ECO DRIVE
DKC 01.1/DKC 11.1 Drive Controllers

Project Planning Manual

DOK-ECODRV-DKC01/11.1*-PRJ3-EN-P
About this documentation

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Validity: The contents of this documentation and the availability of the product are subject to change.
What is this documentation for?

It supplies information on:

- planning the mechanical control cabinet
- planning the electrical system in the control cabinet
- logistic handling of the equipment
- preparing the resources for start-up

Supplementary documentation

"ECODRIVE DKC Servo Drives with MKD"
- Selection Lists -
DOK-ECODRV-DKC+MKD****-AUS1-EN-P
for selecting the motor controller combination.

"MKD Digital AC Motors"
- Project Planning Manual -
DOK-MOTOR*-MKD********-PRJ2-EN-P
for a detailed description of the servomotors and for the selection of the required cable.

"ECODRIVE DKC01.1/DKC11.1 Drive Controllers"
- Description of Functions -
DOK-ECODRV-DKC01/11.1-FKB1-EN-P
for testing and selecting the functions.

"EMC in Drive and Control Systems"
- Project Planning -
209-0049-4305-02 EN/04.96
for the EMC-compliant planning and installation of the drive system (EMC = Electromagnetic Compatibility).
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1 Introduction to the system

1.1 Application features

The drive system with the ECODRIVE drive controllers is the most cost-effective solution offering the highest functionality for almost any field of application in which translatory or rotary motions are to be automated. Outstanding performance data, an extensive range of functions as well as an excellent price-to-performance ratio represent the salient features of this drive system.

Product features in terms of the technical applications are:
- universal implementation
- lower total costs
- digital drive concept
- highly dynamic operation
- cost-effective direct connection to the power connection
- software travel limit switch
- absolute or incremental position detection
- absolute or incremental position output
- integrated holding brake control
- increased operating safety
- adjustable error response
- automatic parameter matching
- easy startup operation

1.2 Overview of the functions

The functions of the digital, intelligent drive system are differentiated primarily according to the interface of the higher-level control. The fields of application for the ECODRIVE drive controllers vary accordingly.

The drive controller **DKC01.1** is used as a:
- servodrive with integrated position control
- servodrive with analog speed interface and integrated actual position detection
- servodrive with stepper interface.
- servodrive with electronic gearbox function

The drive controller **DKC11.1** represents a particularly cost-effective solution. It is used as a:
- servodrive with analog speed interface and integrated actual position detection
Servodrive with integrated position control

- Up to 32 positioning blocks can be stored in the drive controller and selected over parallel inputs. The positioning block is executed autonomously.
- Mechanical translatory elements such as gear ratios or feed constants are adapted in the drive.
- All position, speed, and acceleration data can be weighted independently of the axis kinematics.
- A drive-internal referencing procedure is available for creating a reference dimension.
- The axis can be moved with the jog function during setup operation.
- The positioning speed can be influenced via the feedrate override.
- Travel limit switch inputs and axis limit values which can be parameterized are available for limiting the travel range.
- The drive status can be detected via status outputs.
Servodrive with analog speed interface and integrated actual position detection

- The analog speed command value can be set to any value.
- The actual position value is output either incrementally or absolutely.
- Using a switching input, the drive can be shut down independent of the command value and stopped free of drift during active control.
The number of steps per rotor rotation can be set to any value between 16 and 65536.

The maximum step frequency is independent of the load. It is technically impossible to "skip" steps due to the position controlled operation.

The stepper interface can be set to three standard signal definitions for exchanging signals between the control and the drive controller.

- quadrature signals
- forwards/backwards signals
- step and direction signal

A drive-internal referencing procedure is available for creating a reference dimension.

The axis can be moved with the jog function during setup operation.

The referencing and jog speed can be influenced via the feedrate override.

Travel limit switch inputs and axis limit values which can be parameterized are available for limiting the travel range.
Servodrive with electronic gearbox function

Fig. 1-4: Servodrive with electronic gearbox function

- Operating modes
  - Speed synchronization
  - Angle synchronization
- The lead axis position is given in degrees (360 degrees represent one lead axis encoder revolution)
- The lead axis encoder must be connected to the DKC stepper interface.

The maximum allowable signal frequency $f_{\text{max}}$ on the stepper interface limits the number of lines $Z_l$ which can be emulated.
Notes
2 Safety instructions for electrical drives

Please read the following instructions carefully before initial startup. These safety instructions must be observed at all times.
If the product is transferred to a third-party, the safety instructions must be included.

WARNING
Improper use of this equipment and non-compliance with the safety instructions provided can result in damage, personal injury or, in extreme cases, death.

2.1 General

INDRAMAT GmbH is not liable for any damages resulting from failure to observe the safety instructions in this document.

- Documentation in the relevant national language should be obtained before initial startup if the language in this documentation is not perfectly understood.
- Proper transport, correct storage, assembly, and installation as well as care in operation and maintenance are prerequisites for optimum and safe operation of this equipment.
- Qualified personnel:
  Only qualified personnel should be permitted to operate this equipment or work in its immediate vicinity. Personnel is considered qualified if it has sufficient knowledge of the assembly, installation, and operation of the product as well as all warnings and precautionary measures in this documentation.
  Furthermore, personnel should be trained, instructed or authorized to switch electrical circuits on and off and to ground and mark them in accordance with the requirements of safety engineering. Personnel should possess adequate safety equipment and be trained in first aid.
- Use only replacement parts approved by the manufacturer.
- All safety regulations and requirements for the specific application must be followed.
- The equipment is designed to be installed in machines for commercial use.
- Startup is only permitted once it is sure that the machine in which the products are installed complies with the requirements of the national safety regulations and safety specifications of the application. European countries: EC Directive 89/392/EEC (Machine Guideline)
- Operation is only permitted if the national EMC regulations for the specific application have been met. European countries: EC Directive 89/336/EEC (EMC Guideline)

The instructions for installation in accordance with EMC requirements can be found in the document "EMC Drive and Control Systems."
The responsibility for adherence to the limiting values required by national regulations lies with the manufacturer of the equipment or machine.
• Technical specifications as well as the connection and installation requirements can be found in the product documentation and must be observed under all circumstances.

2.2 Protection against contact with electrical parts

Note: Only relevant for devices and drive components with voltages exceeding 50 volts.

Coming into contact with components carrying voltages greater than 50 volts can be dangerous. Certain parts are under dangerous voltage when operating electrical devices.

**DANGER**

`High Voltage!`

Danger to life or risk of bodily injury!

⇒ Follow general construction and safety regulations when working on electrical installations.

⇒ Before switching on power, be sure that the ground wire is permanently connected to all electrical units according to the connection diagram.

⇒ At no time may electrical equipment be operated if the ground wire is not permanently connected to the proper terminals, even for brief measurements or tests.

⇒ Disconnect the equipment from the power supply line or the voltage source before beginning work. Secure equipment from reclosure.

⇒ Wait 5 minutes after switching off power to allow capacitors to discharge before using the equipment. Measure the voltage of the capacitors before beginning work in order to eliminate dangers arising from touching components.

⇒ Never touch the electrical connection points of a component while the power is turned on.

⇒ Cover live parts properly before switching the equipment on so they cannot be touched. Covers provided with the equipment must be installed before operating the equipment to prevent contact with live parts. The equipment may only be operated with the covers designed for shock-hazard protection.

⇒ A GFCI protective device (ground fault circuit interrupter) cannot be used for AC drives! Protection against indirect contact must be ensured by other means, for example, by using an overcurrent protection device in accordance with relevant standards. European countries: in accordance with EN 50178/1994, section 5.3.2.3

⇒ For installation equipment protection against indirect contact must be ensured using an external housing, such as a control cabinet. European countries: in accordance with EN 50178/1994, section 5.3.2.3
High discharge current!
Danger to life or risk of bodily injury!
⇒ All units and the motors must first be connected to a
grounding point with the ground wire or must be
grounded themselves before switching on power.
⇒ The discharge current is greater than 3.5 mA. A per-
manent connection to the power supply line is there-
fore required for all units. European countries (EN
50178/1994, section 5.3.2.3)
⇒ Before startup operation always connect the protec-
tive conductor or the ground conductor. Otherwise the
housing may harbor high voltages.

2.3 Protection against shocks caused by safety extra-low
voltage (SELV)

All connectors and terminals on INDRAMAT products with voltages from
5 to 50 volts are safety extra-low voltages offering a shockproof design to
meet the following standards:
• international: IEC 364-4-411.1.5
• European countries in the EC: EN 50178/1994, section 5.2.8.1

High electrical voltages due to incorrect connec-
tions!
Danger to life or risk of bodily injury!
⇒ Only equipment and lines carrying protective extra low
voltage (PELV) may be connected to connectors and
terminals with voltages ranging from 0 to 50 volts.
⇒ Connect only voltages and circuits safely isolated from
dangerous voltages. Isolation can be achieved, for
example, by using safe isolation transformers, opto-
couplers or power supply independent battery opera-
tion.
2.4 Protection against dangerous movements

Dangerous movements can be caused if the connected motors are not controlled correctly.

There are various causes of dangerous movements:
- faulty wiring or cable connections
- operating the components improperly
- defective measured value transmitters and primary detectors
- defective components
- errors in the software

These errors can occur just after the equipment has been switched on or after an indefinite period of time.

The monitors in the drive components virtually exclude failure in the connected drives. However, personnel safety requires that additional measures be taken to ensure correct operation. Faulty drive motions which are influenced by the type of control and the operating status cannot be entirely excluded until the installed monitors take effect.
Dangerous movements!
Danger may result in equipment damage, personal injury or death!
⇒ Personal safety must be ensured by higher-level, monitoring at the installation or precautionary measures for the reasons listed above. These are provided by the plant manufacturer according to the specific conditions of the plant based on a danger and malfunction analysis. The safety regulations in effect for the plant are included herein.

Avoiding accidents:
⇒ Stay away from the machine’s movement area. Possible measures to be taken to prevent access by unauthorized persons:
  - protective fence
  - protective railing
  - protective covering
  - light barrier
⇒ Fences and coverings should be strong enough to withstand the maximum possible momentum.
⇒ Mount the emergency stop switch (E-stop) at an easily accessible place in the immediate vicinity. Verify that the E-stop switch works before starting operation.
⇒ Isolate the drive power connection by means of an E-stop circuit or use a starting lock-out to prevent unintentional startup.
⇒ Make sure that the drives have been shut down before accessing or entering the danger zone.
⇒ Disable electrical power to the equipment using a master switch and secure against reclosure during:
  - maintenance and repair work
  - equipment cleaning
  - long downtime periods
⇒ Avoid operating high-frequency, remote control, and radio equipment near electrical equipment and their supply leads. If the use of such equipment cannot be avoided, verify that the system and plant are in perfect working order in all working situations before initial operation. If necessary, the plant must undergo special EMC testing.
2.5 Protection against magnetic and electromagnetic fields during operation and assembly

Magnetic and electromagnetic fields near current-carrying conductors and permanent magnets pose a serious health hazard for persons with pacemakers, metal implants and hearing aids.

![WARNING]

Health hazard for persons with pacemakers, metal implants and hearing aids in the immediate vicinity of electrical equipment.

⇒ Persons with pacemakers and metal implants must not be permitted access to the following areas:
   - Areas in which electrical equipment and parts are mounted, operated or put into operation.
   - Areas in which motor parts with permanent magnets are stored, repaired or mounted.

⇒ If it becomes necessary for a person with a pacemaker to enter such an area, this must be approved by a physician beforehand.

Implanted pacemakers or those to be implanted have a varying degrees of resistance to interference, making it impossible to establish any general guidelines.

⇒ Persons with metal implants or metal splitters as well as hearing aids should consult a physician before entering such areas since they represent a health hazard.
2.6 Protection during handling and assembly

Handling or assembling drive components improperly may lead to personal injury.

Risk of injury due to improper handling!
Bodily injury may be caused by crushing, shearing, cutting, and pounding forces.
⇒ Observe general construction and safety regulations when working on electrical installations.
⇒ Use suitable assembly and transport equipment.
⇒ Take precautions to prevent pinching and crushing.
⇒ Use only suitable tools. Use special tools as prescribed.
⇒ Employ lifting devices and tools according to the manufacturers’ instructions.
⇒ If necessary, use suitable protective equipment (for example goggles, safety shoes, protective gloves).
⇒ Do not stand under suspended loads.
⇒ Remove any leaking liquids on the floor immediately to prevent slipping.

2.7 Safe battery usage

Batteries consist of reactive chemicals contained in a solid case. Improper use can therefore lead to injuries or equipment damage.

Risk of injury due to improper handling!
⇒ Do not attempt to reactivate empty batteries by heating them or by any other means (danger of explosion or corrosion).
⇒ Do not recharge batteries because they may leak or explode.
⇒ Do not dispose of batteries by throwing them into a fire.
⇒ Do not attempt to disassemble batteries.
⇒ Do not damage the electrical components installed in the equipment.

Note: Environmental protection and disposal! The batteries contained in the product are considered hazardous material for land, sea, and air transport according to the legal regulations (danger of explosion). Dispose used batteries separately from other waste. Observe the national regulations in the country of installation.
Notes
3 Selecting the components

3.1 Overview of the required components

---

Those components shown with a gray-shaded background are absolutely necessary.

Fig. 3-1: Overview of the required components
3.2 Selection procedure

Dimensioning and selecting the servo drive
⇒ Dimension the drive according to how it is to be used. A document for this is under preparation.
⇒ Select motor/drive combination (DKC + MKD) using the "Selection Data" documentation (see pg. 3, supplementary documentation).

Compiling the required data
⇒ Enter the values obtained from dimensioning and enter the drives selected into table Fig. 3-2.
⇒ Calculate the continuous regenerative power according to the specifications in Chapter 5 and enter them in table Fig. 3-2.

Selecting the required components
⇒ Use firmware "FWA-ECODRV-ASE-02VRS-MS" for DKC01.1-*** and DKC11.1-*** (no selection required at this time)
⇒ "Select ready-made cables for the connection between the DKC and MKD by using the document "MKD Servomotors - Project Planning Manual" (see pg. 3 of supplementary documentation)."
⇒ Select fuse protector Q1 (see Chapter 11.2).
⇒ Select line contactor K1 (see Chapter 11.2).

Determining components which may be additionally required
⇒ Check the rated line voltage.
  • If, in the case of the DKC**.*-040-7, the rated line voltage falls below or exceeds 3xAC (380-460)V ±10%, select a DST transformer (see Chap. 9.2).
  • If, in the case of the DKC**.*-030-3, the rated line voltage falls below or exceeds 3xAC230V ±10%, select a DST transformer (see Chap. 9.3).
⇒ Check the DC24V control voltage supply for the DKC. If a voltage of DC24 Volt ± 20 % is not available, select a suitable NTM power supply (see Chap. 7).
⇒ Check the DC24V voltage for the motor holding brake. If a voltage of DC24 Volt ± 10 % is not available, then select a suitable NTM power supply (see Chap. 7).
⇒ Check the continuous regenerative power. If it exceeds 0.15 kW, then consider option with BZM auxiliary bleeder module (see Chap. 5).
⇒ Check the peak regenerative power. If it exceeds 5 kW, then consider option with DKC**.*-040-7 and if needed, the BZM auxiliary bleeder module (see chapter 5).
⇒ If the continuous regenerative power exceeds approx. 0.1 kW and the drive system energy content is less than 200W, the use of an auxiliary capacitance module CZM can be economical. This makes it possible to reduce the dissipated energy for the control cabinet by an amount equal to the continuous regenerative power (see Chap. 6).
⇒ Check the EMC conditions. INDRAMAT recommends the use of NFD or NFE mains filters to maintain EMC limiting values (see Chap. 8).
### 3.3 Compiling the required data

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<tr>
<th>Designation</th>
<th>Symbol</th>
<th>Values/Units</th>
</tr>
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<tbody>
<tr>
<td>Effective load torque</td>
<td>( M_{EFF} )</td>
<td>in Nm</td>
</tr>
<tr>
<td>Acceleration torque</td>
<td>( M_{ACC} )</td>
<td>in Nm</td>
</tr>
<tr>
<td>Operating torque</td>
<td>( M_{BEARB} )</td>
<td>in Nm</td>
</tr>
<tr>
<td>Motor speed used</td>
<td>( \text{in} \ \text{NUTZ} )</td>
<td>in min(^{-1})</td>
</tr>
<tr>
<td>Load moment of inertia</td>
<td>( J_{LAST} )</td>
<td>in kgm(^2)</td>
</tr>
<tr>
<td>Maximum rotary energy in the mechanical system (E-stop case)</td>
<td>( W_{ROT,MAX} )</td>
<td>in Ws</td>
</tr>
<tr>
<td>Continuous regenerative power</td>
<td>( P_{RD} )</td>
<td>in kW</td>
</tr>
<tr>
<td>Continuous torque at standstill</td>
<td>( M_{ON} )</td>
<td>in Nm</td>
</tr>
<tr>
<td>Maximum torque</td>
<td>( M_{MAX} )</td>
<td>in Nm</td>
</tr>
<tr>
<td>Short-term operation torque</td>
<td>( M_{KB} )</td>
<td>in Nm</td>
</tr>
<tr>
<td>Maximum motor speed</td>
<td>( n_{MAX} )</td>
<td>in min(^{-1})</td>
</tr>
<tr>
<td>Required power connection output</td>
<td>( S_{AN} )</td>
<td>in kVA</td>
</tr>
<tr>
<td>Required mains rated voltage</td>
<td>( U_{N} )</td>
<td>in V</td>
</tr>
<tr>
<td>Motor/controller combination</td>
<td>DKC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MKD</td>
<td></td>
</tr>
<tr>
<td>Motor moment of inertia</td>
<td>( J_{M} )</td>
<td>in kgm(^2)</td>
</tr>
<tr>
<td>DKC current consumption</td>
<td>( I_{DC} )</td>
<td>0.7</td>
</tr>
<tr>
<td>Power consumption of the motor holding brake (if present) refer to the project planning manual MKD Motors</td>
<td>( I_{N,HB} )</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 3-2: Data required for selecting the components
4 ECODRIVE DKC drive controllers

4.1 Hardware

View of unit

![DKC controllers view](image)

**Fig. 4-1: Main distinguishing hardware features of the DKC controllers**
Dimensional sheets and installation dimensions

Fig. 4-2: Dimensional data and installation dimensions DKC01.1-030-3-FW
Fig. 4-3: Dimensional data and installation dimensions DKC01.1-040-7-FW/DKC11.1-040-7-FW
## Technical data

### Power connection / Power section

<table>
<thead>
<tr>
<th>Designation</th>
<th>Symbol</th>
<th>Unit</th>
<th>DDKC01.1-030-3-FW</th>
<th>DDKC**.1-040-7-FW</th>
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<tbody>
<tr>
<td>Operating mode at the mains</td>
<td></td>
<td></td>
<td>single-phase</td>
<td>three-phase</td>
</tr>
<tr>
<td>Mains input voltage</td>
<td>( U_n )</td>
<td>V</td>
<td>1 x AC 230 ± 10%</td>
<td>3 x AC 230 ± 10%</td>
</tr>
<tr>
<td>Maximum conn. voltage</td>
<td>( S_{MAX} )</td>
<td>kVA</td>
<td>1,8</td>
<td>3,2</td>
</tr>
<tr>
<td>Making current</td>
<td>( I_{EN} )</td>
<td>A</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mains frequency</td>
<td>( f_s )</td>
<td>kHz</td>
<td>50...60</td>
<td>50...60</td>
</tr>
<tr>
<td>Switching frequency (selectable)</td>
<td></td>
<td>kHz</td>
<td>4 or 8</td>
<td>4 or 8</td>
</tr>
<tr>
<td>Continuous current at ( f_s = 4 ) kHz</td>
<td>( I_{CONT} )</td>
<td>A</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Continuous current at ( f_s = 8 ) kHz</td>
<td>( I_{CONT} )</td>
<td>A</td>
<td>11</td>
<td>12,5</td>
</tr>
<tr>
<td>Rated current</td>
<td>( I_{VTP} )</td>
<td>A</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>Peak current</td>
<td>( I_{PEAK} )</td>
<td>A</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>Power dissipation, without bleeder dissipation</td>
<td>( P_i )</td>
<td>W</td>
<td>100</td>
<td>180</td>
</tr>
<tr>
<td>Peak bleeder output DDKC</td>
<td>( P_{BM.DDKC} )</td>
<td>kW</td>
<td>5 (for 1 s)</td>
<td>10 (for 0,5 s)</td>
</tr>
<tr>
<td>Continuous bleeder output DDKC</td>
<td>( P_{BD.DDKC} )</td>
<td>kW</td>
<td>0,15</td>
<td>0,15</td>
</tr>
<tr>
<td>Maximum feedback energy DDKC</td>
<td>( W_{MAX.DDKC} )</td>
<td>kW</td>
<td>5,0</td>
<td>5,0</td>
</tr>
<tr>
<td>Storage energy DDKC</td>
<td>( W_{SW.DDKC} )</td>
<td>Ws</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>DC bus capacitance</td>
<td>( C_{DKC} )</td>
<td>mF</td>
<td>0,15</td>
<td>0,15</td>
</tr>
<tr>
<td>DC bus voltage</td>
<td>( U_{DC} )</td>
<td>V</td>
<td>not lead to the outside</td>
<td>DC 500...800</td>
</tr>
</tbody>
</table>

1) The drive data for 4 and 8 kHz switching frequencies are listed in the document "ECODRIVE DKC servo drive" - Selection Data.
2) Value dependent on power input voltage

---

### DC24V Power supply

<table>
<thead>
<tr>
<th>Designation</th>
<th>Symbol</th>
<th>Unit</th>
<th>DDKC01.1-030-3-FW</th>
<th>DDKC**.1-040-7-FW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control voltage connection for DDKC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input voltage</td>
<td>( U_{N,DC} )</td>
<td>V</td>
<td>DC (19,2 ... 28,8) V</td>
<td></td>
</tr>
<tr>
<td>Maximum ripple content</td>
<td>( w )</td>
<td>%</td>
<td>must not exceed the input voltage range</td>
<td></td>
</tr>
<tr>
<td>Current consumption</td>
<td>( I_{N,DC} )</td>
<td>A</td>
<td>0,7</td>
<td></td>
</tr>
</tbody>
</table>

**Voltage connection for holding brake**

| Input voltage                           | \( U_{N,HB} \) | V      | DC 24 ± 10%       |                   |
| Maximum ripple content                  | \( w \) | %      | must not exceed the input voltage range |
| Current consumption                     | \( I_{N,HB} \) | A      | please see MKD dokumentation |
Additional connection of the DC24 power supply

The DKC drives should be firmly connected to the DC24V power supply; preferred method Fig. 4-6

They can also be connected to the DC24V power supply in a switchable manner Fig. 4-7

---

**Preferred method:**
The power supply is firmly connected to the attached DKC

![Diagram of preferred method](image1)

**Connecting additional DKC`s**

**The power supply is connected to the attached DKC in a switchable manner**

![Diagram of switchable method](image2)

**Fig. 4-6:** Principle for connecting the DC24V control voltage by switching on the power supply via Q2, preferred method

**Fig. 4-7:** Principle for connection the 24V via S1 with a starting current limiter
Ambient and installation conditions

Selection lists are specified for each motor/drive documentation. Please refer to the documentation "ECODRIVE Servodrives DKC with MKD - Selection Lists -

The selection lists apply within the given ambient and installation conditions (see Fig. 4-9).

For different conditions, the short-term operating torque is reduced according to the diagrams (see Fig. 4-8). If deviating ambient temperatures and higher installation altitudes occur simultaneously, both load factors must be multiplied.

![Fig. 4-8: Load utilization as a value dependent upon ambient temperature and installation altitude](image)

<table>
<thead>
<tr>
<th>Designation</th>
<th>Symbol</th>
<th>Unit</th>
<th>DKC01.1-030-3-FW</th>
<th>DKC**.1-040-7-FW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient and installation conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling the power section</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permissible ambient temperature with nominal data</td>
<td>$T_{UM}$</td>
<td>°C</td>
<td></td>
<td>+0...+45</td>
</tr>
<tr>
<td>Max. permissible ambient temperature with reduced nominal data</td>
<td>$T_{UM,MAX}$</td>
<td>°C</td>
<td></td>
<td>+55</td>
</tr>
<tr>
<td>The values indicated in the selection data for $M_{DN}$ and $M_{KB}$ drop in the range of +45 to +55°C by 2% per °C of rise in temperature.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage and transport temperature</td>
<td>$T_{L}$</td>
<td>°C</td>
<td></td>
<td>-30...+85</td>
</tr>
<tr>
<td>Max. installation elevation with nominal data</td>
<td>m</td>
<td></td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Max. permissible relative humidity</td>
<td>%</td>
<td></td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>Max. permissible absolute humidity</td>
<td>g/m³</td>
<td></td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Degree of contamination</td>
<td></td>
<td></td>
<td>Non-conductive dirt contamination, no condensation</td>
<td></td>
</tr>
<tr>
<td>Protection category</td>
<td></td>
<td></td>
<td>IP20, as per EN 60529 = DIN VDE 0470-1-1992 (IEC 529-1989) stationary use in control cabinets</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>m</td>
<td>kg</td>
<td>4.4</td>
<td></td>
</tr>
</tbody>
</table>

![Fig. 4-9: Ambient and installation conditions](image)
Type code and rating plate

<table>
<thead>
<tr>
<th>Type code fields:</th>
<th>Example: DKC 01.1 - 040 - 7 - FW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive controller</td>
<td>DKC</td>
</tr>
<tr>
<td>Series</td>
<td>01</td>
</tr>
<tr>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Version</td>
<td>1</td>
</tr>
<tr>
<td>Type</td>
<td>30 A</td>
</tr>
<tr>
<td></td>
<td>40 A</td>
</tr>
<tr>
<td>Rated intermediate circuit voltage</td>
<td>300 V</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Firmware</td>
<td>FW</td>
</tr>
</tbody>
</table>

A firmware specifying the functions of the drive must be ordered separately.

Fig. 4-10: DKC type code

<table>
<thead>
<tr>
<th>Type of machine</th>
<th>Production week</th>
</tr>
</thead>
<tbody>
<tr>
<td>DKC01.1-040-7-FW</td>
<td>K16/96</td>
</tr>
<tr>
<td>253158</td>
<td></td>
</tr>
<tr>
<td>SN253160-01708</td>
<td>A03</td>
</tr>
</tbody>
</table>

Fig. 4-11: DKC rating plate
4.2 Firmware

The firmware located in the drive controller determines the functional features of the ECODRIVE drive controller.

The firmware "FWA-ECODRV-ASE-02VRS-MS" is for the drive controllers DKC01.1-*** and DKC11.1-***.

The firmware has its own order number. This means that it is always possible to order the identical firmware version.

The firmware is updated constantly to eliminate any bugs without altering the functionality. It is identified on the type code as the firmware release version.

If newer functions are added, the index of the firmware version is incremented (see type codes).

![Type codes: Example: FWA-ECODRV-ASE-02VRS-MS](image1)

![Fig. 4-12: ECODRIVE firmware type code](image2)

![Fig. 4-13: Firmware rating plate](image3)
4.3 An overview of the electrical connections

Front view with supply terminals

---

**X5:**
15-pole D-Sub connector (INS 439)

**X1, X2, X3, X4, X6:**
Screw-down push-in terminals
0.2...2.5 mm², AWG 24-12

**X7, X8, X9:**
Screw-down push-in terminals
0.2...4 mm², AWG 24-10

---

1) not on DKC11.1-040-7-FW

---

Fig. 4-14: Front view of the DKC with supply terminals
Overall connection diagrams

Fig. 4-15: DKC01.1 with POSITIONING interface
ECODRIVE DKC01.1/DKC11.1 Drive Controllers

DKC01.1 drive controller in operating mode
ANALOG interface

1) Switching capacity DC 24 V / 2.5 A
2) Specifications for ready-made cables, connectors, and types of cables can be found in the documentation "Connection Accessories for INDRAMAT drives" cable document no. 209-0050-4399-XX or in the motor project planning manuals.
3) The ground connector of units with discharge currents > 3.5 mA must be at least 10 mm² for mechanical reasons. (DIN VDE 0160/EN 50178)

Symbols:
- □ Plug-in terminal
- □ Plug-in screw terminal, male
- □ Plug-in connector, male
- - Plug-in screw terminal, female
- - Plug-in connector, female

Fig. 4-16: DKC01.1 with ANALOG interface; Supply terminal assignment
4-12 ECODRIVE DKC drive controllers

ECODRIVE DKC01.1/DKC11.1 Drive Controllers

Fig. 4-17: DKC11.1-040-7-FW with ANALOG interface
ECODRIVE DKC01.1/DKC11.1 Drive Controllers

ECODRIVE DKC drive controllers 4-13

Fig. 4-18: DKC01.1 with stepping interface
4.4 Electrical connection to the supply terminal strips

The description of the electrical connections below are first grouped according to numbers of the supply terminal strips (e.g. X1, X2 etc.) and then according to the functions.

Serial interface X1

The serial interface is generally used for programming, parameterization and diagnoses during startup operation and service procedures. It can be alternatively operated as a RS 232 or RS 485.

RS-232 interface

The RS-232 interface is needed for programming, parameterizing and diagnosis during startup operation and service procedures. It is also used when setting the drive addresses as a requirement for operations via RS-485. With the RS 232, it is possible to parameterize only one drive at a time when using the DriveTop startup program.

Fig. 4-19: Connecting a PC to a RS-232 interface on a DKC
**RS-485 interface**

The RS-485 interface is needed for programming, parameterizing and diagnosis during startup operation and service procedures.

The RS 485 interface allows:

- the implementation of a serial bus with up to 31 stations connected by means of a twisted pair cable (half duplex mode),
- a transmission length of up to 500 meters
- data rates of 9600/19200 baud and
- the implementation of a central PC-based visualization unit.

Via the RS-485 several DKCs can be put into operation with Drive Top without reconnecting the interface cable.

To operate DriveTop with several ECOGRIVEs, a RS-232/485 converter is required between the PC and the drives.

The following application example displays a tested assembly with RS-485 connection using the Phoenix Contact converter PSM-EG-RS232/RS485-P/2D.

**Interface converter PSM-EG-RS232/RS485-P/2D**

The Phoenix Contact interface converter PSM-EG-RS232/RS485-P/2D implements the interface in a way suited for industrial use and for assembly in cabinets.

---

**Note:**

The cable connection to the equipment must not be arranged in a star topology but must be wired individually from one DKC to the next.

The RS-485 requires a terminator on both ends. Both the terminator integrated into the interface converter (180 Ohms) and the pull-up and pull-down resistors (470 Ohms each) must be activated. The other end of the cable must also be terminated with a 180 Ohm / 0.5W resistor. The terminator is connected directly to the DKC, plug X1, pins 4 and 5.
Switch position in the interface converter

The converter can be modified for various peripherals by using specific switch positions. The switch positions shown below must be used strictly for the following wiring diagrams.

- Switch RS-485 to **ON**
  \[ \Rightarrow \text{180 Ohm circuit termination and 470 Ohms pull-up/down are connected} \]
- Switch RS232 to **DTE** (Data Terminal Equipment) data direction change-over for RS-485 via RTS
  \[ \Rightarrow \text{pin 2: TxD, pin 3: RxD,} \]
- Set the jumper connection to 3 and 4 - data direction change-over polarity
  \[ \Rightarrow \text{transmit mode: Signal to RTS +3V to +15V} \]
  \[ \Rightarrow \text{receive mode: Signal to RTS -3V to -15V} \]

![Fig. 4-21: Switch position /jumper position in the interface converter PSM-EG-RS232 / RS 485-P / 2D](XX5000D1.th5)
The interface converter must be connected via the D-SUB male connector because of the effects of interference.

1) Connect the outer shield to the PC and converter at the ground potential (strain relief of the metallized connector shell)
2) Data direction for switch position S1 = DTE

Fig. 4-22: RS-232 cable (PC interface converter)

1) Connect the outer shield to the PC and converter at the ground potential (strain relief of the metallized connector shell)
2) Data direction for switch position S1 = DTE

Fig. 4-23: RS-485 cable (interface converter - DKC)
X2 positioning or stepper interface

Note: Does not apply to the DKC11.1-040-FW!

The cables for the control inputs and status reports required for both the POSITIONING interface and the stepper interface are connected to the X2/(13-24) supply terminals.

The X2/(1-12) supply terminal is given its function by parameterizing the operating mode during startup.

- The positioning blocks are selected at the POSITIONING interface.
- The signals for the stepper motor control are transmitted via these terminal strips at the stepper interface.

Control inputs and status reports in the positioning and stepper interface

Control inputs for referencing

Fig. 4-24: Inputs for referencing
Control inputs for jog mode

- **Positive jog**: HIGH, 0.5 mm², max. 20 m, X2
- **Negative jog**: HIGH, 0.5 mm²

Inputs:

<table>
<thead>
<tr>
<th>Input voltage</th>
<th>min.</th>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>16 V</td>
<td>30 V</td>
</tr>
<tr>
<td>LOW</td>
<td>-0.5 V</td>
<td>8 V</td>
</tr>
</tbody>
</table>

Input resistance: approx. 8 kOhm

Fig. 4-25: Jog inputs

Control inputs for the travel range limit/sensor inputs

- **Positive limit switch**: HIGH, 0.5 mm², max. 20 m, X2
- **Negative limit switch**: HIGH, 0.5 mm²

Inputs:

<table>
<thead>
<tr>
<th>Input voltage</th>
<th>min.</th>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>16 V</td>
<td>30 V</td>
</tr>
<tr>
<td>LOW</td>
<td>-0.5 V</td>
<td>8 V</td>
</tr>
</tbody>
</table>

Input resistance: approx. 8 kOhm

Useful in operating mode: Positioning interface

Fig. 4-26: Travel limit switch
Status reports

max. 20 m

0 V$_{\text{ext}}$

Outputs:

<table>
<thead>
<tr>
<th>Output voltage</th>
<th>min.</th>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>16 V</td>
<td>U$_{\text{ext}}$</td>
</tr>
<tr>
<td>LOW</td>
<td>0 V</td>
<td>1 V</td>
</tr>
</tbody>
</table>

Output current I$_\text{out}$: 80 mA

Rise and fall time: ca. μs

Overload protection: when out > 300 mA the output switch to LOW

Fig. 4-27: Status reports
Positioning interface

Positioning signals and outputs for acknowledging the positioning signals

Inputs:

<table>
<thead>
<tr>
<th>Input voltage</th>
<th>min.</th>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>16 V</td>
<td>30 V</td>
</tr>
<tr>
<td>LOW</td>
<td>-0.5 V</td>
<td>8 V</td>
</tr>
</tbody>
</table>

Input resistance: approx. 5 kΩ

Outputs:

<table>
<thead>
<tr>
<th>Output voltage</th>
<th>min.</th>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>16 V</td>
<td>U_{\text{ext.}}</td>
</tr>
<tr>
<td>LOW</td>
<td>0 V</td>
<td>1 V</td>
</tr>
</tbody>
</table>

Output current I_{\text{out}}: 80 mA

Rise and fall time: ca. 5 µs

Overload protection: when I_{\text{out}} > 300 mA the outputs switch to LOW

Fig. 4-28: Connecting the positioning input signals and outputs for acknowledging the positioning signals
**Note:** If the inputs POS 1 and POS 2 in Fig. 4-28 are assigned a LOW signal, 5 volts are applied there. If a PLC is connected, this can cause the control LEDs to respond. This is prevented by an interconnected blocking diode in accordance with the circuit proposal Fig. 4-29.

![Fig. 4-29: Circuit proposal](image)

### Stepper interface

Control modes via the stepper interface

1: Quadrature-signals

![Graph](image)

2: Forward-backwards-signals

![Graph](image)

3: Step and direction signals

![Graph](image)

![Fig. 4-30: Control modes of the stepper interface](image)
Control with differential signals

- Logical 1 is recognized if a positive differential voltage is applied from SM+ to SM-.
- Logical 0 is recognized if a negative differential voltage is applied from SM+ to SM-.
- To increase noise immunity, the differential voltage range should be at least 2.5 volts. The greater the differential voltage range, the higher the operational reliability against interference.

![Control with differential signals](image)

Fig. 4-31: Control with differential signals
**Single-channel control via npn – open-collector outputs (NPN)**

Dimensioning the pull-up resistors (2k4 resistors in Fig. 4-32) depends on the load capability (current, power dissipation) of the open-collector outputs of the control.

**Note:** Controlling the stepper interface with differential signals is preferable to single-channel control as the noise immunity of differential signals is generally better than with zero-referenced signals.

---

**Fig. 4-32: Control with open-collector outputs**
X3 analog inputs and outputs

The inputs and outputs for operating the analog interfaces are connected via the supply terminal X3/(1-8).

- torque reduction
- setpoint input
- diagnostics outputs
- override function for positioning control

The actual position is output either as an incremental, parallel or absolute value serial via the X3/(9-16) supply terminal.

Analog interface

Analog setpoint input for control of speed or torque and override function

Inputs:

<table>
<thead>
<tr>
<th>Input voltage</th>
<th>min.</th>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>between E1-E2</td>
<td>±10 V</td>
<td>±15 V</td>
</tr>
<tr>
<td>between E1-0VM; E2-0VM</td>
<td>±10 V</td>
<td>±15 V</td>
</tr>
<tr>
<td>Input current: E1; E2</td>
<td>0.5 mA</td>
<td></td>
</tr>
<tr>
<td>Input resistance</td>
<td>approx. 20 kOhm</td>
<td></td>
</tr>
<tr>
<td>Input drift</td>
<td>18 µV/°C</td>
<td></td>
</tr>
<tr>
<td>AD-convertor</td>
<td>12 Bit</td>
<td></td>
</tr>
<tr>
<td>Resolution per Bit</td>
<td>4.8 mV</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 4-33: Analog setpoint input
Torque reduction

Inputs:
- Input voltage: ±10 V
- Input current: 0.5 mA
- Input resistance: approx. 20 kOhm
- Input drift: 18 µV/°C
- AD-convertor: 12 Bit
- Resolution per Bit: 4.8 mV

Outputs:
- Output voltage: ±10 V
- DA-transformer: 8 Bit
- Resolution per Bit: 78 mV

Fig. 4-34: Connecting the analog torque reduction

Diagnostics outputs

Outputs:
- Output voltage: ±10 V
- DA-transformer: 8 Bit
- Resolution per Bit: 78 mV

Fig. 4-35: Connection assignments of the diagnostic outputs
ECODRIVE DKC01.1/DKC11.1 Drive Controllers

Actual position value

360° electric = one cycle

Square-wave pulse looking onto motor shaft and with clockwise rotation

$t_1 < 50\,\text{ns}$

Fig. 4-36: Signals for the incremental actual position value output

CNC
Positions-interface -incremental-

$0\,\text{V}_{\text{ext}}$

RS422 compatible differential outputs:

<table>
<thead>
<tr>
<th>Output voltage</th>
<th>min.</th>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH</td>
<td>2.5 V</td>
<td>5 V</td>
</tr>
<tr>
<td>LOW</td>
<td>0 V</td>
<td>0.8 V</td>
</tr>
</tbody>
</table>

Output current $I_{\text{out}}$: max. 20 mA

Output frequency: max. 504 kHz

Overload: Do not short-circuit outputs. Danger of damage!

Fig. 4-37: Incremental actual position value output
Recommended input circuit for secondary electronics

RS-422
DIN 66 259, sec. 3

+5V

Z0 = 120 W

Recommended differential line receiver
AM 26 LS 32
MC 3486
SN 75 ALS 193
SN 75 ALS 195

Fig. 4-38: Recommended input circuit

Actual position value, in the SSI format

G0 = least significant bit in gray code
G23 = most significant bit in gray code
m = stored parallel information
T = pulse time max. 10 µs min. 1 µs
\( t_m \) = monoflop time 25 µs
\( T_p \) = pulse break 25 µs
\( t_v \) = delay time of the first pulse max. 540 ns, all others 360 ns
PFB = power failure bit (not used and always logically LOW)

Fig. 4-39: Pulse timing diagram for absolute actual position value output (SSI format)
**Actual value position SSI format**

![Actual value position SSI format diagram]

**RS422 compatible differential outputs:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output voltage</td>
<td>2.5 V</td>
<td>5 V</td>
</tr>
<tr>
<td>LOW</td>
<td>0 V</td>
<td>0.8 V</td>
</tr>
<tr>
<td>Output current I&lt;sub&gt;out&lt;/sub&gt;</td>
<td></td>
<td>20 mA</td>
</tr>
<tr>
<td>Overload protection</td>
<td>Outputs may not be short-circuited. Danger of damage!</td>
<td></td>
</tr>
</tbody>
</table>

**RS422 compatible differential inputs:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage</td>
<td>2 V</td>
<td>5 V</td>
</tr>
<tr>
<td>LOW</td>
<td>0 V</td>
<td>0.8 V</td>
</tr>
<tr>
<td>Input resistor</td>
<td>12 kOhm</td>
<td></td>
</tr>
<tr>
<td>Pulse frequency</td>
<td>(100-1000) kHz</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 4-40: Output of the absolute actual position value according to the SSI format

**X4 terminals for the control circuit**

![X4 terminals for the control circuit diagram]

**Inputs:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage</td>
<td>16 V</td>
<td>30 V</td>
</tr>
<tr>
<td>LOW</td>
<td>-0.5 V</td>
<td>8 V</td>
</tr>
<tr>
<td>Input resistance</td>
<td>approx. 8 kOhm</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 4-41: Terminals for the control inputs, control voltage, and stand-by contact
X5, X6, X7 motor connections

For the terminal connection assignments to the motor connections, refer to the overall connection diagram in Fig. 4-15.
For further information, please see the documentation "ECODRIVE servomotors MKD" - Project Planning Manual -.

X9 DC bus connection

| Note: Does not apply to DKC01.1-030-3-FW! |
| DC bus connection for connecting: |
| an auxiliary bleeder module BZM01.1 |
| or |
| an auxiliary capacitance module CZM01.1 |
| or |
| a DKC drive controller |

The maximum line length is 1.0 m (twisted) with at least a 2.5 m² cross section.

Fig. 4-42: DC bus connection
5  BZM auxiliary bleeder module

5.1 Dimensioning the components relevant for regeneration

For each servo-technical application, it is necessary to check whether the
• continuous regenerative power
• peak regenerative power
• regenerative energy
needed for the application can be sufficiently absorbed by the bleeder (brake resistance).

If the available regenerative power and energy from the mechanics ex-
cceeds the absorbing capabilities of the bleeder built into the unit, this ca-
pability can be increased on the DKC**.*-040-7-FW by using the following
hardware configurations.
• A drive and auxiliary bleeder module connected via the DC bus circuit.
  (1 DKC+BZM)
• Several drive controllers connected via the DC bus circuit. (up to 6
  DKCs)
• Several drive controllers and auxiliary bleeder modules connected via
  the DC bus circuit. (up to 6 DKC+BZM)
1. Continuous regenerative power

\[ P_{RD} \leq P_{BD,DKC} + P_{BD,BZM} \]

\[ P_{RD} = \frac{\sum W_{\text{ROT}} + \sum W_{\text{POT}}}{t_{z} \cdot 1000} \]

\[ W_{\text{ROT}} = \frac{J_{\text{LAST}} + J_{M}}{2} \cdot \left( \eta_{\text{NUTZ}} \cdot \frac{2 \cdot \pi}{60} \right)^{2} \cdot z_{\text{DEC}} \]

\[ W_{\text{POT}} = m_{\text{LAST}} \cdot g \cdot h \cdot z_{\text{AB}} \]

2. Peak regenerative power

\[ P_{RS} \leq P_{BM,DKC} + P_{BM,BZM} \]

\[ P_{RS} \rightarrow \text{siehe Auswahl Daten zu den Servoantrieben} \]

3. Regenerative energy (a single braking in E-stop)

\[ W_{\text{POT, MAX}} + W_{\text{ROT, MAX}} \leq W_{\text{MAX, DKC}} + W_{\text{MAX, BZM}} \]

\[ W_{\text{MAX, DKC}} \rightarrow \text{siehe Abb. Technische Daten DKC} \]

\[ W_{\text{MAX, BZM}} \rightarrow \text{siehe Abb. Technische Daten BZM} \]

- \( P_{RD} \): continuous regenerative power from the mechanical system during operation in kW
- \( P_{BD, DKC} \): continuous regenerative power in kW that the drive controller can process in continuous operation
- \( P_{BD, BZM} \): continuous regenerative power that the auxiliary module can process in continuous operation, in kW
- \( P_{RS} \): peak regenerative power in kW
- \( W_{\text{ROT}} \): rotary energy inWs
- \( W_{\text{POT}} \): potential energy in Ws
- \( W_{\text{ROT, MAX}} \): max. occurring rotary energy in an emergency stop in Ws
- \( W_{\text{POT, MAX}} \): max. occurring potential energy in an emergency stop (E-stop) in Ws
- \( t_{z} \): cycle time in s
- \( J_{\text{LAST}} \): load torque in kgm²
- \( J_{M} \): motor inertia, in kgm²
- \( m_{\text{LAST}} \): load weight in kg
- \( W_{\text{MAX, BZM}} \): storable energy in the BZM in kWs
- \( W_{\text{MAX, DKC}} \): storable energy in the DKC in kWs
- \( g \): gravitational acceleration 9.81 ms²
- \( h \): lowering dimension in m
- \( \eta_{\text{NUTZ}} \): motor speed used in min⁻¹
- \( z_{\text{AB}} \): number of drops per cycle
- \( z_{\text{DEC}} \): number of braking actions per cycle

Fig. 5-1: Check the conditions for regenerative power and regenerative energy in a DKC connected to a BZM via the DC bus.
1. Continuous regenerative power

$$\sum P_{RD} \leq 0.8 \cdot \sum P_{BD, DKC}$$

$$P_{RD} = \frac{\sum W_{ROT} + \sum W_{POT}}{t_z \cdot 1000}$$

$$W_{ROT} = \frac{(J_{last} + J_m)}{2} \cdot (n_{nutz} \cdot \frac{2 \cdot \pi}{60})^2 \cdot z_{DEC}$$

$$W_{POT} = m_{last} \cdot g \cdot h \cdot z_{AB}$$

2. Peak regenerative power

$$\sum P_{RS} \leq 0.8 \cdot P_{BM, DKC}$$

$$P_{RS} \rightarrow \text{siehe Auswahldaten zu den Servoantrieben}$$

3. Regenerative energy (a single braking in E-stop)

$$\sum W_{POT, MAX} + \sum W_{ROT, MAX} \leq 0.8 \cdot \sum W_{MAX, DKC}$$

$$W_{MAX, DKC} \rightarrow \text{siehe Abb. Technische Daten DKC}$$

- $P_{RD}$: continuous regenerative power of the mechanical system that is generated in continuous operation, in kW
- $P_{BD, DKC}$: continuous regenerated power that the drive controller can process in continuous operation, in kW
- $P_{RS}$: peak regenerated power in kW
- $W_{ROT}$: rotary energy in Ws
- $W_{POT}$: potential energy in Ws
- $W_{ROT, MAX}$: max. occurring rotary energy in an E-stop in Ws
- $W_{POT, MAX}$: max. occurring potential energy in an E-stop in Ws
- $t_z$: cycle time in s
- $J_{last}$: load torque in kgm²
- $J_m$: motor inertia, in kgm²
- $m_{last}$: load weight in kg
- $W_{MAX, BZM}$: storable energy in BZM 01.1 in kWs
- $W_{MAX, DKC}$: storable energy in the DKC in kWs
- $g$: 9.81 ms⁻²
- $h$: lowering dimension in m or number of braking actions
- $n_{nutz}$: motor speed used in min⁻¹
- $z_{AB}$: number of drops per cycle
- $z_{DEC}$: number of braking actions per cycle

Fig. 5-2: Checking the conditions for regenerative power and regenerative energy with several DKCs connected via the DC bus
1. Continuous regenerative power

\[ \sum P_{RD} \leq 0.8 \cdot \sum P_{BD,DKC} + \sum P_{BD,BZM} \]

\[ P_{RD} = \sum \frac{W_{ROT} + W_{POT}}{t_z} \cdot 1000 \]

\[ W_{ROT} = \frac{(J_{LAST} + J_M)}{2} \cdot \left( \eta_{NUTZ} \cdot \frac{2 \cdot \pi}{60} \right) \cdot z_{DEC} \]

\[ W_{POT} = m_{LAST} \cdot g \cdot h \cdot z_{AB} \]

2. Peak regenerative power

\[ \sum P_{RS} \leq 0.8 \cdot P_{BM,DKC} + P_{BM,BZM} \]

\[ P_{RS} : \text{peak regenerative power in kW} \]

3. Regenerative energy (a single braking in the E-stop position)

\[ \sum W_{POT,MAX} + \sum W_{ROT,MAX} \leq 0.8 \cdot \sum W_{MAX,DKC} + \sum W_{MAX,BZM} \]

\[ W_{MAX,DKC} : \text{storable energy in kWs} \]

\[ W_{MAX,BZM} : \text{storable energy in BZM 01.1 in kWs} \]

**Fig. 5-3:** Check the conditions for regenerative power and regenerative energy in a DKC connected to a BZM via the DC bus
5.2 Dimensional data and installation dimensions

Fig. 5-4: Dimensions of the auxiliary bleeding module BZM01.1

Clearance to adjacent units

min. 80 mm
5.3 Technical data

<table>
<thead>
<tr>
<th>Designation</th>
<th>Symbol</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous bleeder output (continuous regenerative power when drives are braked)</td>
<td>$P_{BD,BZM}$</td>
<td>kW</td>
<td>1</td>
</tr>
<tr>
<td>Peak bleeder power (peak regenerative power)</td>
<td>$P_{BM,BZM}$</td>
<td>kW</td>
<td>40</td>
</tr>
<tr>
<td>Maximum feedback energy</td>
<td>$W_{MAX,BZM}$</td>
<td>kWs</td>
<td>40</td>
</tr>
<tr>
<td>Control voltage between X4/1 and X4/4</td>
<td>$U_{N,BZM}$</td>
<td>V</td>
<td>DC 24 V ±20%</td>
</tr>
<tr>
<td>Current consumption of the 24 V connection</td>
<td>$I_{N,BZM}$</td>
<td>mA</td>
<td>90</td>
</tr>
</tbody>
</table>

Fig. 5-5: Technical data for the BZM

5.4 Front view

Fig. 5-6: Front view of the auxiliary bleeder module BZM01.1 with supply terminals
5.5 Electrical connections

![Connection diagram for auxiliary bleeder module BZM01.1]

5.6 Type code and rating plate

![Type code diagram]

![Rating plate diagram]
Notes
6 CZM Auxiliary Capacitance Module

6.1 Dimensioning

Note: Only applies to DKC01.1-040-7-FW and DKC11.1-040-7-FW!

When braking the drive, the rotary energy available in the mechanics is released as regenerative energy in the DC bus of the DKC. It can be:

- released in the form of heat via the bleeder module or auxiliary bleeder integrated into the DKC
- or -
- stored as energy in the DKC with a connected auxiliary capacitance module and reused for subsequent acceleration procedures. This reduces the power dissipated in the cabinet; energy consumption is lowered.

For successful implementation while avoiding an unnecessary power loss in the cabinet, note the following:

\[ W_{\text{ROT}} \leq W_{\text{ZW, DKC}+\text{CZM}} \]

Fig. 6-1: Condition for avoiding power dissipation from the regenerative energy

Calculating the rotary energy of an application

\[ W_{\text{ROT}} = \frac{(J_{\text{LAST}} + J_{\text{M}})}{2} \cdot (\eta_{\text{NUTZ}} \cdot \frac{2 \cdot \pi^2}{60})^2 \]

\( W_{\text{ROT}} \): rotary energy of the application in Ws
\( \eta_{\text{NUTZ}} \): maximum effective speed in min\(^{-1}\)
\( J_{\text{LAST}} \): load torque of the application in kgm\(^2\)
\( J_{\text{M}} \): motor inertia

Fig. 6-2: Calculating the rotary energy

Storable energy in the DKC with a connected CZM01.1

\[ W_{\text{ZW, DKC}+\text{CZM}} = \frac{C_{\text{DKC}} + C_{\text{CZM}}}{2} \cdot (U_{\text{B}}^2 - U_{\text{ZW}}^2) \cdot 10^{-3} \]

\( W_{\text{ZW, DKC}+\text{CZM}} \): storable energy in the DKC with CZM in Ws
\( C_{\text{CZM}} \): capacity of the CZM in mF (value = 1.0 mF)
\( C_{\text{DKC}} \): DC bus capacity of the DKC in mF (value = 0.15 mF)
\( U_{\text{B}} \): UB : Response threshold of the bleeder in DKC in V (value = 820)
\( U_{\text{ZW}} \): nominal voltage (DC bus) in V (UZW = (2 \times 0.98 \times U_{\text{N}}))
\( U_{\text{N}} \): line voltage (effective value) in V

Fig. 6-3: Calculating the storable energy with a CZM01.1
Application example

DKC01.-40-7 with AC motor MKD 071 B with the following data:

<table>
<thead>
<tr>
<th>Designation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotor inertia of the MKD 071 B</td>
<td>$J_M = 0.00087 \text{ kgm}^2$</td>
</tr>
<tr>
<td>Maximum effective motor speed</td>
<td>$n_{Nutz} = 3200 \text{ min}^{-1}$</td>
</tr>
<tr>
<td>Load inertia of the application</td>
<td>$J_{LAST} = 0.00261 \text{ kgm}^2$</td>
</tr>
<tr>
<td>Cycle time</td>
<td>$t_z = 0.8 \text{ s}$</td>
</tr>
<tr>
<td>Line voltage</td>
<td>$U_N = 400 \text{ V}$</td>
</tr>
</tbody>
</table>

Fig. 6-4: Technical data for application example DKC01.1 with MKD

This produces the following results:

$$W_{\text{ROT}} = 195 \text{ Ws}$$

$$W_{\text{ZW, DKC+CZM}} = 209 \text{ Ws}$$

This indicates that the condition $W_{\text{ROT}} \leq W_{\text{ZW, DKC+CZM}}$ has been fulfilled. If the same amount of energy were released via a bleeder, this would result in a continuous regenerative power of 243 Watts as dissipated power in the control cabinet due to the cycle time.
6.2 Dimensional data and installation dimensions

Fig. 6-6: Dimensions for the auxiliary capacitance modules CZM01.1
6.3 Front view

Fig. 6-7: Front view of the auxiliary capacitance module CZM01.1

6.4 Electrical connection

Fig. 6-8: Connecting the auxiliary capacitance module CZM01.1
6.5 Type code and rating plate

Type code fields:

- Auxiliary capacitance module: CZM
- Series: 01
- Version: 1
- Rated capacity: 1.0 mF
- DC bus nominal voltage: 700 V

Example: CZM 01.1 - 01 - 07

Fig. 6-9: Type code

Rating plate:

- Type of machine: CZM01.1-01-07
- Production week: K21/96
- Part no.: 260068
- Barcode: SN260100-01061
- Serial number: A01
- Change index: A01

Fig. 6-10: Rating plate
Notes
7 DC24V NTM power supplies

7.1 Application recommendations

If there is no external DC24V control voltage available, then INDRAMAT recommends the use of NTM power supply units.

- The power supplies contain an overvoltage safety switch with automatic shutdown. After the automatic shutdown device has responded, operation can be resumed by switching the power supply off and on again briefly.
- The power supplies always function with a starting current limiter. However, if you switch on and off again within a period of 10 s, the starting current limit may not work!
- The NTM01.1-024-004 and NTM01.1-024-006 power supplies make it possible to measure the voltage applied to the load via sensor cables. If there is a voltage drop, the power supply will increase the output voltage accordingly.

Fuse protector Q2 INDRAMAT recommends a 10A automatic circuit breaker of 10 A with tripping characteristics for the DC24V NTM power supplies.

Interference suppression Use the line filter NFE01.1-250-006 for interference suppression.

7.2 Technical data

<table>
<thead>
<tr>
<th>Designation</th>
<th>Symbol</th>
<th>Unit</th>
<th>NTM01.1-024-002</th>
<th>NTM01.1-024-004</th>
<th>NTM01.1-024-006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal current of the 24 V output for the 45°C ambient temperature</td>
<td>I_N</td>
<td>A</td>
<td>2.1</td>
<td>3.8</td>
<td>5.5</td>
</tr>
<tr>
<td>Output for 45°C ambient temperature</td>
<td>P_OUT</td>
<td>W</td>
<td>50</td>
<td>100</td>
<td>150</td>
</tr>
<tr>
<td>Input current at 230 (115) V</td>
<td>I_IN</td>
<td>A</td>
<td>0.61 (1.2)</td>
<td>1.2 (2.2)</td>
<td>1.9 (3.2)</td>
</tr>
<tr>
<td>Inrush current at 230 (115) V in the mains supply lead when powering up. Make sure fuse has proper size.</td>
<td>I_EN</td>
<td>A</td>
<td>32 (16)</td>
<td>32 (16)</td>
<td>32 (16)</td>
</tr>
<tr>
<td>Input voltage</td>
<td>U_N</td>
<td>V</td>
<td>Standard AC 170 to 265 by rearranging a bridge AC 85...132</td>
<td>NFE01.1-250-006 (recommended interference suppression filter to maintain EMC values)</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 7-1: Technical data for DC24V NTM power supplies
7.3 Dimensional data and installation dimensions

![Dimensional Sheet DC24V - NTM Power Supplies](image)

Table of dimensions

<table>
<thead>
<tr>
<th>INDRAMAT Type of power unit</th>
<th>A</th>
<th>A1</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTM01.1-024-002</td>
<td>173</td>
<td>168.7</td>
<td>100</td>
<td>45</td>
<td>17</td>
</tr>
<tr>
<td>NTM01.1-024-004</td>
<td>202</td>
<td>197.7</td>
<td>97</td>
<td>51</td>
<td>20</td>
</tr>
<tr>
<td>NTM01.1-024-006</td>
<td>212</td>
<td>207.7</td>
<td>97</td>
<td>70</td>
<td>20</td>
</tr>
</tbody>
</table>

Fig. 7-2: Dimensional sheet DC24V – NTM power supplies

7.4 Front views

![Front View and Terminal Designations of Power Supply NTM01.1-024-002](image)

LED green = Output voltage applied
Output voltage: DC 24 V V+, Zero point V-
Protective ground: FG
Input voltage: L, N

Potentiometer for fine adjustments of output voltage
Pins for changing input voltage

1) Pins not connect = input voltage AC (200-240) V
Pins connect = input voltage AC (100-120) V

Fig. 7-3: Front view and terminal designations of the power supply NTM01.1-024-002
7.5 Electrical connection

Always use the NTM together with the line filter NFE01.1-230-006.

**Note:** The bridge circuits V+/S+ and V-/S- must be removed if sensor inputs are used.

**Note:** The 0 V connection on the secondary side of 24V power supplies is always attached to the central reference ground point in the control cabinet (see Chap. 8.3)
7.6 Type code

Fig. 7-7: Type code
8 NFD / NFE line filter

8.1 Selection

The filters listed here are designed for the DKC drive controller power connection. Please see Chap. 8.4 for information on the line filter for interference suppression on the DC24V NTM power supply.

| Max. line power connection voltage of the 50..60 Hz $U_N$ in V | Rated line current $I_{Hz}$ (1) in A | No. of phases | Type of line filter (degree of protection IP10) | Supply terminals | Brush shunt | Power dissipation | Weight n kg |
|---|---|---|---|---|---|---|---|---|
| AC 480 V +10% | 7,5 | 3 | NFD 02.1-460-008 | 6 | AWG 10 | ----- | ----- | 8,7 | 1,5 |
| AC 480 V +10% | 16 | 3 | NFD 02.1-480-016 | 6 | AWG 10 | 1,34 | 16 | 9 | 1,7 |
| AC 480 V +10% | 30 | 3 | NFD 02.1-480-030 | 10 | AWG 6 | 5,37 | 10 | 14 | 1,8 |
| AC 480 V +10% | 55 | 3 | NFD 02.1-480-055 | 10 | AWG 6 | 6 | 13,5 | 20 | 3,1 |
| AC 480 V +10% | 75 | 3 | NFD 02.1-480-075 | 25 | AWG 3 | ----- | ----- | 20 | 4 |
| AC 480 V +10% | 130 | 3 | NFD 02.1-480-130 | 50 | AWG 1/0 | ----- | ----- | 40 | 7,5 |
| AC 480 V +10% | 180 | 3 | NFD 02.1-480-180 | 95 | AWG 4/0 | ----- | ----- | 61 | 11 |
| AC 230 V +10% | 7,5 | 1 | NFD 02.1-230-008 | 6 | AWG 10 | ----- | ----- | 7,2 | 1,1 |

(1) = max. continuous current at the power connection at an ambient temperature of 45°C

Fig. 8-1: Technical data of the available line filters

Technical Data

<table>
<thead>
<tr>
<th>Operating frequency</th>
<th>from DC to 60 Hz at 40 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power dissipation</td>
<td>measured 2 or 3 x R $I_{Nenn}^2$</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-25 ...+ 85 °C</td>
</tr>
<tr>
<td>Overload</td>
<td>1.5 $I_{Nenn}$ 1 min per hour</td>
</tr>
<tr>
<td>Saturation reaction</td>
<td>Reduction of the filter attenuation by 6 dB at 2.5 to 3 times the rated current</td>
</tr>
<tr>
<td>Test voltage</td>
<td>L/N -&gt; PE or L -&gt; PE: 2800 V DC 2 s at 25 °C</td>
</tr>
<tr>
<td>L -&gt; PE or L -&gt; L: 2125 V DC 2 s or 25 °C</td>
<td></td>
</tr>
<tr>
<td>Current reduction at excess temperatures</td>
<td>$I = \frac{I_N}{\sqrt{85 - \Theta}} \cdot \frac{\Theta}{40} \cdot I_N$ in reference to 45°C</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP 10</td>
</tr>
</tbody>
</table>

Fig. 8-2: Ambient and operating conditions
## 8.2 Dimensional data and installation dimensions

![NFD and NFE filters](image)

<table>
<thead>
<tr>
<th>Dimension</th>
<th>NFE 02.1-230-008</th>
<th>NFD 02.1-480-008</th>
<th>NFD 02.1-480-016</th>
<th>NFD 02.1-480-030</th>
<th>NFD 02.1-480-055</th>
<th>NFD 02.1-480-075</th>
<th>NFD 02.1-480-130</th>
<th>NFD 02.1-480-160</th>
<th>NFD 02.1-480-180</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-</td>
<td>305</td>
<td>335</td>
<td>329</td>
<td>329</td>
<td>429±1.5</td>
<td>438±1.5</td>
<td>±1</td>
<td>±1</td>
</tr>
<tr>
<td>B</td>
<td>210</td>
<td>142±0.8</td>
<td>150±1</td>
<td>185±1</td>
<td>220</td>
<td>240</td>
<td>240</td>
<td>±1.5</td>
<td>±1.5</td>
</tr>
<tr>
<td>C</td>
<td>15</td>
<td>55</td>
<td>60</td>
<td>80</td>
<td>80</td>
<td>110±0.8</td>
<td>110±0.8</td>
<td>±0.6</td>
<td>±0.6</td>
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<tr>
<td>D</td>
<td>0.75</td>
<td>275±0.8</td>
<td>305</td>
<td>300</td>
<td>300</td>
<td>400±1.2</td>
<td>400±1.2</td>
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<td>E</td>
<td>60</td>
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<td>J</td>
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<td>M10</td>
</tr>
</tbody>
</table>

Fig. 8-3: Dimensional data, installation dimensions of the NFD, NFE line filters
The mounting plate or the control cabinet housing to which the DKC is mounted are the preferred locations for assembly.

---

DANGER

Live parts (greater than 50 V)!
Electric shock on contact!
⇒ Before startup operation, the protective ground conductor must first be permanently connected to the filter and then grounded!
⇒ Before touching bare connection lines and terminals, isolate the filter with the connected terminals or disconnect it. Allow time for discharging! Do not work on connecting cables until then!
⇒ Due to the high discharge current of the filter, operation is not permitted without a connected protective conductor!
⇒ This is why the filter may only be operated with a permanently connected protective conductor with a cross section ≥10 mm²!
⇒ Remove any paint or coatings from the mounting points of the filter.
⇒ Use a tooth-lock washer with galvanized or tin-plated screws.

---

8.3 Electrical connection

To assemble and install the line filters, observe the recommendations in the documents
"EMC in Drive and Control Systems"
- Project Planning Manual -

---

Fig. 8-4: Single-phase line filter connection with NFE02.1-230-008

1) The use of switch-mode power sections (NTM) requires the preliminary switching of the NFE 01.1-230-006 mains filter
2) Mounting on mounting panel of DKC is recommended
1) The use switch-mode power sections (NTM) requires the preliminary switching of the NFE 01.1-230-006 mains filter
2) AC 230 V connecting voltage (+10% -15%) (50 to 60 Hz)
3) Mounting on mounting panel of DKC is recommended

Fig. 8-5: Three-phase line filter connection with NFD01.1 or NFD02.1
8.4 Line filters for DC24V NTM power supplies

When using the NTM power supply, use the NFE01.1-250-006 line filter for interference suppression.

![Dimension drawing: Line filter NFE01.1-250-006](image)

![Contact assignment of the line filter NFE01.1-250-006](image)

The line filter is connected via 6.3-1 tab receptacles in accordance with DIN 462 545.

8.5 Type code

![Type code](image)
Notes
9  DST / DLT transformers

9.1  Selection

Transformers are only needed if the line voltage exceeds the permitted rated voltage of the DKC.

**Grounded power supply lines**

For grounded power supply lines, the line voltage is matched to the rated voltage of the unit using autotransformers:

- for DKC**.*-040-7-FW/DKC11.1-040-7-FW with autotransformers suitable for a specific **output voltage range**.
- for DKC**.*-030-3-F with autotransformers designed for a specific **output voltage**.

**Ungrounded power supply lines**

To match the voltage for grounded power supply lines, always connect isolating transformers to prevent excess voltages between the outer conductor and ground.

- for the DKC**.*-040-7-FW this documentation does not offer a range of products for selecting suitable isolating transformers (Unterlage bei Bedarf anfordern).
- for the DKC**.*-030-3-FW the isolating transformer can be selected according to Fig. 9-4.

9.2  Autotransformers for DKC**.*-040-7-FW

Select an autotransformer according to the line voltage and the power requirements of the system.

Proceed with the selection as follows:

⇒ Determine the rating group and read the gearing ratio "i" using the required rated line voltage range from the diagram in Fig. 9-1.
⇒ Calculate the actual transformer output voltage using the rated line voltage and the gearing ratio "i".
⇒ Check drive data. The output voltage of the transformer affects the drive data. See documentation "ECODRIVE Servodrives DKC with MKD"- Selection lists.
⇒ Select a three-phase autotransformer via the required connected load.
Fig. 9-1: Classification of three-phase autotransformers into rating groups
DST autotransformer with secondary or output voltage AC (380 to 460) V

Standing version for mounting with base: DST...,../S

Rating plate (example)

Block diagram

Fig. 9-2: DST autotransformers for the DKC**.1-40-7-FW to match the line voltage
9.3 Autotransformers for DKC**.*-030-3-FW

DST autotransformers with a secondary or output voltage of AC 220...230V

Standing version for foot mounting type: DST.../S

Lying version for wall mounting type DST.../L

Rating plate (example)

<table>
<thead>
<tr>
<th>Type designation DST</th>
<th>Dimensions in mm</th>
<th>Power dissipation in W</th>
<th>Max. connec. in cross sect. in mm</th>
<th>Wght. in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5/.../380/415/440-220</td>
<td>150 165 170 75 80 125 70 100 154</td>
<td>30 4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>0.5/.../380/460/500-220</td>
<td>150 165 170 90 95 125 70 100 154</td>
<td>70 4</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>1.0/.../380/415/440-220</td>
<td>180 190 205 105 100 125 80 125 185</td>
<td>45 4</td>
<td>8,5</td>
<td></td>
</tr>
<tr>
<td>1.0/.../380/460/500-220</td>
<td>180 190 205 115 100 150 80 125 185</td>
<td>55 4</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>1.5/.../380/415/440-220</td>
<td>180 190 205 110 110 150 80 125 185</td>
<td>55 4</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>1.5/.../380/460/500-220</td>
<td>205 210 235 120 110 150 95 145 209</td>
<td>75 4</td>
<td>11,5</td>
<td></td>
</tr>
<tr>
<td>2.0/.../380/415/440-220</td>
<td>205 210 235 120 110 170 95 145 209</td>
<td>80 4</td>
<td>11,5</td>
<td></td>
</tr>
<tr>
<td>2.0/.../380/460/500-220</td>
<td>240 260 270 120 135 200 110 170 240</td>
<td>90 4</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>2.5/.../380/415/440-220</td>
<td>240 260 270 140 155 200 110 170 240</td>
<td>110 4</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>2.5/.../380/460/500-220</td>
<td>240 260 270 140 155 200 110 170 240</td>
<td>110 4</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>3.5/.../380/415/440-220</td>
<td>240 260 270 140 155 200 110 170 240</td>
<td>125 10</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>3.5/.../380/460/500-220</td>
<td>240 260 270 150 165 200 110 170 240</td>
<td>130 10</td>
<td>24,5</td>
<td></td>
</tr>
<tr>
<td>4.0/.../380/415/440-220</td>
<td>240 260 270 160 175 200 110 170 240</td>
<td>140 10</td>
<td>24,5</td>
<td></td>
</tr>
<tr>
<td>4.0/.../380/460/500-220</td>
<td>240 260 270 150 165 200 110 170 240</td>
<td>140 10</td>
<td>24,5</td>
<td></td>
</tr>
<tr>
<td>5.0/.../380/415/440-220</td>
<td>240 260 270 155 170 200 110 170 240</td>
<td>160 10</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>5.0/.../380/460/500-220</td>
<td>300 325 340 140 165 250 140 210 310</td>
<td>180 10</td>
<td>30,5</td>
<td></td>
</tr>
<tr>
<td>7.5/.../380/415/440-220</td>
<td>300 325 340 155 180 250 140 210 310</td>
<td>200 10</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>7.5/.../380/460/500-220</td>
<td>300 325 340 165 195 250 140 210 310</td>
<td>230 10</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>10/.../380/415/440-220</td>
<td>300 325 340 180 205 250 140 210 310</td>
<td>250 10</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>10/.../380/460/500-220</td>
<td>300 325 340 195 220 250 140 210 310</td>
<td>250 10</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>12.5/.../440/460-220</td>
<td>335 365 380 195 225 280 160 230 350</td>
<td>270 10</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>12.5/.../500/525-220</td>
<td>335 365 380 195 225 280 160 230 350</td>
<td>285 10</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>15/.../440/460-220</td>
<td>335 365 380 195 225 280 160 230 350</td>
<td>290 10</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>15/.../500/525-220</td>
<td>360 395 400 190 215 300 170 250 370</td>
<td>305 16</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>15/.../500/525-220</td>
<td>360 395 400 190 215 300 170 250 370</td>
<td>310 16</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>18/.../440/460-220</td>
<td>360 395 400 190 215 300 170 250 370</td>
<td>330 16</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>18/.../500/525-220</td>
<td>360 395 400 190 215 300 170 250 370</td>
<td>350 16</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>18/.../500/525-220</td>
<td>360 395 400 205 230 300 170 250 370</td>
<td>375 16</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>20/.../380/415/440-220</td>
<td>360 395 400 190 215 300 170 250 370</td>
<td>380 16</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>20/.../440/460-220</td>
<td>360 395 400 205 230 300 170 250 370</td>
<td>395 16</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>20/.../500/525-220</td>
<td>420 450 460 215 210 350 190 280 420</td>
<td>430 16</td>
<td>92</td>
<td></td>
</tr>
</tbody>
</table>

* = L, lying version
= S, standing version

Fig. 9-3: Three-phase autotransformers for the DKC01.1-030-3-FW for connecting to power supply lines > 230 V
ECODRIVE DKC01.1/DKC11.1 Drive Controllers

DST / DLT transformers 9-5

DST autotransformers with a secondary or output voltage of AC 220...230V

Standing version for foot mounting type: DST...S

Lying version for wall mounting type DST...L

Rating plate (example)

Connection diagram

Type designation

DST 2,5/3/380/415/440-220

Power dissipation in W

Max. connection in cross sect. in mm²

Wgt. in kg

Fig. 9-4: Three-phase isolating transformer documentation for the DKC01.1-030-3-FW for connecting to power supply lines > 230 V (ungrounded power supply lines)
9.4 Electrical connection of the DKC via transformer

Power connection on X8:
- 3 x AC 380...480 V bei DKC 01.1-040-7-FW
- 3 x AC 380...480 V bei DKC 11.1-040-7-FW
- 3 x AC 230 V bei DKC 01.1-030-3-FW

Mains filter
- 3 x AC 50...60 Hz
- PE
- L1
- L2
- L3
- N

DKC
- PE
- L1
- L2
- L3

DST
- PE
- L1
- L2
- L3

NFD

1) Protective conductor connection ≥ 10mm² (EN 50178)

Fig. 9-5: Power connection via a three-phase autotransformer

Power connection on X8:
- 1 x AC 230 V bei DKC 01.1-030-3-FW

Mains filter
- 1 x AC 50...60 Hz
- PE
- L1
- N

DKC01.1-030-3
- PE
- L1
- L2
- L3

NFE

1) Protective conductor connection ≥ 10mm² (EN 50178)

Fig. 9-6: Direct power connection via single-phase via autotransformer
### 9.5 Type code

<table>
<thead>
<tr>
<th>Type code fields:</th>
<th>Example:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product group</strong></td>
<td>DST 20,00/S/380,415-220-YYNO</td>
</tr>
<tr>
<td>Three-phase autotransformer</td>
<td>DST</td>
</tr>
<tr>
<td>Three-phase isolating autotransformer</td>
<td>DLT</td>
</tr>
<tr>
<td><strong>Rated power in kVA</strong></td>
<td>20 kVA</td>
</tr>
<tr>
<td><strong>Mounting style</strong></td>
<td>L</td>
</tr>
<tr>
<td>horizontal mounting</td>
<td></td>
</tr>
<tr>
<td>vertical mounting</td>
<td>S</td>
</tr>
<tr>
<td><strong>Rated output voltage (phase to phase)</strong></td>
<td>380,415</td>
</tr>
<tr>
<td>AC 380 V; AC 415 V</td>
<td></td>
</tr>
<tr>
<td><strong>Rated output voltage (phase to phase)</strong></td>
<td>220</td>
</tr>
<tr>
<td>AC 230 V</td>
<td></td>
</tr>
<tr>
<td><strong>Connection symbol</strong></td>
<td>YYNO</td>
</tr>
</tbody>
</table>

Fig. 9-7: Type code for transformers
Notes
10 Planning the control cabinet

10.1 Notes on installing the control cabinet

All ECODRIVE drive components -- with the exception of the motors -- are designed to be installed into a control cabinet. When planning the control cabinet, it is necessary to take the technical data of the drive components into account.

Power dissipation

Power dissipation is determined by the current load and the continuous regenerative power. The actual power dissipation is dependent on the respective cycle load. The servomotor implemented has been laid out for this load cycle.

On the average, the continuous current at standstill $I_{sn}$ will flow through the drive controller as a maximum value.

Determining power dissipation

⇒ See the respective document "ECODRIVE Servomotors MKD" - Project Planning - for the continuous current at standstill $I_{sn}$.

⇒ Using the $I_{sn}$ value of the motor selected, find the value in the diagram in Fig. 10-1 for the current-dependent power dissipation $P_{V,DKC}$.

⇒ Convert the continuous regenerative power found in Tab. Fig. 3-2 with the factor 0.8. as bleeder-dependent power dissipation $P_{V,Bleeder}$ in the DKC.

⇒ Add both dissipation values ($P_{V,DKC}$ and $P_{V,Bleeder}$). Use the total ($P_{V,ges}$) for planning the control cabinet.

![Fig. 10-1: Determining the power dissipated in the control cabinet](DG2021/5.0)
10.2 Using heat-exchange units in the control cabinets

Improperly installed and operated heat-exchange units are a risk to the drive components installed in the control cabinet due to the condensation and condensed water which these may cause!

**Risk of condensation**
Humid air enters the cabinet and, as it cools, condenses onto the installed drive components.

**Risk of condensation**
If the heat-exchange unit is not properly installed in the control cabinet, accumulating condensed water can drip into the installed drive components or be sprayed into them by the cold air current.

**Avoiding condensation**
Proper use of the heat-exchange units:
- When using heat heat-exchange units, the cabinets must be well sealed so that moisture cannot form caused by humid outside air entering the cabinets!
- In the event that the control cabinets are operated with open doors (startup operation, servicing, etc.), ensure that the drive components are never cooler than the air in the control cabinets after the doors have been closed. Otherwise, condensation may occur. For this reason, it is important that the heat-exchange unit continues to operate when the system has been shut down to ensure that temperature within the control cabinet does not deviate from that of the drive components.
- Set the heat-exchange unit to a permanent temperature of 40 °C. Not lower!
- Heat-exchangers with follow-up temperature must be set so that the temperature inside the cabinet is never lower than the outside temperature. Set the temperature limit to 40 °C!

**Avoiding dripping and sprayed water**
The heat-exchange units must be arranged in such a way that condensed water that may accumulate cannot drip into the installed drive components. Units on top of the cabinet require a special design!

Make sure that the control cabinet is constructed in such a way that the blower of the cooling unit cannot spray condensed water which may have collected, onto the drive components!

**Summary**
- Ensure that no condensed water can drip into the installed drive components!
- Make sure that the temperature of the heat-exchange unit has been properly set!
Fig. 10-2: Arranging the heat-exchange unit on the top of the control cabinet

Fig. 10-3: Arranging the heat-exchange unit at the front of the control cabinet
Notes
11 Power connection

11.1 Direct power connection

**DKC01.1-040-7-FW**

It is possible to connect these drives directly to grounded three-phase current lines with AC 380...480 V, +10 %. Only a fuse protector Q1, a mains contactor K1, and normally a line filter are required in the power input line.

If the line voltage exceeds the permitted input voltage range, then the voltage must be matched by means of an autotransformer which, in turn, has also been laid out for a specific voltage range (see Chapter 9-1).

**DKC01.1-030-3-FW**

It is possible to connect these drives directly to grounded three-phase current lines with 3 x AC 230 V, +10 %. A single-phase power connection 1 x AC 230V is possible for small amounts of power.

Only a fuse protector Q1, a line contactor K1, and normally a line filter are required in the power input line.

If the line voltage deviates from the permitted input voltage, the voltage is usually matched using an autotransformer or for special line conditions, using an isolating transformer (see Chapter 9-1).

---

**Fig. 11-1: Direct three-phase power connection**

**Fig. 11-2: Direct single-phase power connection**
11.2 Line contactor/fuse protector

A selection table (see Fig. 11-6) is available to facilitate the selection of a suitable line contactor and fuse protector device for the power connection.

Calculating the phase current at the power connection

To be able to select a suitable line contactor and suitable power connection fuse protector, the phase current \( I_N \) at the power connection must first be calculated.

The apparent power \( S \) is used to determine the phase current \( I_N \) at the power connection.

Locate the apparent power in the selection table of the drive components, or calculate it according to formula Fig. 11-4. For several drive controllers, add the individual apparent power values.

\[
P_{DC} = \frac{M_{EFF} \cdot n_{MITTEL} \cdot 2\pi}{60} \cdot k
\]

- \( P_{DC} \): DC bus power in W
- \( M_{EFF} \): Effective torque in Nm
- \( n_{MITTEL} \): Average speed in min\(^{-1}\)
- \( k \): Factor for motor and controller efficiency = 1.25

Fig. 11-3: Calculating the DC bus power

\[
S_{AN} = P_{DC} \cdot F
\]

- \( F \): Factor for the connected load
  - \( F = 2.6 \) for \( P_{DC} = 500 \) W
  - \( F = 1.95 \) for \( P_{DC} = 2000 \) W

Fig. 11-4: Calculating the power connection output

\[
I_N = \frac{S_{AN}}{U_N} \quad \text{Single-phase connection:}
\]

\[
I_N = \frac{S_{AN}}{U_N \cdot \sqrt{3}} \quad \text{Three-phase connection:}
\]

- \( I_N \): Phase current at the power connection in A
- \( S_{AN} \): Power connection output in VA
- \( U_N \): Voltage between the phases of the power supply lines in V

Fig. 11-5: Calculating the phase current at the power connection
Selecting fuse protector Q1 and line contactor K1

**Fuse protector Q1**
The fuse protector must be rated 1.5 times higher than the actual current at the power connection $I_N$.

Fuse protection can be implemented using:
- an automatic circuit breaker (power circuit breaker) or
- a power circuit breaker or
- safety fuses.

**Line contactor K1**
Select the line contactor according to the phase current at the power connection and the rated line voltage.

The rated current of the line contactor must be 1.5 times higher than the actual phase current at the power connection.

For a rated line voltage of $3 \times 400$ V, 50 Hz, the line contactors listed in the selection table are recommended depending on the phase current $I_N$.

**Selection table**
The types specified in the selection table are from the Siemens company and serve as examples. Similar products from other manufacturers can also be used.

<table>
<thead>
<tr>
<th>Phase current $I_H$ in A</th>
<th>Line cross section (1)</th>
<th>Recommended fuse protection</th>
<th>Recommended line contactor (for $U_H = 3 \times 400$ V, 50 Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 8.7</td>
<td>1.0</td>
<td>3VU1300 - ML00</td>
<td>3TF40 12 7</td>
</tr>
<tr>
<td>Up to 11</td>
<td>1.5</td>
<td>3VU1300 - MM00</td>
<td>3TF41 16 10</td>
</tr>
<tr>
<td>Up to 15</td>
<td>2.5</td>
<td>3VU1300 - MP00</td>
<td>3TF42 22 13</td>
</tr>
<tr>
<td>Up to 21</td>
<td>4.0</td>
<td>3VU1300 - MP00</td>
<td>3TF43 32 19</td>
</tr>
</tbody>
</table>

(1) Values apply to PVC insulated multi-wire cables in protective pipes and installation ducts with an ambient temperature of 45 °C (compliant to EN 60204-1/1992)

(2) The current was fixed based on operating mode AC 3 for a line voltage of AC 400 V, 50 Hz.

(3) $N$ = maximum number of connectable drives taking the starting current into consideration. If more drives are connected than indicated, a fuse protector or line contactor with a higher current rating must be selected.

Fig. 11-6: Selection table for fuse protector Q1 and line contactor K1
11.3 Control circuit to the power connection

The control circuit recommended by INDRAMAT indicates the function principle.

The choice of the control and its efficiency depends on the range of functions and the efficiency of the entire plant or machine. Therefore, it is the manufacturer’s responsibility to make this choice.

**Stand-by signal contact**

The stand-by message is output over a relay contact (make contact). If the stand-by contact closes, the drive is then ready for input power. It is thus used as a condition for switching in the line contactor (see Fig. 11-7).

**Note:** The contactor coil can cause excess voltages when switched off. The excess voltage can lead to premature failure of the stand-by contact. To attenuate the excess voltage, use an overvoltage limiter with diode combination.

The use of varistors as a suppressor circuit is not permitted. Varistors decay and increase their blocking-state currents. This can result in premature failure if the connected components and devices.

**Switching states**

The stand-by contact opens when:

- there is no control voltage for the DKC,
- if there are errors in the drive.

![Control circuit diagram](image-url)

**Fig. 11-7: Principal control switch to the DKC**

1) Integrating the Bb-Kontakte of additional DKCs and BZM in series connection
2) Switching capacity of Bb-Contacts DC 24V/1A
3) Drive enable for additional DKCs and BZM in series connection
4) Use overvoltage limiter with diode combinations
11.4 Protection against indirect contact

As a result of the high capacitive leakage currents via the cable insulation, it is not possible to install a GFCB device in the power input line (compliant to DIN VDE 0160, section 6.5).

Thus, protection against indirect contact must be achieved by other means.

The drive system components have a protective grounded housing. This makes protection against indirect contact possible by grounding.
Notes
12 Preparing for Startup

Required equipment

The following equipment is necessary when starting operation of an ECODRIVE drive system:

• measuring devices
• a personal computer (PC)
• connecting cables (PC-DKC)
• setpoint generator

Measuring devices

The following measuring devices are required so that torque, current and speed can be measured as analog signals at the analog outputs:

• a multimeter for measuring voltage (suffices for series startups) and
• an oscilloscope or recorder (only needed for recording the signal sequences during startup operation for prototypes).

Personal computer (PC)

The PC is needed for programming, parameterization and diagnostics during startup operation and service procedures.

Hardware requirements:

• IBM compatibility
• 80386-SX microprocessor (80486 recommended)
• at least 4 MB RAM memory (8 MB recommended)
• harddisk with at least 2.5 MB of free storage space
• 3.5" floppy disk drive with a capacity of 1.44 MB
• one free serial RS-232 interface in the PC (COM 1 or COM 2)
• an EGA monitor or monitor with higher resolution
• a mouse or compatible pointing device

Software requirements:

• The operating system DOS 5.0 or higher
• Windows 3.1 or higher
• DriveTop startup program (floppy disk is included with ECODRIVE)

Connecting cables (PC-DKC)

To connect a PC with a 9-pin D-subminiature connector, use cable type IKS101.

To connect a PC with a 25-pin D-subminiature connector, use cable type IKS102.

Pin assignment of the cable Fig. 4-19.
Setpoint generator

To position the drive, a setpoint value must be input via the proper interface (positioning, analog or stepper interface).

For test purposes a speed setpoint must be input via the analog interface using a setpoint generator.

To do so, the EOCDRIVE must be switched to the main operating mode "Speed control with an analog setpoint value!" when operating via the positioning or stepper interface.

The following figure illustrates a circuit proposal for a setpoint generator.

---

![Figure 12-1: Circuit proposal setpoint generator for connecting an analog interface](image)
13 Condition of the drive components on delivery

Packaging

Packaging units  The packaging differs depending on the order.
Each drive component is packaged individually, or several drive components are placed together in a single package.
Accessories are fastened to the unit.

Packaging materials  INDRAMAT will take packaging materials back free of charge. The customer is liable for return transport costs.

Packaging labels  The bar-code label on the packaging identifies the components inside and the order number.

![Bar-code label structure](image)

Accompanying documents

An envelope containing a delivery notice in duplicate is attached to one of delivered packages. These are the only shipping documents provided unless special arrangements were made when the order was placed.
Either the delivery notice or the freight papers will list the total number of packages or transport containers included in the shipment.

Identification of the components

Each drive component is identified by a type designation.
There is a rating plate on all pieces of equipment, including the motor.
A label (cable tag) is wrapped around the ready-made cable. The type designation and the cable length is indicated on the tag. (The actual cable designation -- without connector-- can be found imprinted on the cable sheath).
The accessories packed in bags are identified either by a printed label on the bags or by an additional enclosed slip.
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### Europe

#### Austria

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#### England

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<tr>
<td>Mannessmann Rexroth Ltd. INDRAMAT Division Cirencester, Glos GL7 1YG 4 Eland Place, Love Lane Telefon: 01285/656871 Telefax: 01285/654991</td>
<td>Rexroth Mecman OY SF-01720 Vantaa Riihimiehentie 3 Telefon: 0/848511 Telefax: 0/846387</td>
<td>Rexroth - Sigma S.A. Division INDRAMAT F-92632 Gennevilleurs Cedex Parc des Barbanniers 4, Place du Village Telefon: 1/41745340 Telefax: 1/47946941</td>
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#### Finland

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<tr>
<td>R rexroth S.A. Centro Industrial Santiago Obradors s/n E-08130 Santa Perpetua de Mogoda (Barcelona) Telefon: 03/718 68 51 Telex: 591 81 Telefax: 03/718 98 62</td>
<td>Goimendi S.A. División Índramat Jolastokieta (Herrera) Apartado 11 37 San Sebastian, 20017 Telefon: 043/40 01 63 Telex: 361 72 Telefax: 043/39 93 95</td>
<td>AB Rexroth Mecman INDRAMAT Division Varavägen 7 S-125 81 Stockholm Telefon: 08/727 92 00 Telefax: 08/64 73 277</td>
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### Other European customer service locations

#### Switzerland

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<tr>
<td>Rexroth AG Geeschäftsbereich INDRAMAT Gewerbestraße 3 CH-8500 Frauenfeld Telefon: 052/720 21 00 Telefax: 052/720 21 11</td>
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#### Russia

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### Customer service locations in Germany

- **Sales Region Central**
  - INDRAMAT GmbH D-97816 Lohr am Main Bgm.-Dr.-Nebel-Str. 2 Telefon: 09352/40-0 Telefax: 09352/40-4885
- **Sales Region East**
  - INDRAMAT GmbH D-09120 Chemnitz Beckerstraße 31 Telefon: 0371/3555-0 Telefax: 0371/3555-230
- **Sales Region West**
  - INDRAMAT GmbH D-40849 Ratingen Hansastraße 25 Telefon: 02102/4318-0 Telefax: 02102/41315
- **Sales Region North**
- **Sales Region South**
  - INDRAMAT GmbH D-80339 München Riederstraße 75 Telefon: 089/540138-30 Telefax: 089/540138-10
- **Sales Region Southwest**

### Other European customer service locations

- **Austria**
  - G.L.Rexroth Ges.m.b.H. Geschäftsbereich INDRAMAT A-1140 Wien Häglingasse 3 Telefon: 1/9852540-400 Telefax: 1/9852540-93
- **Belgium**
  - Mannessmann Rexroth N.V.-S.A. Geschäftsbereich INDRAMAT B-1740 Temat Industrielaan 8 Telefon: 02/5823180 Telefax: 02/5824310
- **Denmark**
  - BEC Elektronik AS DK-8900 Randers Zinkvej 6 Telefon: 086/447866 Telefax: 086/447160
- **England**
  - Mannessmann Rexroth Ltd. INDRAMAT Division Cirencester, Glos GL7 1YG 4 Eland Place, Love Lane Telefon: 01285/656871 Telefax: 01285/654991
- **Finland**
  - Rexroth Mecman OY SF-01720 Vantaa Riihimiehentie 3 Telefon: 0/848511 Telefax: 0/846387
- **France**
  - Rexroth - Sigma S.A. Division INDRAMAT F-92632 Gennevilleurs Cedex Parc des Barbanniers 4, Place du Village Telefon: 1/41745340 Telefax: 1/47946941
  - France
- **Netherlands**
  - Hydraudyne Hydrauliek B.V. Kruisbroeksestraat 1a P.O. Box 32 NL-5280 AA Boxtel Telefon: 04116/51951 Telefax: 04116/51483
- **Spain**
  - AB Rexroth Mecman INDRAMAT Division Varavägen 7 S-125 81 Stockholm Telefon: 08/727 92 00 Telefax: 08/64 73 277
- **Sweden**
  - AB Rexroth Mecman INDRAMAT Division Varavägen 7 S-125 81 Stockholm Telefon: 08/727 92 00 Telefax: 08/64 73 277
  - Switzerland
- **Switzerland**
  - Rexroth SA Département INDRAMAT Chemin de l’Ecole 6 CH-1036 Sullens Telefon: 021/731 43 77 Telefax: 021/731 46 78
  - Russia
- **Russia**
  - Tschudneinco E.B. Arsenia 22 153000 Ivanovo Rußland Telefon: 093/22 39 633
## Other international locations

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<tr>
<th>Country</th>
<th>Company</th>
<th>Address</th>
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<tr>
<td>Argentina</td>
<td>Mannesmann Rexroth S.A.C.</td>
<td>Division INDRAMAT</td>
<td>Acassuso 48 417</td>
<td>1605 Munro (Buenos Aires)</td>
<td>Argentina</td>
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<tr>
<td>Argentina</td>
<td>Nakase</td>
<td>Asesoramiento Tecnico</td>
<td>Diaz Velez 2929</td>
<td>1636 Olivos</td>
<td>(Provincia de Buenos Aires)</td>
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<tr>
<td>Australia</td>
<td>Australian Industrial Machinery Services Pty. Ltd.</td>
<td>Unit 3/45 Horse ST</td>
<td>Campbellfield VIC 2061</td>
<td>Australia</td>
<td>Telephone: 03/93 59 0228</td>
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<tr>
<td>Canada</td>
<td>Basic Technologies Corporation</td>
<td>Burlington Division</td>
<td>3426 Mainway Drive</td>
<td>Burlington, Ontario</td>
<td>Canada</td>
</tr>
<tr>
<td>China</td>
<td>Rexroth (China) Ltd</td>
<td>Shanghai Office</td>
<td>Room 206</td>
<td>Shanghai Intern. Trade Centre</td>
<td>2200 Yanan Xi Lu</td>
</tr>
<tr>
<td>China</td>
<td>Rexroth (China) Ltd</td>
<td>Room 903, Jiel Building</td>
<td>44-35 Yoido-Dong, 45-35 Yoido-Dong</td>
<td>Youngdeungpo-Ku</td>
<td>Seoul, Korea</td>
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<tr>
<td>China</td>
<td>Rexroth (China) Ltd</td>
<td>19 Cheung Shun Street</td>
<td>1st Floor, Cheung Sha Wan, Kowloon, Hong Kong</td>
<td>Telephone: 741 13 51-54 und 741 14 30</td>
<td>Telex: 3346 17 GL REX HK</td>
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<tr>
<td>China</td>
<td>Rexroth (China) Ltd</td>
<td>199 Wu Cao Road, Hua Cao</td>
<td>Minhang District</td>
<td>Shanghai 201 103</td>
<td>P.R. China</td>
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<tr>
<td>China</td>
<td>Rexroth (China) Ltd</td>
<td>1, Jiangoumenwai Avenue</td>
<td>Beijing 100004</td>
<td>P.R. China</td>
<td>Telephone: 010/50 50 380</td>
</tr>
<tr>
<td>China</td>
<td>Rexroth (China) Ltd</td>
<td>Shanghai Parts &amp; Service Centre</td>
<td>199 Wu Cao Road, Hua Cao</td>
<td>Minhang District</td>
<td>Shanghai 201 103</td>
</tr>
<tr>
<td>Korea</td>
<td>Rexroth-Seki Co Ltd.</td>
<td>2110 Austin Avenue</td>
<td>Rochester Hills, Michigan 48309</td>
<td>USA</td>
<td>Telephone: 810/853-82 90</td>
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<tr>
<td>Korea</td>
<td>Seo Chang Corporation Ltd.</td>
<td>1500-12 Da-Dae-Dong</td>
<td>Saha-Gu, Pusan, 604-050</td>
<td>Korea</td>
<td>Telephone: 051/264 90 01</td>
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<tr>
<td>USA</td>
<td>Rexroth Corporation</td>
<td>845 5029 Rex B</td>
<td>Telephone: 80/839 21 01</td>
<td>80/839 73 74</td>
<td>80/839 43 45</td>
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<td>USA</td>
<td>Rexroth Corporation</td>
<td>INDROMAT Division</td>
<td>2110 Austin Avenue</td>
<td>Rochester Hills, Michigan 48309</td>
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