



Technical information VDE 0530

Extract from the DIN 57530, VDE 0530 Regulations, Part 1

If not expressly agreed otherwise, all motors and geared motors are made and tested according to VDE 0530. The user should therefore take careful note of DIN 57530/ VDE when designing a drive. Neckar-Motoren has made this job easier for you and put together the most important points below.

1. Temperature

1.1 Cooling

The surrounding air is the coolant (indirect air cooling). The temperature of the ambient air must be under 40°C and the place of installation of the drive must not be above 1000 m; otherwise a special design required.

1.2 Excess temperature of the winding

Heat in the motor is mainly produced in the winding. For the maximum permitted starting temperature of 40°C in 1.1 the Norm allows a so-called **excess temperature** for the winding. The excess temperature is calculated from the measured resistance change in the winding wires. (see VDE 0530, Part 1, Section 15)

2. Types of operation

An exact definition of the types of operation is necessary in order to ensure that limit temperatures listed in 1 are not exceeded. For this the steady-state temperature and the final state temperature is defined in such a way that the excess temperature $\Delta\vartheta$ during one hour of operation may change by a max. of 2° C.

The following types of operation are to be differentiated:

2.1 Continuous duty S 1

An operation with constant load with a duration long enough to for the thermal steady-state condition to be reached.

Our motors are normally designed for continuous operation S1; the series KV for S 2. This is at the same time the rated duty.

2.2 Short-time duty S 2

An operation with constant load, with a duration not long enough to reach the thermal steady-state condition and a subsequent pause of such duration that the machine temperature, which has dropped again, is only less than 2°C different from that of the coolant.

2.3 Intermittent duty S 3

An operation comprised of a series of similar duty cycles each consisting of a period of constant load and then a pause, whereby the starting current does not noticeably affect warming.

2.4 Intermittent duty with an effect by the starting process S 4

An operation comprised of similar duty cycles, each consisting of a noticeable starting time, a period of constant load and then a pause. (see VDE 0530, Part 1, Section 4)

3. Power supply

Alternating and 3-phase current motors are designed according to DIN 57530, VDE 0530 for practically sinusoidal and symmetrical voltages.

Direct current motors, powered through a rectifier, require a smoothing choke due to superimposed alternating currents to lower the losses and improve commutation (see thyristor control).

3.1 Voltage fluctuations

IEC 38 sets tolerances of +6% –10% for alternating voltages 230/400 V.

For operation with these tolerances the motors can exceed the mean limit temperature by 10°C. (Table 1, VDE 0530, Part 1).

3.2 Winding test

The winding test for electric strength has already been carried out during production. The last high voltage test is carried out during the final test just before shipment. The corresponding values are documented. If an additional high voltage test is required by the customer, this is carried out at 80% of the voltage.

4. EMV (Electromagnetic compatibility)-Regulations

Within the framework of the harmonisation process within the EU the EMV test will also be standardised as of 1.1.96. In the future electrical devices may not be operated if they do not conform to the above regulation.

The miniature motors series R, K, D, SM, M do not require a suppresser in normal operation.

The collector motors series G can be delivered with basic suppression if required, with a scope which has to be agreed.

We recommend the device as an entity.

Series	K, D, KD, KV	$\Delta\vartheta$ 80 K	Insulation class B
Series	G, RH	$\Delta\vartheta$ 80 K	Insulation class B
Series	R, SM	$\Delta\vartheta$ 80 K	Insulation class B
Series	MH	$\Delta\vartheta$ 60 K	Insulation class A
Series	M without shaft decoder	$\Delta\vartheta$ 80 K	Insulation class B
Series	M with shaft decoder		permitted temperature depends on shaft decoder!

See shaft decoder programme

$\Delta\vartheta$ = excess temperature $\vartheta_{\max} = \vartheta\Delta + 40 \text{ K} = \text{max. permitted winding temperature}$



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5. Noise intensity (Measurement areas, sound pressure level)

Measurement with a microphone separation of 1 m with miniature motors and miniature geared motors is problematic and too inaccurate because of the low noise level. The factory test, after agreement, is carried out in a sound proofed housing with a microphone **separation of 30 cm** vertically from the motor shaft. The results can be converted for 1 m separation. The measurement is carried out according to the evaluation graph dB (A). The noise behaviour of a motor is dependent on various effects such as:

- type of bearing, lubrication, fit,
- mechanical and electromagnetic unbalance,

- precision of the individual parts,
 - care during assembly,
 - commutator, especially rotation reversal,
 - connection to the surroundings (structure-bound sound emission),
 - resonance formation, among others.
- For geared motors there is also the additional rolling sound of the toothed wheels. The following table shows reference points as average values for our motors and geared motors. During operation other factors come into play. A check is always necessary on the equipment. The following summary should only give reference points for the appraisal of a drive. These values can be reduced by special agreement.
(see VDE 0530, Part 1, Section 54)

6. Protection type according to DIN VDE 0530, EN 60034, Part 5

Part 5 of DIN VDE 0530 defines the protection types of **housings** for enclosed electrical machines. (The protection type does **not** cover the shaft seal!)

The type of protection is defined by the identification letters IP and the identification numbers.

First identification No.	Protection against contact and foreign bodies
0	No protection
1	Protection against large foreign bodies (Ø larger than 50 mm)
2	Protection against medium foreign bodies (Ø larger than 12 mm)
3	Protection against small foreign bodies (Ø larger than 2,5 mm)
4	Protection against granular foreign bodies (Ø larger than 1 mm)
5	Protection against damaging dust deposits
6	Protection against dust penetration

Second identification No.	Protection against water
0	No protection
1	Protection against vertically falling water droplets
2	Protection against water droplets falling at an angle (up to 15° to the vertical)
3	Protection against water spray (up to 60° to the vertical)
4	Protection against water spray (from all directions)
5	Protection against water jets (from all directions)
6	Protection against flooding
7	Protection against dipping
8	Protection against submerging

Example IP 54

Identification letters **IP**

First identification number **5**

Second identification number **4**

Motor is protected against dust and splashed water



Drive Design

The correct design of a drive can require a larger or smaller expenditure (advice, sampling, tests etc.) corresponding to the degree of difficulty of the application.

You can simplify the advice stage of complicated cases by previously clearing the following questions:

1. Which voltage supply or supplies is (are) available?

The voltage supply also normally determines the type of motor with its advantages and disadvantages. We differentiate between the following types with the corresponding voltage supplies.

- 1.1 Capacitor motors
 - Single phase supply with operating capacitor
 - Single-phase supply with frequency inverter
- 1.2 Three-phase current motors
 - 3-phase supply
 - Single-phase supply with frequency converter (3-phase output, other winding in this case)
- 1.3 Direct current motors
 - Single-phase supply with transformer and bridge rectifier
 - Single-phase supply and mains unit
 - Single-phase supply and control/regulation
- 1.4 Electronically commutated direct current motors and servomotors
Single-phase supply with transformer and controller
- 1.5 Stepping motors and servomotors
Single-phase supply with mains unit and control
- 1.6 Synchronous motors
 - Single phase supply with operating capacitor
 - Single-phase supply with frequency converter

2. Can you give the power demand for your machine as a function of the speed?

Accurate knowledge of the power profile enables the corresponding drive to be dimensioned more precisely.

Possible problems could be:

- Starting behaviour
- Acceleration ability
- Accuracy in maintaining speed
- Power peaks (can be as high as 5x the rated power)

3. What type of operation is required?

The type of operation is determined by the variation in time of the power output of the motor (for definitions see Page 7). Thus has a decisive effect on service life and size of the drive.

It is important to know the average on-period for short-time duty; for continuous duty the number of rotation changes is still of importance. Here also, it is a fact that: Accurate knowledge of the variation in time of the speed and torque enables the suitable drive to be dimensioned more precisely.

4. What is the service life that you expect from the drive?

In terms of service life brushless drives and capacitor-3-phase-synchronous and electronically commutated motors are clearly better than direct current motors with brushes.

As a rough approximate value, 20,000 to 40,000 operating hours can be attained for these. Depending on the application, conventional direct current motors can reach over 5,000 operating hours. However, operating and surrounding conditions can drastically reduce the service life.

5. What are the surrounding in which the drive will be placed?

5.1. Cooling conditions are the most important. Which coolants (generally air), ambient temperature, convection hinder or improve heat emission (fans), or hinder heat conduction, contact with hot areas (flanges), hot surfaces? These points are very important for determining the maximum power of the motor.

5.2. The surrounding conditions also determine the necessary type of protection against dust and water, according to the table on Page 8. It is important to note that the output shaft is **not** covered by the type of protection.

On the other hand, the terminal boxes and plugs often have a higher type of protection (see Pages 14/15).

5.3. In some cases it is also important to know the installation position and the position of the connection cable and plug.

6. Is thermal protection required?

Thermal protection is recommended if the drive is operated close to the permitted limit temperature. Two measures come into consideration for this:

6.1. Use of a PTC (Positive temperature coefficient) resistor (Tk)

This must be insulated and inserted into the winding. The temperature dependent resistance of the PTC resistor must be evaluated by external electronics; this therefore, does not offer inherent protection.

6.2. Thermocouple installation (Th)

The thermocouple is also insulated and inserted into the winding. The design of this thermocouple is possible as an ON or Off switch. If not otherwise requested the installation is made as an Off switch with a switching capacity of:

$$250 \text{ V} \quad 2,5 \text{ A at } \cos \varphi = 1 \\ 1,6 \text{ A at } \cos \varphi = 0,6$$

For single-phase alternating current the installation is carried out directly into the main phase. The motor is switched off when the set temperature is reached.

Two variations are available:

- Switching on again after cooling
- Switching on again only after disconnection from the supply.

7. Noise development

Are there any increased demands on noise development? Noise reduction is first of all possible by reducing the speed (use of 8 pole or 4 pole motors instead of 2 pole AC motors).

For the gears it is also possible to use laminated plastic in the first stage. The resonance amplitude can also be reduced by specially balancing the rotor. Other than that it is imperative to get advice on site.



Drive Design

8. Do you need a brake?

A motor equipped with a brake can be necessary to

- shorten the slowing-down time after switching the motor off (Slowing-down brake)
- hold the motor in a determined position after power failure (Holding or Safety brake)

9. Do you need speed control?

The use of a control system is recommended if the speed must be held exactly independent of other parameters. This consists of a sensor which measures the speed (shaft decoder, tachometer, resolver etc.) and control electronics. Our sales department will give you support for this.

10. Do you need gears?

Gears are needed to

- reduce the speed of the drive motor and
- at the same time increase the torque

If it is just a case of lowering the speed, there are enough possibilities today to do this electronically (controller, frequency converter). If however the torque must be substantially increased at the same time, this can only be done using a gear.

If i = the transmission then

$$n [\text{gear}] = \frac{n [\text{Motor}]}{i}$$

At the same time the torque is increased by the factor

$$M [\text{gear}] = M [\text{Motor}] \times i \times \eta$$

whereby η is the efficiency of the gear. When dimensioning a gear the transmission and output torque must be determined. The conversion of power and torque can be found from the approximation:

$$P [\text{W}] = \frac{M [\text{Ncm}] \times n [\text{min}^{-1}]}{955}$$

11. Which type of gear is advantageous?

We supply the following types:

- **Spur gears** also have high efficiency with large transmissions and offer an excellent price/performance relationship.
- **Worm gears** are characterised by continuous power transmission, power deflection through 90° and the option to have a second shaft end. The fact that they can self-lock and that efficiency is lower at high transmissions should be taken into consideration.
- **Planetary gears** offer triple meshing and the highest torque for a given volume. They are further characterised by a centric output shaft and high efficiency.

12. Which operational factors are present?

Reduction of the torque on the gear output

In order to get a uniform service life, the torque on the gear output of the various types of gear must be reduced (see the table below). The torque M available from the type of operation/load is found by multiplying the maximum rated torque M_{max} by the application factor f_b given in the table.

$$M = M_{\text{max}} \times f_b$$

For example the torque is $M = 0.5 \times M_{\text{max}}$ for the operation/load "rotation change, pulsating" for up to 10 changes, 24 h duty/day.

Generally "Running against a block" is not permitted as the gear can be destroyed. When designing a gear the application factors in the table must be observed. A calculation of the torque of the motor-gear combination must be made in every case.

Application factors f_b

Operation type	Load type			Operation period in h/day					
	Uniform	Pulsating	Surging	3 h up to 10 changes/h			8 h over 10 changes/h		
One rotation direction	○			1	1	0.83	1	0.83	0.66
Rotation change	○			1	0.77	0.63	0.83	0.63	0.52
One rotation direction		○		0.9	0.77	0.63	0.77	0.66	0.55
Rotation change		○		0.71	0.58	0.5	0.63	0.53	0.43
One rotation direction			○	0.83	0.66	0.55	0.66	0.55	0.45
Rotation change			○	0.63	0.5	0.43	0.5	0.43	0.35

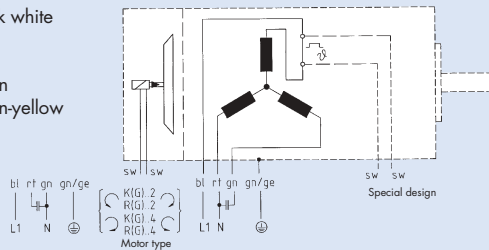
All details in the catalogue refer to an application factor $f_b = 1$.



Circuit Diagrams

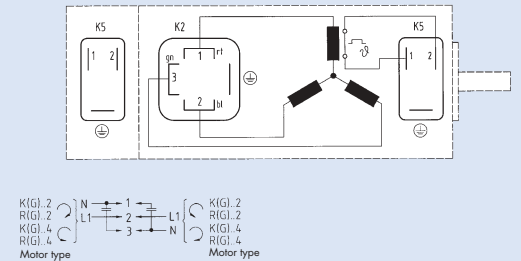
Single-phase capacitance motors series K, KV Synchronous motors series R

sw = black white
rt = red
bl = blue
gn = green
gn/ge = green-yellow



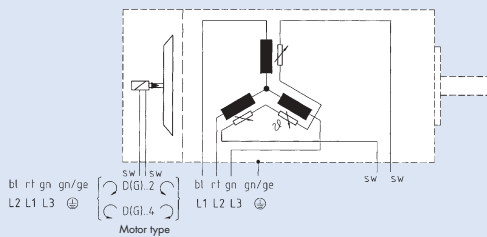
Circuit diagram. Loose stranded wire
Connection for motor types K ..8 correspond to K ..4

Slowing-down brake B Bimetal thermal protection optional



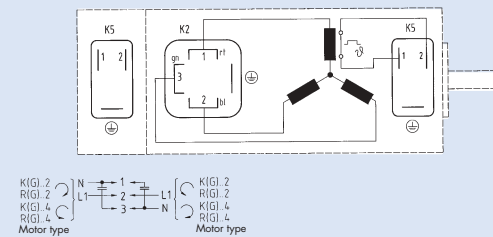
Circuit diagram, Connections K 5, K 2

3-phase current motors series D



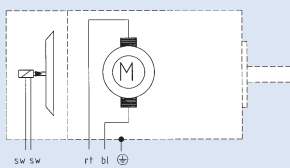
Circuit diagram. Loose stranded wire
Connection for motor types D ..8 correspond to D ..4

Slowing-down brake B PTC resistor thermal protection optional

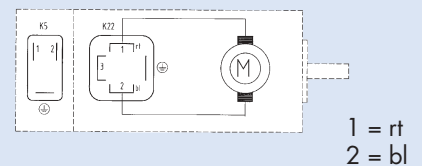


Circuit diagram, Connections K 5, K 22

Mechanically commutated direct current motors series G

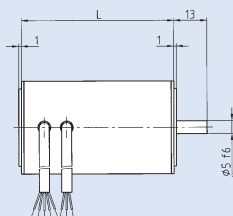


Circuit diagram. Loose stranded wire
rt bl input direction brushes



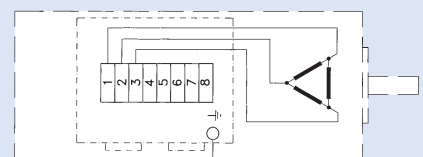
Circuit diagram, Connections K 5, K 2
rt bl input direction brushes

Electronically commutated direct current motors series M



Size 3: Loose stranded, 200 mm

Blue: Phase A	Violet: + 12 V
Red: Phase B	Black: 0 Volt
Green: Phase C	Orange: Sensor 1
	Yellow: Sensor 2
	White: Sensor 3



Size 5, 6, 8 Standard design

1 Phase A	4 RLG + 12 V
2 Phase B	5 0V
3 Phase C	6 Sensor 1
	7 Sensor 2
	8 Sensor 3



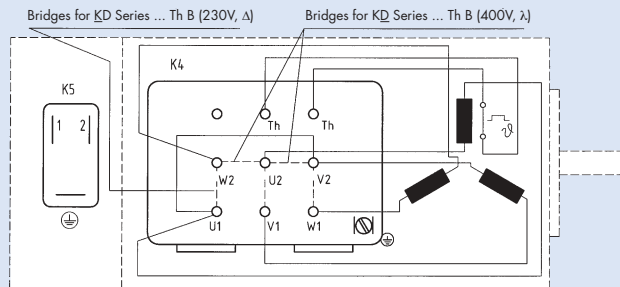
Circuit Diagrams, Plug Positions

Alternating/3-phase current motors series KD

KD-design with 6 pole terminal box and the option for slowing-down brake B as well as PTC resistor thermal protection

Slowing-down brake B optional

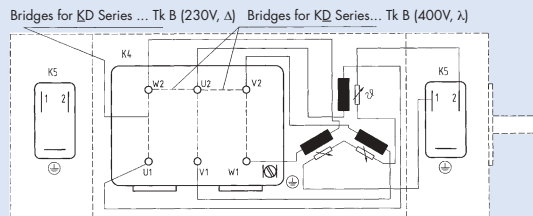
PTC resistor thermal protection, optional



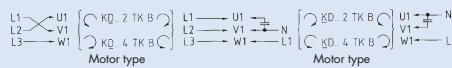
KD-design with 9 pole terminal box and the option for slowing-down brake B as well as bimetal thermal protection

Slowing-down brake B optional

Bimetal thermal protection, optional



All rotation direction details are with reference to the motor drive side

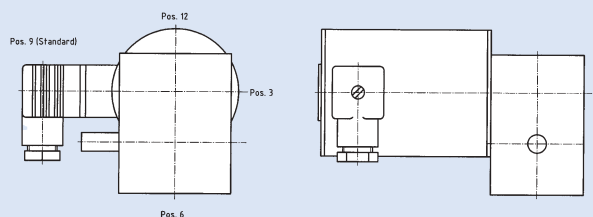
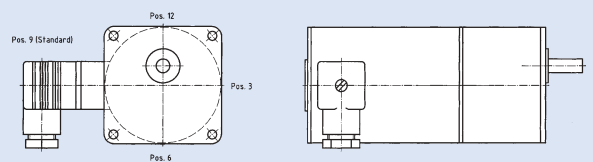


Plug Positions

Standard plug position (9 o'clock).
Intermediate positions possible, with the Exception of series G motors

Standard plug position left (9 o'clock).
for motors with gears series Z and M.

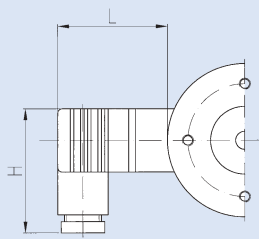
Standard plug position left (9 o'clock)
for motors with worm gears series S 345, S 567, S 668 and S 769.



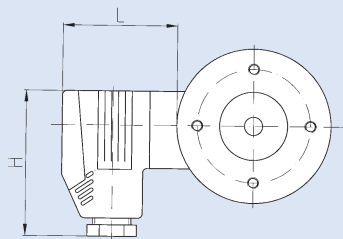


Types of Connection

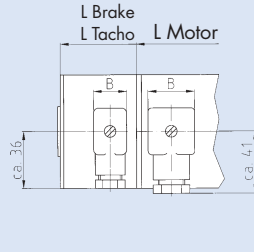
Alternating/3-phase current motors series KD



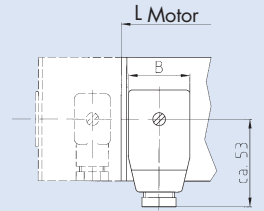
K 2/K 5



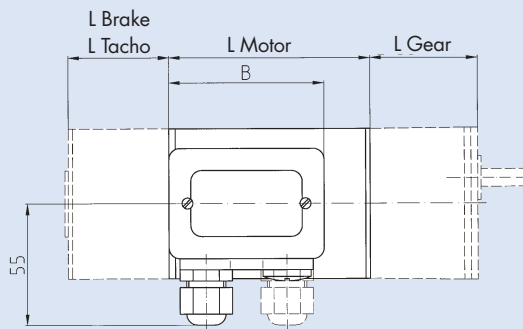
K 2



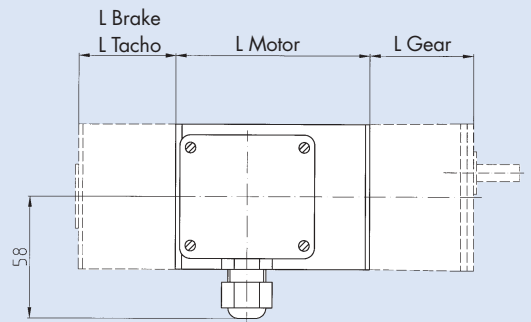
K 5 K 2



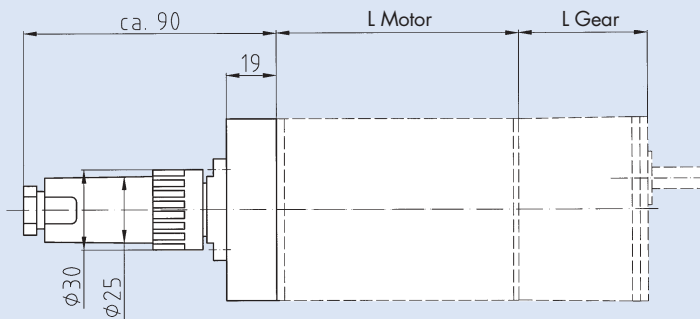
K 5 K 22



K 4

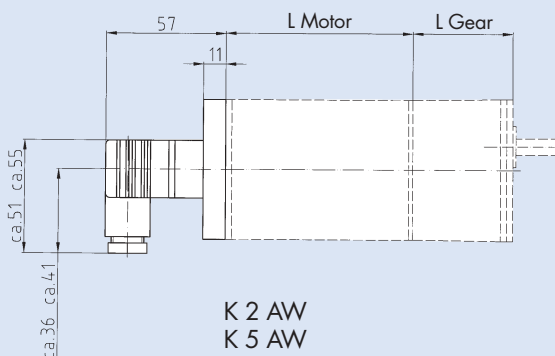


K 6

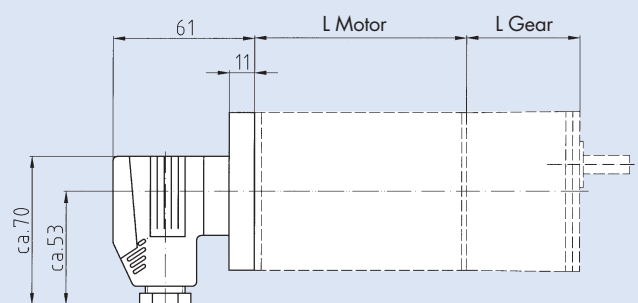


K 9

Optional connections



K 2 AW
K 5 AW



K 22 AW



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