant temperature higher than 40 °C	Regrease bearing with suitable grease
●	V-type rotary seal or gamma ring are dragging	Replace V-type rotary seal or gamma ring, maintain the prescribed installation clearance
● ●	Lubrication insufficient	Lubricate according to instructions
● ●	Bearing is corroded	Replace bearing
● ●	Bearing clearance too small	Use bearing with larger bearing clearance
●	Bearing clearance too large	Use bearing with smaller bearing clearance
●	Chatter marks in the bearing track	Replace bearing
●	Standstill marks	Replace bearing
●	Cylindrical roller bearing operated at low load	Change the bearing according to manufacturer's instructions
●	Coupling pushes or pulls	Re-align motor & driven machine
●	Belt tension too high	Adjust the belt tension according to instructions
● ●	Bearing not aligned or stressed	Check the bearing bore, consult the manufacturer

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