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Rexroth EcoDrive 03 Drive Controllers DKC**.3-040, -100, -200

R911320342
Edition 01

Instruction Manual



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Title

Rexroth EcoDrive 03
Drive Controllers
DKC03.3-040, -100, -200

Type of Documentation

Instruction Manual

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Internal File Reference

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Purpose of Documentation

This documentation provides information on the installation and operation of the described products, by persons trained and qualified to work with electrical installations.

Record of Revisions

Description	Release Date	Notes
Instruction Manual	03.2007	1st edition

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1 Important Notes

1.1 Safety Instructions

General Information

- Do not attempt to install or commission this device without first reading all documentations provided with the product. Read and understand these safety instructions and all user documentation prior to working with the device. If you do not have the user documentation for the device, contact your responsible Bosch Rexroth sales representative. Ask for these documents to be sent immediately to the person or persons responsible for the safe operation of the device.
- If these documentations contain some information you do not understand, it is absolutely necessary that you ask Bosch Rexroth for explanation before you start working on or with the devices.
- Only persons who are trained and qualified for the use and operation of the device may work on this device or within its proximity. The persons are qualified if they have sufficient knowledge of the assembly, installation and operation of the equipment as well as an understanding of all warnings and precautionary measures noted in this documentation.
- Only trained, instructed and qualified persons are allowed to switch electrical circuits and devices on and off in accordance with technical safety regulations, to ground them and to mark them according to the requirements of safe work practices. These persons must have adequate safety equipment and be trained in first aid.
- Technical data, connections and operational conditions are specified in the reference documentations for the product and must be followed at all times.
- If the products take the form of hardware, then they must remain in their original state, in other words, no structural changes are permitted. It is not permitted to decompile software products or alter source codes.
- Do not mount damaged or faulty products or use them in operation.
- Only use spare parts and accessories approved by Bosch Rexroth.
- Follow all safety regulations and requirements for the specific application as practiced in the country of use.
- If the device is resold, rented and/or passed on to others in any other form, these safety instructions must be delivered with the device in the official language of the user's country.
- Proper and correct transport, storage, assembly and installation as well as care in operation and maintenance are prerequisites for optimal and safe operation of this device. Observe the data contained in the corresponding product documentations.



WARNING

Improper use of these devices, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, may result in material damage, bodily harm, electric shock or even death!

⇒ Observe the following safety instructions!

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Contact with Electrical Parts



DANGER

High electrical voltage! Danger to life, electric shock and severe bodily injury!

- Follow general construction and safety regulations when working on power installations.
- Before switching on the device, the equipment grounding conductor must have been non-detachably connected to all electrical equipment and motors in accordance with the connection diagram.

  The equipment grounding conductor of the electrical equipment and the units must be non-detachably and permanently connected to the power supply unit at all times. The leakage current is greater than 3.5 mA.

  Over the total length, use copper wire of a cross section of a minimum of 10 mm^2 for this equipment grounding connection!
- Before working with electrical parts with voltage potentials higher than 50 V, the device must be disconnected from the mains voltage or power supply unit. Provide a safeguard to prevent reconnection.
- Wait **30 minutes** after switching off power to allow capacitors to discharge before beginning to work. Measure the electric voltage on the capacitors before beginning to work to make sure that the equipment is safe to touch.
- Never touch the electrical connection points of a component while power is turned on.
- Install the covers and guards provided with the equipment properly before switching the device on. Before switching the equipment on, cover and safeguard live parts safely to prevent contact with those parts.
- A residual-current-operated circuit-breaker or r.c.d. cannot be used for electric drives! Indirect contact must be prevented by other means, for example, by an overcurrent protective device according to the relevant standards.

Handling and Assembly



CAUTION

Risk of injury by improper handling! Bodily injury by bruising, shearing, cutting, hitting!

- Observe the general construction and safety regulations on handling and assembly.
- Use suitable devices for assembly and transport.
- Avoid jamming and bruising by appropriate measures.
- Always use suitable tools. Use special tools if specified.
- Use lifting equipment and tools in the correct manner.
- If necessary, use suitable protective equipment (for example safety goggles, safety shoes, safety gloves).
- Do not stand under hanging loads.
- Immediately clean up any spilled liquids because of the danger of skidding.

Dangerous Movements

Dangerous movements can be caused by faulty control of connected motors. Some common examples are:

- improper or wrong wiring of cable connections
- incorrect operation of the equipment components
- wrong input of parameters before commissioning
- malfunction of sensors, encoders and monitoring devices
- defective components
- software or firmware errors

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Dangerous movements can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation.

The monitoring in the drive components will normally be sufficient to avoid faulty operation in the connected drives. Regarding personal safety, especially the danger of bodily harm and material damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.



DANGER

Dangerous movements! Danger to life, risk of injury, severe bodily harm or material damage!

- For the above reasons, ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation.

  They have to be provided for by the user according to the specific conditions within the installation and a hazard and fault analysis. The safety regulations applicable for the installation have to be taken into consideration. Unintended machine motion or other malfunction is possible if safety devices are disabled, bypassed or not activated.

To avoid accidents, bodily harm and/or material damage:

- Keep free and clear of the machine's range of motion and moving parts. Possible measures to prevent people from accidentally entering the machine's range of motion:
  - use safety fences
  - use safety guards
  - use protective coverings
  - install light curtains or light barriers
- Fences and coverings must be strong enough to resist maximum possible momentum.
- Mount the emergency stop switch in the immediate reach of the operator. Verify that the emergency stop works before startup. Don't operate the device if the emergency stop is not working.
- Isolate the drive power connection by means of an emergency stop circuit or use a safety related starting lockout to prevent unintentional start.
- Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone.
- Additionally secure vertical axes against falling or dropping after switching off the motor power by, for example:
  - mechanically securing the vertical axes,
  - adding an external braking/ arrester/ clamping mechanism or
  - ensuring sufficient equilibration of the vertical axes.
- The standard equipment motor brake or an external brake controlled directly by the drive controller are **not sufficient to guarantee personal safety!**
- Disconnect electrical power to the equipment using a master switch and secure the switch against reconnection for:
  - maintenance and repair work
  - cleaning of equipment
  - long periods of discontinued equipment use
- Prevent the operation of high-frequency, remote control and radio equipment near electronics circuits and supply leads. If the use of such devices cannot be avoided, verify the system and the installation for possible malfunctions in all possible positions of normal use before initial startup. If necessary, perform a special electromagnetic compatibility (EMC) test on the installation.

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Magnetic and Electromagnetic Fields



WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

- Persons with heart pacemakers and metal implants are not permitted to enter following areas:
  - Areas in which electrical equipment and parts are mounted, being operated or commissioned.
  - Areas in which parts of motors with permanent magnets are being stored, repaired or mounted.
- If it is necessary for somebody with a pacemaker to enter such an area, a doctor must be consulted prior to doing so. The interference immunity of present or future implanted heart pacemakers differs greatly, so that no general rules can be given.
- Those with metal implants or metal pieces, as well as with hearing aids must consult a doctor before they enter the areas described above.
  Otherwise health hazards may occur.

Hot Parts



CAUTION

Hot surfaces at motor housings, on drive controllers or chokes! Danger of burns!

- Do not touch surfaces of device housings and chokes in the proximity of heat sources! Danger of burns!
- Do not touch housing surfaces of motors! Danger of burns!
- According to operating conditions, temperatures can be higher than **60 °C (140 °F)** during or after operation.
- Before accessing motors after having switched them off, let them cool down for a sufficiently long time. Cooling down can require **up to 140 minutes**! Roughly estimated, the time required for cooling down is five times the thermal time constant specified in the Technical Data.
- Wear safety gloves or do not work at hot surfaces.
- For certain applications, the manufacturer of the end product, machine or installation, according to the respective safety regulations, has to take measures to avoid injuries caused by burns in the end application. These measures can be, for example: warnings, guards (shielding or barrier), technical documentation.

1.2 Appropriate Use

This product may only be used for the applications mentioned in the reference documentations (see chapter “Reference Documentations”) and under the described application, ambient and operating conditions.

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2 Identification

2.1 Type Code

Note: The following figure illustrates the basic structure of the type code. Our sales representative will help you with the current status of available versions.

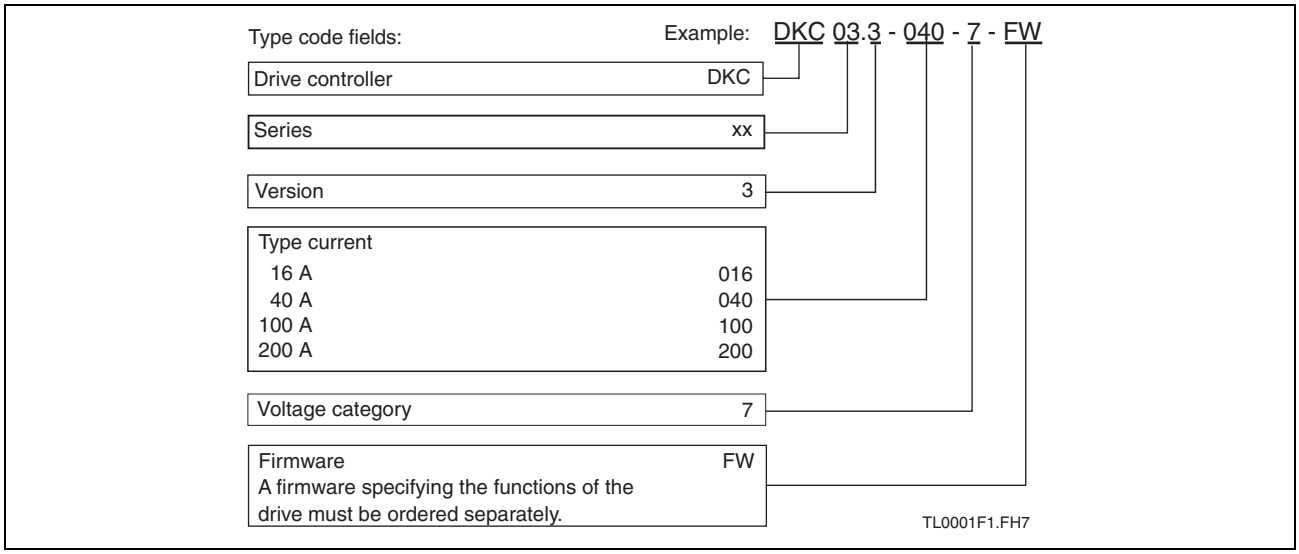


Fig. 2-1: Type code

2.2 Type Plates

Basic Unit

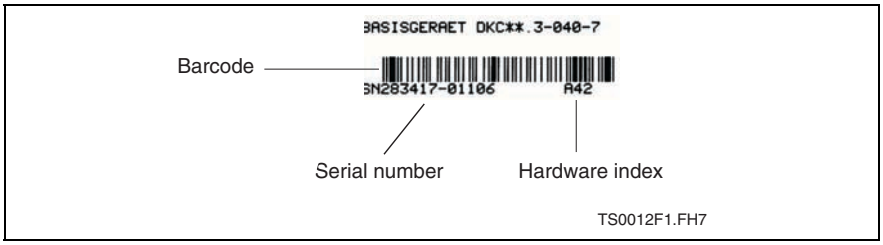


Fig. 2-2: Type plate

Unit type

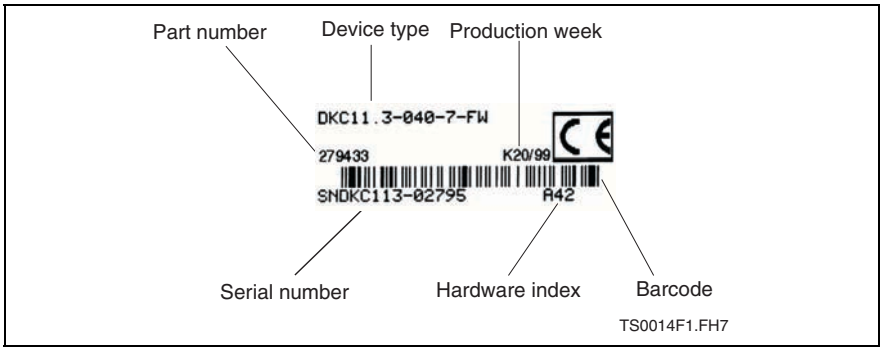


Fig. 2-3: Type plate – DKC example

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2.3 Scope of Supply

- firmware module
- contact protection
- connectors according to the following table:

Type	Connectors - type independent X..									Connectors - type dependent X..								
	1	2	3	4	6	8	9	10	11	15	20	21	30	40	41	50	60	210
DKC01.3-***-7	X		X	X	X	X	X	X	X	X								
DKC02.3-***-7	X		X	X	X	X	X	X	X									
DKC03.3-***-7	X		X	X	X	X	X	X	X									
DKC04.3-***-7	X		X	X	X	X	X	X	X									
DKC05.3-***-7	X		X	X	X	X	X	X	X									
DKC06.3-***-7	X		X	X	X	X	X	X	X								X	
DKC11.3-***-7	X		X	X	X	X	X	X	X									
DKC21.3-***-7	X		X	X	X	X	X	X	X									
DKC22.3-***-7	X		X	X	X	X	X	X	X									

Fig. 2-4: Connectors for DKC**.3-040...200-7-FW included in the scope of supply

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3 Ratings and Dimensions

Description	Symbol	Unit	DKC03.3-040	DKC03.3-100	DKC03.3-200
listing according UL-standard (UL)			UL 508 C		
listing according CSA-standard (UL)			Canadian National Standard(s) C22.2 No. 14-05		
UL files (UL)			E134201	E134201	E134201
pollution degree (UL)			Use in a pollution degree 2 environment		
maximum ambient temperature with nominal data (UL)	T_{amax}	°C	45	45	45
maximum ambient temperature with reduced nominal data (UL)	T_{amax_red}	°C	55	55	55
Weight	m	kg	5,7	9,7	19,5
Device height (UL) [1)]	H	mm	360	360	360
Device depth (UL) [2)]	T	mm	261	261	261
Device width (UL) [3)]	B	mm	65	105	230
minimum distance on the top of the device [4)]	d_{top}	mm	150	150	150
minimum distance on the bottom of the device [5)]	d_{bot}	mm	80	80	80
rated control voltage input (UL) [6)]	U_{N3}	V	24	24	24
rated power consumption control voltage input without holding brake, without control section at U_{N3} = DC 24 V (UL) [7)]	P_{N3}	W	21	26	29
short circuit current rating, SCCR, symmetrical amperes (UL) [8)]	I_{SCCR}	A rms	42000	42000	42000
rated input voltage, power (UL) [9)]		V	200 … 480	200 … 480	200 … 480
tolerance rated input voltage (UL)		%	±10	±10	±10
input number of phases (UL)			1 × AC, 3 × AC	1 × AC, 3 × AC	1 × AC, 3 × AC
input frequency (UL)	f_{LN}	Hz	50 … 60	50 … 60	50 … 60
tolerance input frequency (UL)		Hz	2	2	2
maximum input current (UL) [10)]	I_{L_cont}	A	16	40	38
branch circuit protection fuse (UL) [11)]			20	70	70
field wiring material (UL) [12)]			Use 60/75 °C copper wire only, use class 1 wire only or equivalent		
required wire size according UL 508 A (internal wiring); at I_{L_cont} (UL) [13)]	A_{LN}		AWG 12	AWG 8	AWG
maximum output voltage (UL)	U_{out}	V	800	800	800
output number of phases (UL)			3	3	3
maximum output current (UL)	I_{out_max}	A	40	100	200
maximum output frequency (UL)	f_{out}	Hz	1000	1000	1000

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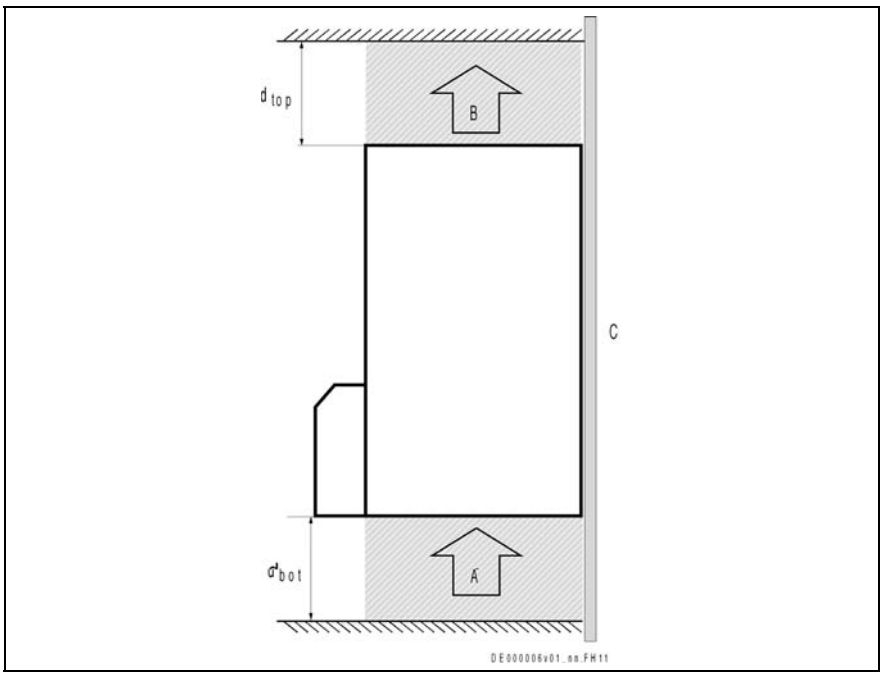
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Description	Symbol	Unit	DKC03.3-040	DKC03.3-100	DKC03.3-200
power dissipation at continuous current I_{out_cont} and continuous DC bus power P_{DC_cont} respectively (UL) [14)]	P_{Diss_cont}	W	180	420	960

1) 2) 3) housing dimension; see related dimension sheet also
4) 5) see fig. "Air inlet and outlet of drive controller"
6) observe supply voltage for motor holding brakes
7) find value for control section in project planning manual
8) Suitable for use on a circuit capable of delivering not more than this SCCR value, 600 V AC or less. The drive series shall be used with listed AC input line fuses or listed circuit breakers specified in this documentation.
9) DKC, CZM, BZM: DC bus L+, L-; Mains input L1, L2, L3
10) at P_{DC_cont}
11) class J branch circuit fuse
12) find value for tightening torque in project planning manual, electrical terminals
13) copper wire; PVC-insulation (conductor temperature 90 °C); Table 13.5.1; Ta ≤ 40 °C
14) plus dissipation of braking resistor

Abb. 3-1: UL ratings and dimensions

Distances



A: air intake
B: air outlet
C: mounting surface in control cabinet
d_{top}: distance top
d_{bot}: distance bottom

Fig. 3-2: Air intake and air outlet at drive controller

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4 Reference Documentations

4.1 Overview

Title	Type	Document Typecode
Servo Applications with 1,5 s Acceleration Time	Selection lists	DOK-ECODR3-SERV-GEN***-AUxx-MS-P
Servo Applications with 400 ms Acceleration Time	Selection lists	DOK-ECODR3-SERV-WZM***-AUxx-MS-P
Main drives with 2AD-, ADF and 1MB-motors	Selection lists	DOK-ECODR3-MAIN*WZM***-AUxx-MS-P
List of Connecting Cables for DIAX04 and ECODRIVE03	Selection lists	DOK-CONNEC-CABLE*STAND-AUxx-EN-P
ECODRIVE03 Drive for Machine Tool Applications With SERCOS-, Analog and Parallel interface	Functional Description	DOK-ECODR3-SMT-01VRS**-FKxx-EN-P
ECODRIVE03 Drive for Machine Tool Applications With SERCOS-, Analog and Parallel interface	Functional Description	DOK-ECODR3-SMT-02VRS**-FKxx-EN-P
ECODRIVE03 Drive for General Automation With SERCOS-, Analog and Parallel interface	Functional Description	DOK-ECODR3-SGP-01VRS**-FKxx-EN-P
ECODRIVE03 Drive for General Automation With Fieldbus-Interfaces	Functional Description	DOK-ECODR3-FGP-01VRS**-FKxx-EN-P
ECODRIVE03 Drive for General Automation With Fieldbus-Interfaces	Functional Description	DOK-ECODR3-FGP-02VRS**-FKxx-EN-P
ECODRIVE03 Drive for General Automation With Fieldbus-Interfaces	Functional Description	DOK-ECODR3-FGP-03VRS**-FKxx-EN-P
LWL Handling	Application Manual	DOK-CONNEC-CABLE*LWL-AWxx-EN-P
Electromagnetic Compatibility (EMC) in Drive and Control Systems	Project Planning Manual	DOK-GENERL-EMV********-PRxx-EN-P
Digital AC Motors MKD	Project Planning Manual	DOK-MOTOR*-MKD********-PRxx-EN-P
Digital AC Motors MHD	Project Planning Manual	DOK-MOTOR*-MHD********-PRxx-EN-P
MKE Digital AC Motors for potentially explosive areas	Project Planning Manual	DOK-MOTOR*-MKE********-PRxx-EN-P
2AD AC Motor	Project Planning Manual	DOK-MOTOR*-2AD********-PRxx-EN-P
ADF Main Spindle Motors	Project Planning Manual	DOK-MOTOR*-ADF********-PRxx-EN-P
1MB Frameless Spindle Motor	Project Planning Manual	DOK-MOTOR*-1MB********-PRxx-EN-P
Synchronous MBS Kit Spindle Motors	Project Planning Manual	DOK-MOTOR*-MBS********-PRxx-EN-P
LAR 070-132 Gehäuse-Linearmotoren	Selection and Project Planning	DOK-MOTOR*-LAR********-AWxx-DE-P
LAF050 – 121 Linear Motors	Selection and Project Planning	DOK-MOTOR*-LAF********-AWxx-EN-P
Linear Synchronous Direct Drives LSF	Project Planning Manual	DOK-MOTOR*-LSF********-PRxx-EN-P
AC Drive Units in Personnel Conveyor Systems	Application Manual	DOK-GENERL-ANTR*PERSON-ANxx-EN-P
AC Drive Units in Hazardous Areas (Expl. Protection)	Application Manual	DOK-GENERL-ANTR*EXPLOS-ANxx-EN-P
ECODRIVE03 Drive for Machine Tool Applications With SERCOS-, Analog and Parallel interface	Troubleshooting Guide	DOK-ECODR3-SMT-01VRS**-WAR*-EN-P

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Title	Type	Document Typecode
ECODRIVE03 Drive for Machine Tool Applications With SERCOS-, Analog and Parallelinterface	Troubleshooting Guide	DOK-ECODR3-SMT-02VRS**-WAR*-EN-P
ECODRIVE03 Drive for General Automation With SERCOS-, Analog and Parallel interface	Troubleshooting Guide	DOK-ECODR3-SGP-01VRS**-WAxx-EN-P
ECODRIVE03 Drive for General Automation With Fieldbus-Interfaces	Troubleshooting Guide	DOK-ECODR3-FGP-01VRS**-WAxx-EN-P
ECODRIVE03 Drive for General Automation With Fieldbus-Interfaces	Troubleshooting Guide	DOK-ECODR3-FGP-02VRS**-WAxx-EN-P
ECODRIVE03 Drive for General Automation With Fieldbus-Interfaces	Troubleshooting Guide	DOK-ECODR3-FGP-03VRS**-WAxx-EN-P

1) In the document typecodes, "xx" is a wild card for the current edition of the documentation (example: "PR01" is the first edition of a Project Planning Manual)

Fig. 4-1: Documentations - Overview

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5 Instructions for Use

5.1 Overcurrent Protection

Branch circuit protection has to be provided externally according to the maximum values (voltage and current or voltage and percent of FLA of the fuses [FLA: Full Load Ampacity]).

5.2 Connections

Wiring Diagram

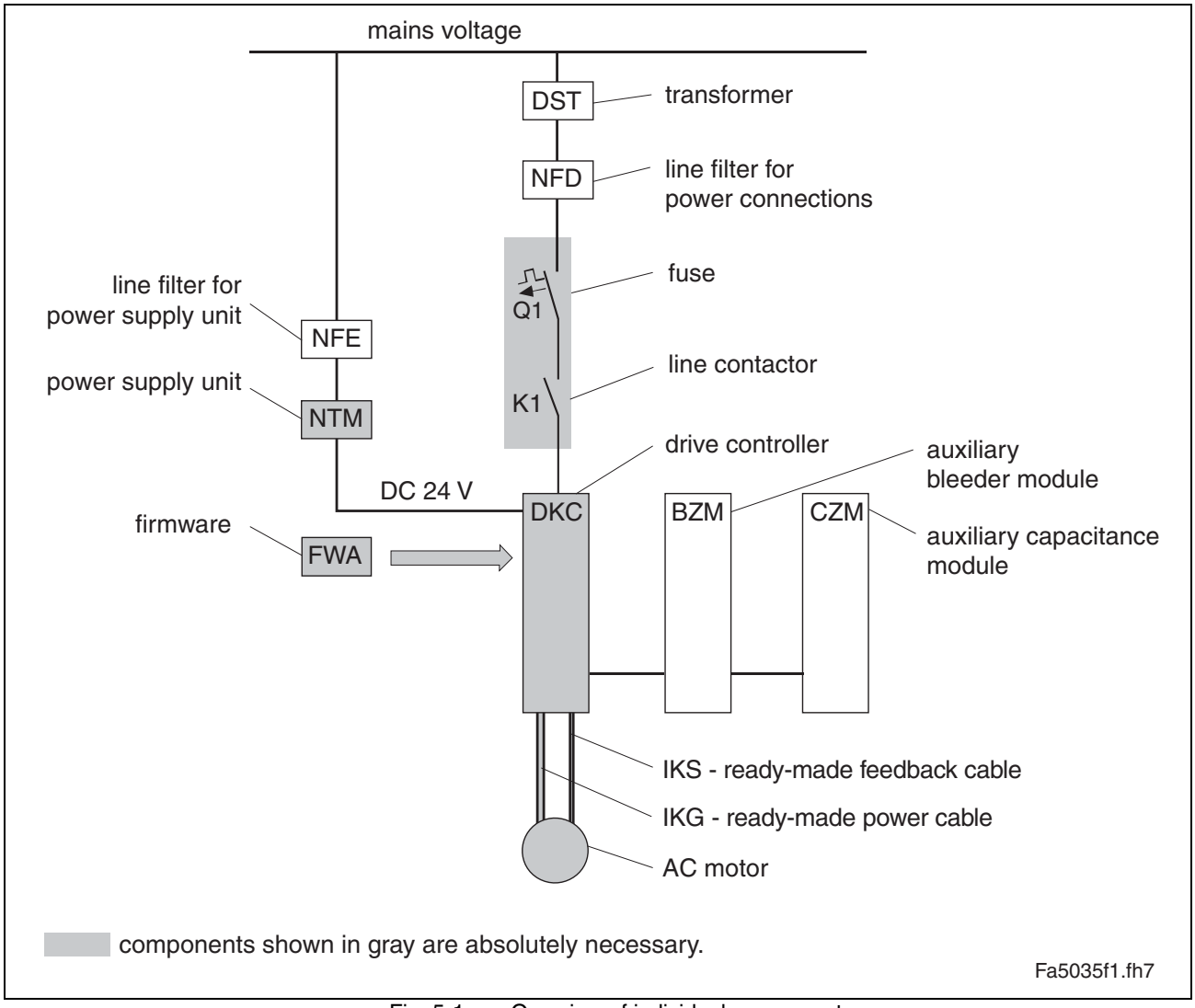


Fig. 5-1: Overview of individual components

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Connection Diagram

Rexroth EcoDrive 03 (DKC**.040, DKC**.100, DKC**.200)

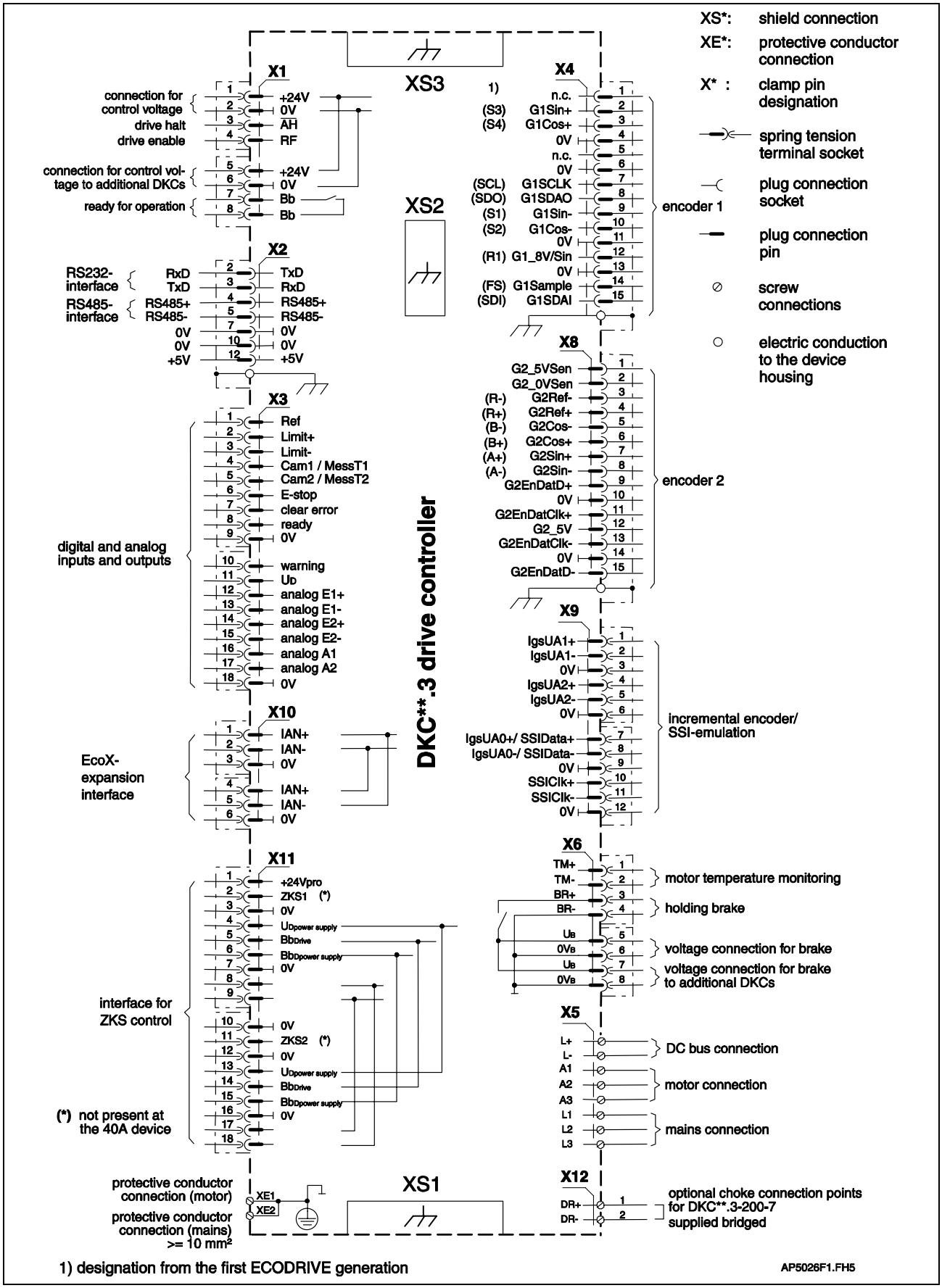


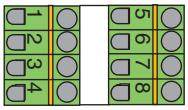
Fig. 5-2: Total connection diagram for DKC**.3

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X1, Connections for Control voltage

Technical description of connector

Illustration:



Ap5264f1.FH7

Fig. 5-3: Connector X1

Design:

Type	No. of pins	Design
Spring contact	2 x 4	Bushing on connector

Fig. 5-4: Design

Connection cross section:

Cross section single wire [mm²]	Cross section multi core wire [mm²]	Wire size in AWG Gauge no.:
0,2-2,5	1,5-2,5	16-12

Fig. 5-5: Connection cross section

24V control voltage supply (+24V and 0V)

Connection +24V and 0V:

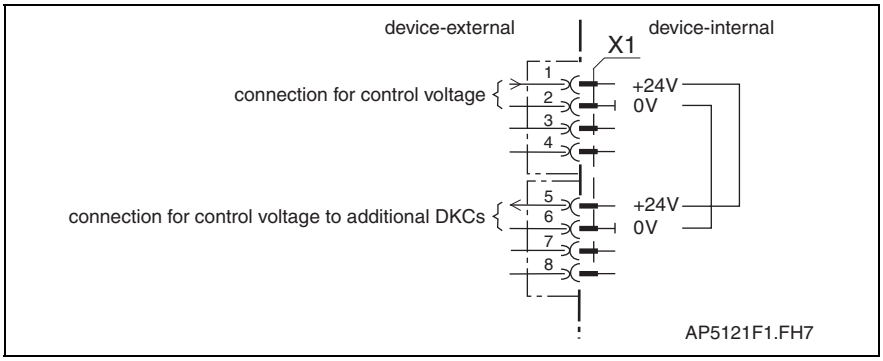


Fig. 5-6: Connections for control voltage

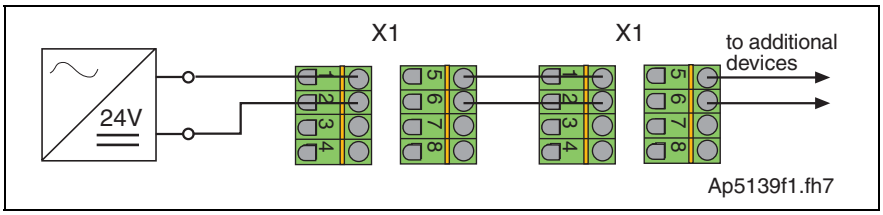


Fig. 5-7: Looping through control voltage

Connection loads +24V and 0V:

Voltage at X1/1 against X1/2:	See chapter "Ratings and Dimensions"
Current or power consumption X1/1:	
Reverse voltage protection:	Via allowed voltage range using internal protection diodes
Max. allowed current load when looping through the control voltage via X1.1/2 to X1.5/6:	DC 10 A

Note: Strong mechanical influence on the test tap of the terminals can increase the transition resistance and destroy the terminals.

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Note: The input 0 V is connected directly to the device potential. The utilization of an insulation monitoring for +24 V and 0 V against device is therefore not possible!

wire +24V and 0V:

wire cross section:	min. 1 mm² for looping through: min. 2,5 mm²
wire routing:	parallel if possible
Max. allowed inductance between 24V source and X1:	100 µH (equals about 2 x 75 m)

Note: If the cross sections of the lines for looping through the control voltage are too small, the terminals can be damaged.

Note:

- Exceeding allowed control voltage generates error message "+24 volt error". (=> See also firmware functional description.)
- Control voltage failure causes the running motor to coast torque-free (without brake).

DANGER

Dangerous movements due to unbraked coasting of motor with control voltage failure!

⇒ Personnel should not remain within the area of the machine with moving parts. Possible preventive steps against unauthorized access are:
– protective fencing
– bars
– covers
– light barriers

⇒ The fences must be able to withstand the maximum possible force that the machine can generate.

Drive halt (AH) and Drive enable (RF)

Note:

- Inputs work with inactive bus communication.
- Inputs don't work with active bus communication (SERCOS interface, Profibus-DP, ...).

Connection AH and RF:

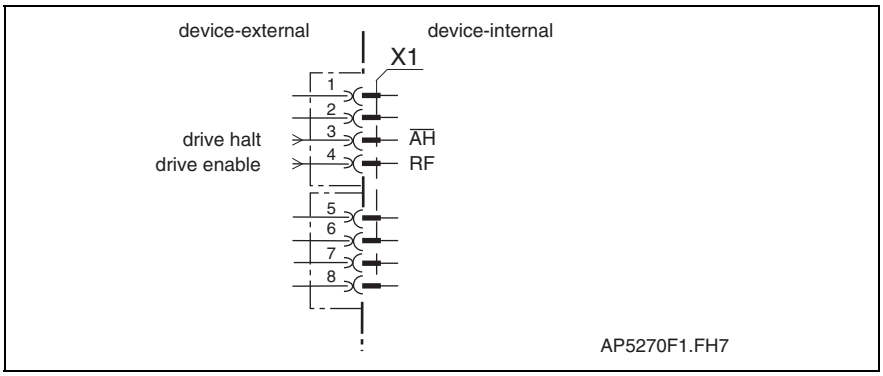
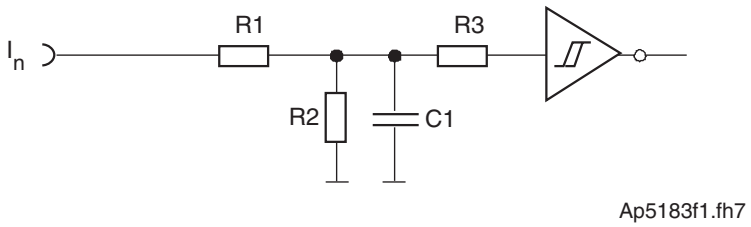


Fig. 5-8: Connections for drive halt and drive enable

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Input circuit AH and RF:



Schematics

R1: 10k
R2: 3k3
R3: 10k
C1: no data
Fig. 5-9: Input circuit

Inputs AH and RF:

Input voltage:	min.	max.
High	16 V	30 V
Low	-0.5 V	3 V
Input resistance	13.3 kOhm ±5%	
Reaction time	See firmware functional description	

Fig. 5-10: Inputs

AH: The drive halt function is used to bring an axis to standstill with defined acceleration and jerk (see firmware functional description).

RF: The input drive enable (RF) activates the drive with a 0-1 edge.

Note: If the inputs are controlled by a power supply other than the DC24 volt supply of the drive controller, then the reference lead of the other power supply must be connected to X1.2 (0 V).

Ready to operate contact Bb

Connection Bb:

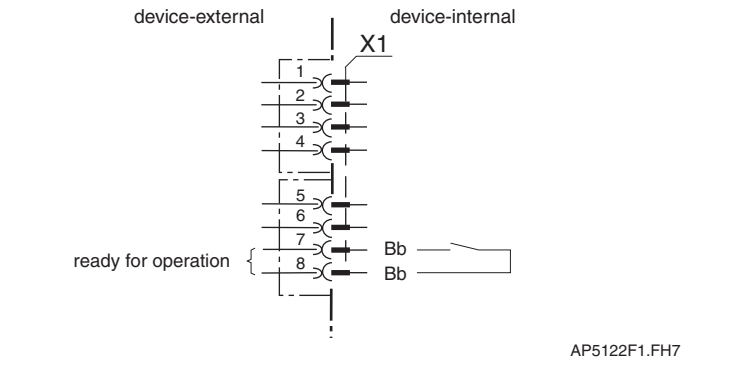


Fig. 5-11: Connections for ready to operate contact

Loadability of the connection Bb:

max. switching voltage:	DC 40 V
max. switching current:	DC 1 A
max. continuous current:	DC 1 A
minimum contact load:	10 mA
Guaranteed number of switching operations at max. time constant of load < 50 ms:	250,000

Rexroth Bosch Group
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Switching states Bb:

The Bb contacts opens:

- if control voltage for DKC is not applied
- if 24 volts not present at the emergency stop input when the E-stop function is activated (depends on parameterization, see function description).
- With an error in the drive (depends on parameterization, see firmware functional description: "Power off on error").

WARNING

Damage possible if Bb contact not connected!

The ready to operate contact Bb acknowledges the drive is ready for mains voltage.

⇒ Integrate Bb contact as per "Control Circuits for the Mains Connection" (see project planning manual).

⇒ The evaluation of the Bb contact by a PLC may not cause any operating delay of more than 10 ms.

Connection of Control Interfaces and Terminals

See project planning manual for more details.

X5, DC bus, Motor and Mains Connections

DANGER

Lethal electric shock caused by live parts with more than 50 V!

⇒ Before working on the drive controller, switch off the power supply via the main switch or the fuse.

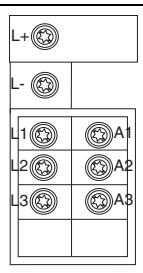
⇒ Always mount or dismount both connectors (motor connector and mains connector) on the drive controller at the same time.

⇒ Connect the protective conductor connections XE1 and XE2 to the protective conductor system of the control cabinet. Check the continuity of the protective conductors from the mains connection to the connected motors.

⇒ Observe information in chapter "Important Notes"

Technical description of connector

Illustration:



Ap5267f1.FH7

Fig. 5-12: Connector X5

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Design:

Type	No. of pins	Design
connection block	2 / 3 / 3	screw-in connection for ring terminals M5

Fig. 5-13: Design

Tightening torque:

min. tightening torque [Nm]	max. tightening torque [Nm]
2.5	3.0

Fig. 5-14: Tightening torque

Connection cross section:

Cross section single wire [mm²]	max. connectable cross section [mm²]	Wire Size in AWG gauge no.:
--	25	--

Fig. 5-15: Connection cross section

DC bus connection

The DC bus connection connects several controllers to each other plus it connects controllers together with auxiliary components

- Increase allowed DC bus continuous power
- Increase allowed bleeder continuous load
- Allow connections for "Central supply"

Connection DC bus:

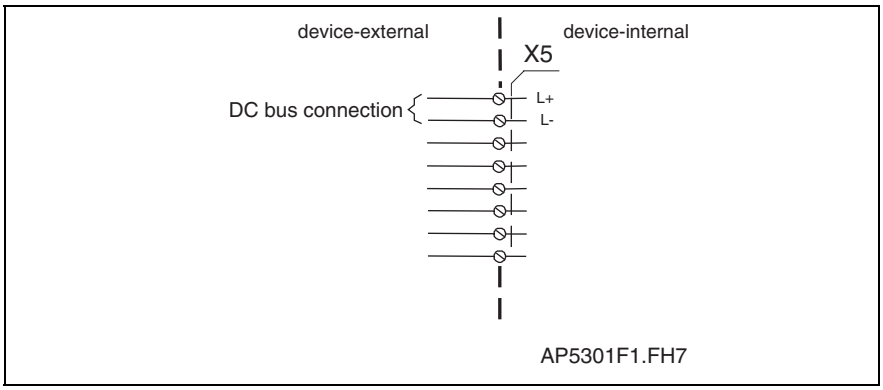


Fig. 5-16: DC bus connection

CAUTION

Damage possible if DC bus connections L+ and L- are reversed!

⇒ Make sure polarity is correct.

wire DC bus:

If the DC bus rails supplied do not make a connection possible, then use short twisted wires to do so.

wire length:	max. 2 x 1 m
wire cross section:	min. 10 mm², not smaller than the cross section of the mains supply lead
wire protection	With a fuse in the mains connections
Voltage resistance of individual wires to ground	≥ 750 V (e.g., litz wires - H07)

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Motor connection

Connection Motor:

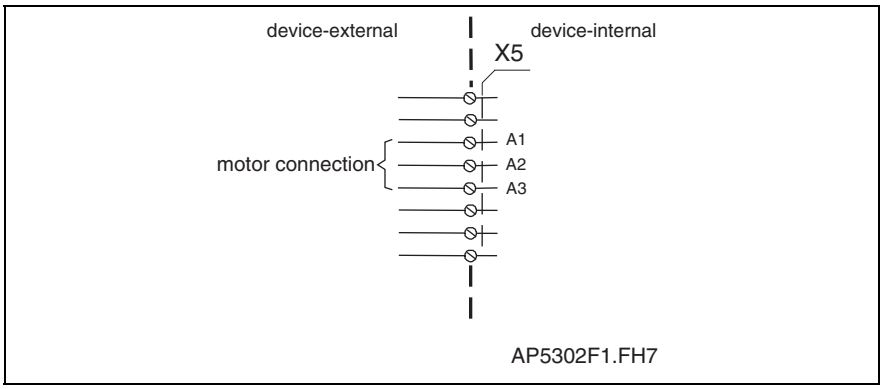


Fig. 5-17: Motor connections

Cable Motor: Use Rexroth motor power cables to connect motor and controller.

Note: For technical data on connections and cross sections, see the motor project planning manual.

Cable length:

Maximum length equals 75 m:

- With two connections between controller and motor (e.g., plugs at exit of control cabinet and at machine)
- Standard cables from Rexroth
- Ambient temperatures of ≤ 40 °C per EN 60 204
- Switch frequency of 4 kHz

Maximum allowed capacitance per unit length at A1, A2, A3:

- with regard to ground: 0.5 nF/m
- cable to cable: 0.5 nF/m

Maximum allowed inductance per unit length an A1, A2, A3:

- 100 nH/m

To maintain EMC values, the motor cable length is limited with a switching frequency of > 4 kHz. It is largely dependent on the application and ambient conditions at the installation and machine.

A guide value is listed below:

Cycle frequency drive controller	Max. length for class B, EN 55011	Max. length for class A, EN 55011
standard setting switching frequency 4 kHz	75 m	75 m
parameter setting switching frequency 8 kHz	25 m	50 m

Fig. 5-18: Guide value for maximum motor cable lengths

Protective conductor connection XE1

WARNING

No guarantee!
If third party cables are used, then the guarantee is forfeited for the entire system.
⇒ Use Rexroth cables!

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Mains connections

The mains connector serves as the connection of the drive controller with the power supply.

Single-phase mains connection:

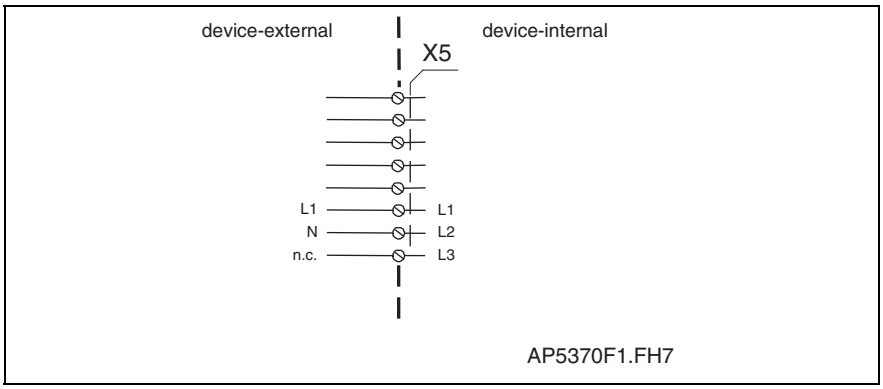


Fig. 5-19: Single-phase mains connection

Three-phase mains connection:

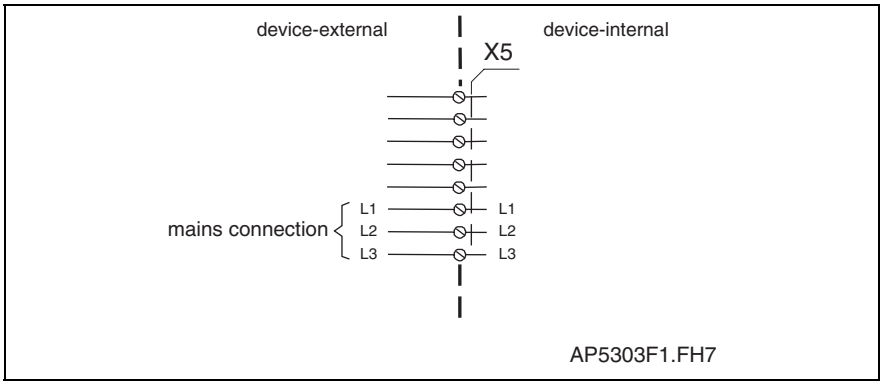


Fig. 5-20: Three-phase mains connection

Protective conductor connection XE2

Note: Mains connections should not be daisy-chained between the units (intermediate connectors for the supply source should be used).

Note: If applicable, an additional input filter SUP-M03-DKCxxx.3 NFD must be installed.

X6, Motor temperature monitoring and holding brakes

Technical description of connector

Illustration:



Fig. 5-21: Connector X6

Design:

Type	No. of pins	Design
Spring contact	2 x 4	Bushing on connector

Fig. 5-22: Design

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Connection cross section:

Cross section single wire [mm²]	Cross section multi core wire [mm²]	Cross section in AWG Gauge no.:
0.2-2.5	1,5-2,5	16-12

Fig. 5-23: Connection cross section

CAUTION

Damages by exchanging the connectors X6.1-4 and X6.5-8!

⇒ Do not exchange connectors X6.1-4 and X6.5-8.

⇒ Only use lines with sufficient cross section.

Motor temperature monitoring (TM+, TM)

Connections TM+ and TM- are used to evaluate the temperature of connected Rexroth motors. These are equipped with a temperature-dependent resistor (either PTC or NTC dependent on the motor type) to monitor temperature. The connection leads are in the motor power cable.

Connection monitoring TM+, TM-:

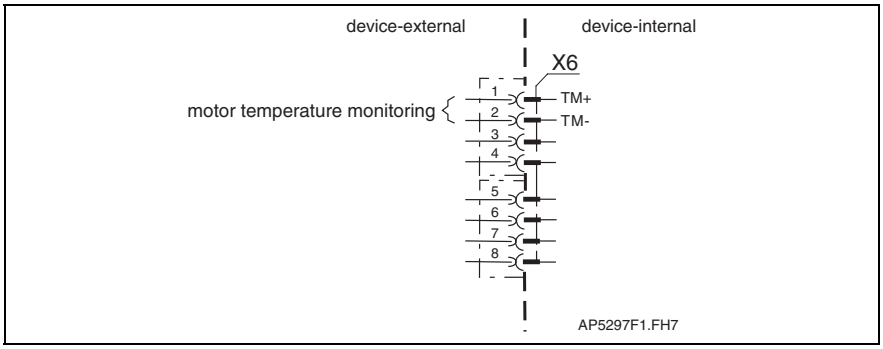
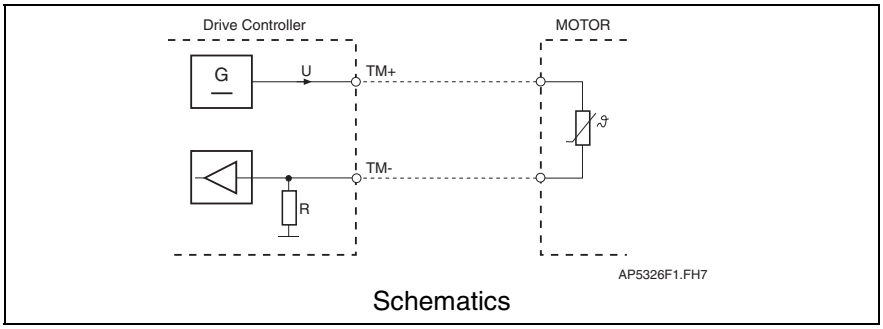


Fig. 5-24: Motor temperature monitoring

Motor temperature evaluation:



U: approximately 5 V
R: approximately 2 k

Fig. 5-25: Motor temperature evaluation

Note: Connections TM+ and TM- are only to be used with Rexroth motors.

⇒ See also firmware functional description : "Temperature monitoring".

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Holding brake (BR+, BR-)

DANGER

Dangerous movements! Danger to personnel from falling or dropping axes!

⇒ The standard equipment motor brake or an external brake controlled directly by the servo drive are not sufficient to guarantee the safety of personnel!

⇒ Personnel safety must be acquired with higher-ranking procedures:

Dangerous areas should be blocked off with fences or grids.

Secure vertical axes against falling or slipping after switching off the motor power by, for example:

- Mechanically securing the vertical axes
- Adding an external brake / clamping mechanism
- Balancing and thus compensating for the vertical axes mass and the gravitational force

These connections control the holding brakes in the connected motors.

For the switching performance, see function description.

To connect external loads note allowed contact loads.

Connection BR+, BR-:

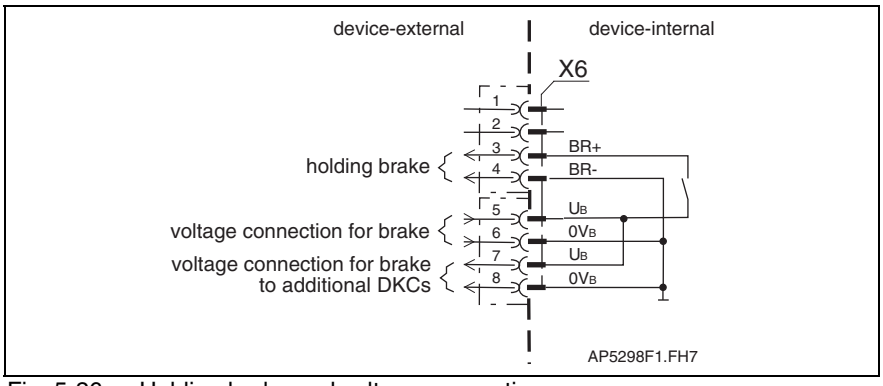


Fig. 5-26: Holding brake and voltage connection

Loadability of connections BR+, BR-:

Units	DKC**.3-040-7, DKC**.3-100-7	DKC**.3-200-7
max. switching voltage:	DC 40 V	
max. switching current:	DC 2 A	DC 4 A
max. continuous current:	DC 2 A	DC 4 A
Minimum contact load:	100 mA	
Guaranteed number of switches at max. time constant of load <50ms ($L_{Bremse}/(24V/I_{Bremse})$):	250.000	
Short-circuit and overload protection in the row to the contact	present	

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Voltage connection for brakes

Note: The motor holding brake is not supplied by the controller. Given one voltage source for brake and control voltage, use parallel leads from the voltage source. Insert the brake voltage supply cable in the touch guard from the bottom or from the side. Note the voltage range for the motor holding brake according to the motor projection.

CAUTION

Risk of damage!

⇒ The maximum allowed current load of the terminals for the voltage supply of the brake and the control voltage supply must also be observed in the case of a short circuit.

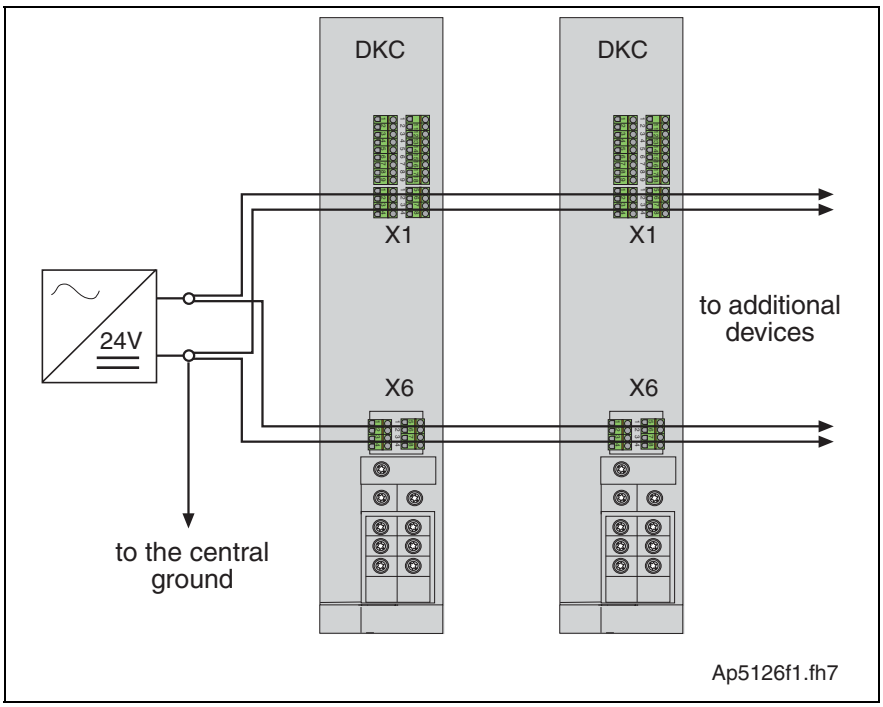


Fig. 5-27: Shared voltage source for brakes and control voltage supply

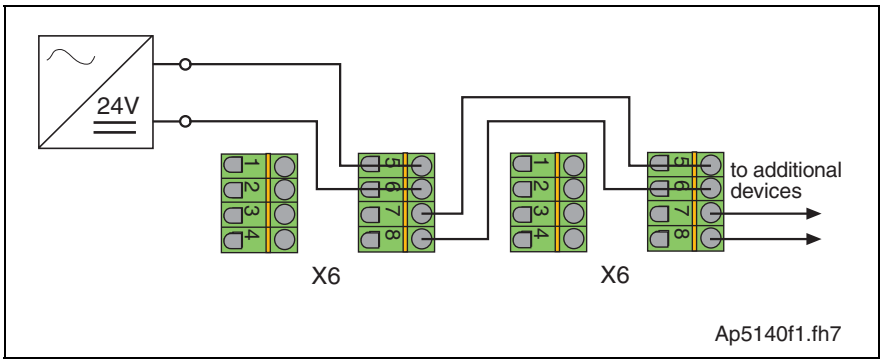


Fig. 5-28: Looping through the brake supply

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Voltage connection for brakes on DKC:

max. voltage at X6.5/7 against X6.6/8:	DC 40 V
current consumption at X6.5 and needed supply voltage:	see "Technical data" brake in the motor manual
max. allowed current load when looping through brake supply over X6.5/6 to X6.7/8:	DC 10 A

Wire voltage connection for brake:

wire cross section:	min. 1 mm² for looping through: min. 2.5 mm²
Voltage resistance of single wire to ground	≥ 750 V (e.g.: litz wires - H07)
wire routing	parallel if possible (twisted)
max. inductance between 24 V source and X6	100 µH (equals about 2 x 75 m)

CAUTION

Risk of damage!

⇒ Risk of damage by increased transition resistance in the case of strong mechanical influence at the test tap.

Motor holding brake

Controlling the motor holding brake:

The controller controls the holding brake.

Technical data Motor holding brake:

Supply voltage, current consumption, linking, separating time, holding torque, etc. see motor manual.

Basic connection of motor power, holding brake and motor temperature monitoring

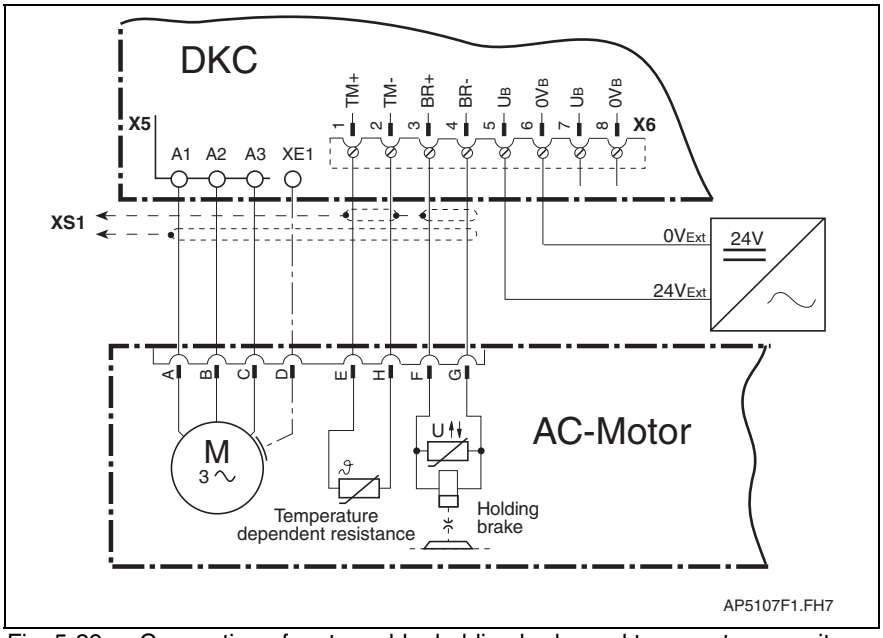


Fig. 5-29: Connection of motor cable, holding brake and temperature monitor for motors with connectors

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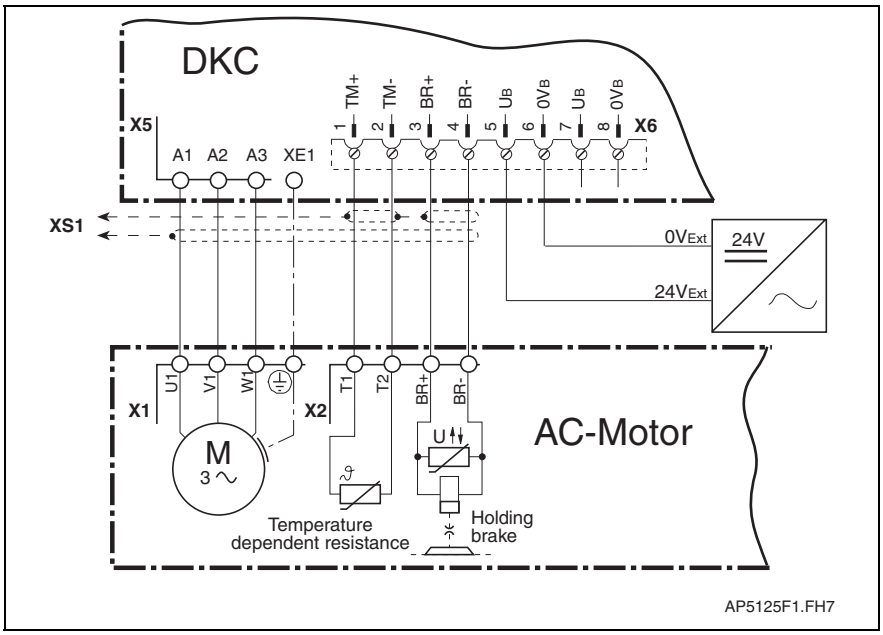


Fig. 5-30: Connection of motor cable, holding brake and temperature monitor for motors with connector box

Note: The cable designations and all details on making cables are outlined in the cable or motor document.

X7, Connection for Programming module

Programming module

The programming module can be broken down into

- Parameter module for user-specific parameters
- Firmware modules for unit-specific firmware

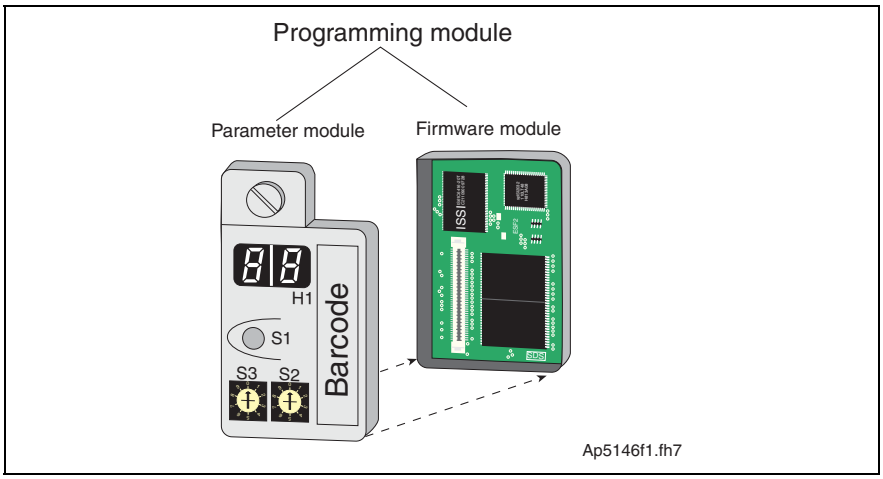


Fig. 5-31: X7, Programming module

H1:	Diagnostic display
S1:	Reset key
S2, S3:	Address switch

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Setting the Drive Address

Switch S2, S3; drive address:

Two decade switches are used to set the drive address. It can be set to any number between 1 and 99.

Example:

Switch setting S3 = 9 (value of tens)

Switch setting S2 = 1 (value of ones)

Drive address = 9 * 10 + 1 = 91

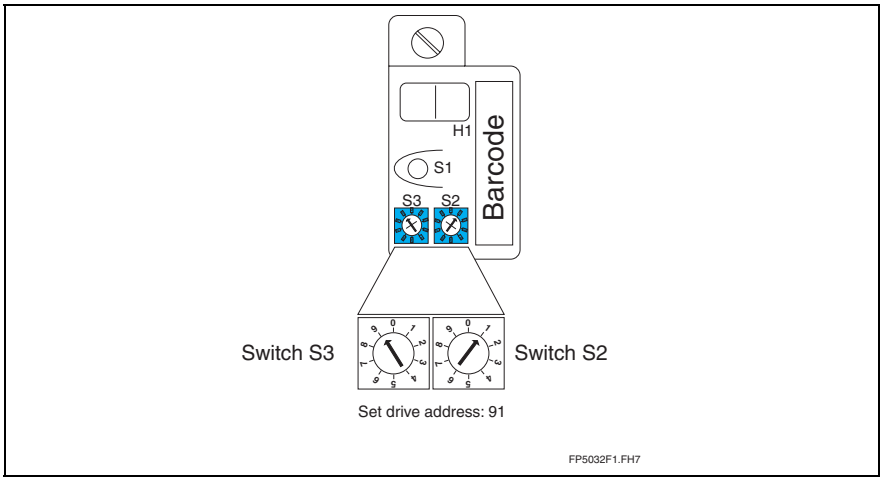


Fig. 5-32: Setting the drive address using a decade switch

Note: The address is not set at delivery.

The setting of switches S2 and S3 depends on the model, firmware and the drive address wanted.

⇒ See firmware functional description.

X12, Optional Choke Connection for DKC**.3-200-7

Technical description of connector

Illustration:

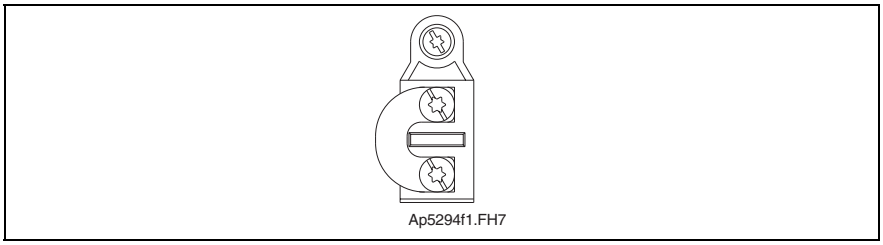


Fig. 5-33: Connector X12

Design:

Type	No. of pins	Design
Screw-in connector	2	screw-in connection for ring terminals M5

Fig. 5-34: Design

Tightening torque:

min. tightening torque [Nm]	max. tightening torque [Nm]
2.5	3.0

Fig. 5-35: Tightening torque

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Connection cross section:

Cross section single wire [mm²]	Cross section multi core wire [mm²]	Cross section in AWG Gauge no.:
--	10 - 25	--

Fig. 5-36: Connection cross section

Connection Choke (DR+, DR-)

Connection DR+, DR-:

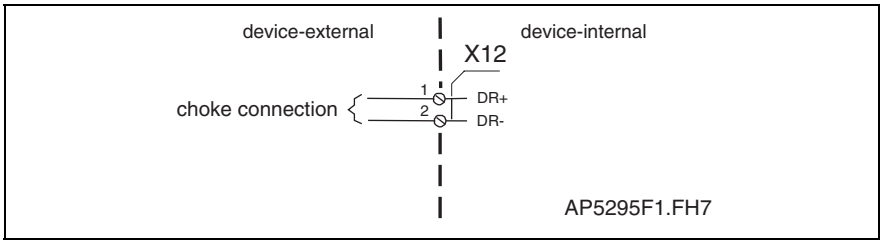


Fig. 5-37: Optional choke connection for DKC**.3-200-7

At delivery: with bridges at: X12.1 to X12.2

Loadability of the connection DR+, DR-:

max. voltage against L-:	DC 900 V
voltage against ground	Applied mains voltage
max. continuous current (rms):	70 A

Wire DR+, DR-:

wire length:	max. 10 m
wire cross section:	min. 10 mm², but not smaller than mains wire cross section
wire routing	twisted
voltage resistance of single litz to ground:	≥ 750 V (e.g.: litz wires - H07)

Note: Connection bridged at delivery.

XE1, XE2 Protective Conductor Connections for Motor and Mains

DANGER

Lethal electric shock caused by live parts with more than 50 V!

⇒ Connect the protective conductor connections of the drive controller to the protective conductor system of the control cabinet.

⇒ Cross section of protective conductor: ≥ 10 mm² (Reason: high leakage currents (EN 50178/1998, section: 5.3.2.1)

⇒ Check the continuity of the protective conductors from the mains connection to the connected motors.

Technical description of connector

Design:

Type	No. of pins	Design
screw-in connection	1	screw-in connection for ring terminals M5

Fig. 5-38: Design

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Tightening torque:

min. tightening torque [Nm]	max. tightening torque [Nm]
2.5	3.0

Fig. 5-39: Tightening torque

Connection cross section:

Cross section single wire [mm²]	Max. connectable cross section in mm²	Max. cross section in AWG gauge no.:
--	25	--

Allocation

XE1 Motor

XE2 Mains

XS1, XS2, XS3 Shield Connections

XS1

Connection for shield:

- Total motor cable shield
- Holding brake
- Motor temperature monitoring
- Mains supply

XS2

Connection for shields of cables at X1, X3 and those for the command communication interfaces.

XS3

Connection for shields of cables at X9, X10 and X11.

Allowed outside diameters:

Drive controller	XS1	XS2	XS3
DKC**.3-040	12-18	6-15	6-15
DKC**.3-100	12-35	6-15	6-15
DKC**.3-200	19-35	6-15	6-15

Fig. 5-40: Allowed outside diameters in mm

Note: Always connect the shield connections of the cables (especially of the motor cables) with a large contact surface.

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5.3 Installation

General Information on How to Install the Drive Controller

Damage can be caused to the drive controller or circuit boards if electrostatic charging present in people and/or tools is discharged across them. Therefore, please note the following information:



CAUTION

Electrostatic charges can cause damage to electronic components and interfere with their operational safety!

⇒ Exposed conductive parts coming into contact with components and circuit boards must be discharged by means of grounding. Otherwise errors may occur when triggering motors and moving elements.

Such exposed conductive parts include:

- the copper bit when soldering
- the human body (ground connection caused by touching a conductive, grounded item)
- parts and tools (place them on a conductive support)

Endangered components may only be stored or dispatched in conductive packaging.

Note: Rexroth connection diagrams are only to be used for producing installation connection diagrams. The machine manufacturer's installation connection diagrams must be used for wiring the installation!

- Lay signal lines separately from the load resistance lines because of the occurrence of interference.
- Transmit analog signals (e.g. command values, actual values) via shielded lines.
- Do not connect mains, DC bus or power leads to low voltages or allow them to come into contact with these.
- When carrying out a high voltage test or an applied-overvoltage withstand test on the machine's electrical equipment, disconnect all connections to the devices. This protects the electronic components (allowed in accordance with EN 60204-1). During their routine testing, Rexroth drive components are tested for high voltage and insulation in accordance with EN 50178.



CAUTION

Risk of damage to the drive controller by connecting and disconnecting live connections!

⇒ Do not connect and disconnect live connections.

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Touch Guard at Devices

WARNING

Lethal electric shock caused by live parts with more than 50 V!

- The appropriate touch guard must be mounted for each device following connection work.
- Never mount a damaged touch guard.
- Immediately replace a damaged touch guard by an undamaged touch guard.
- Keep the cutouts at the touch guard as small as possible. Only remove the cutouts if necessary.

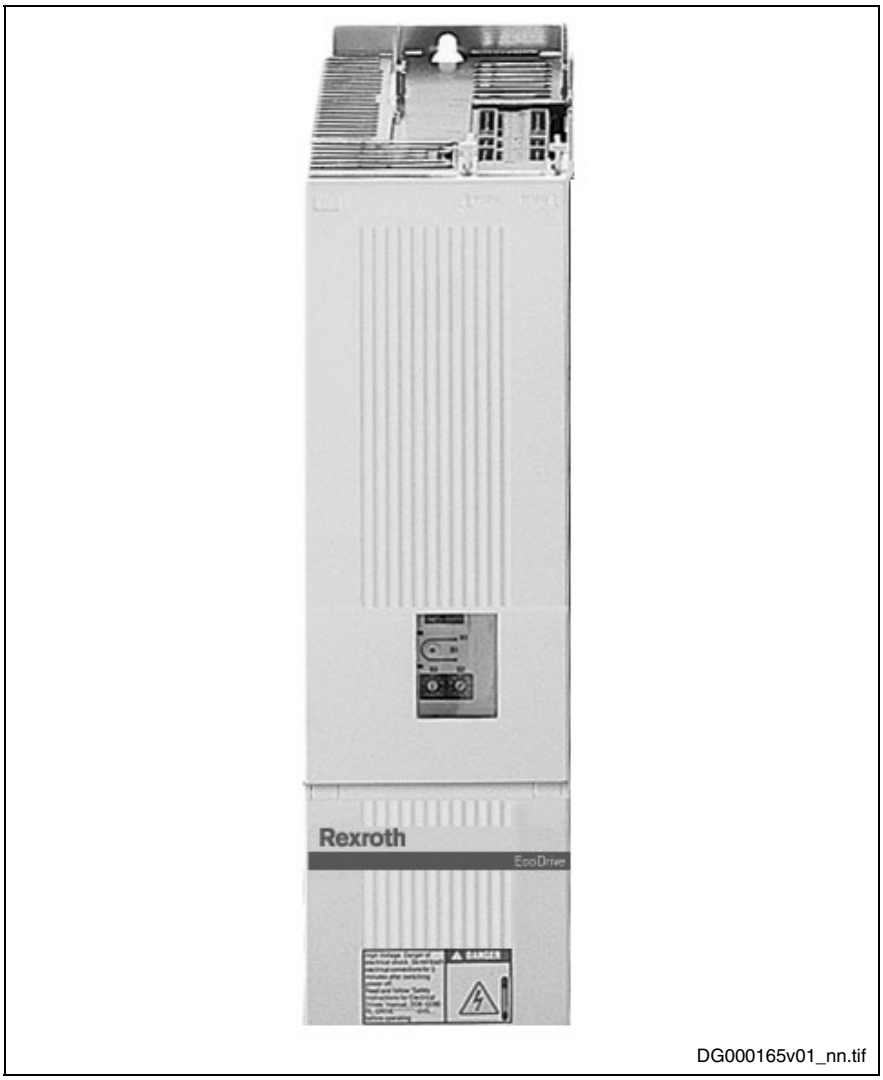


Abb. 5-41: Drive controller with touch guards

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Sizing of Enclosure and Control Cabinet

Control Cabinet with Multiple-Line Structure

Note: Particular attention should be paid to the maximum allowed air intake temperature of components when they are arranged in multiple lines in the control cabinet. Where necessary, cooling air guides are to be provided with blowers specially used for this purpose.

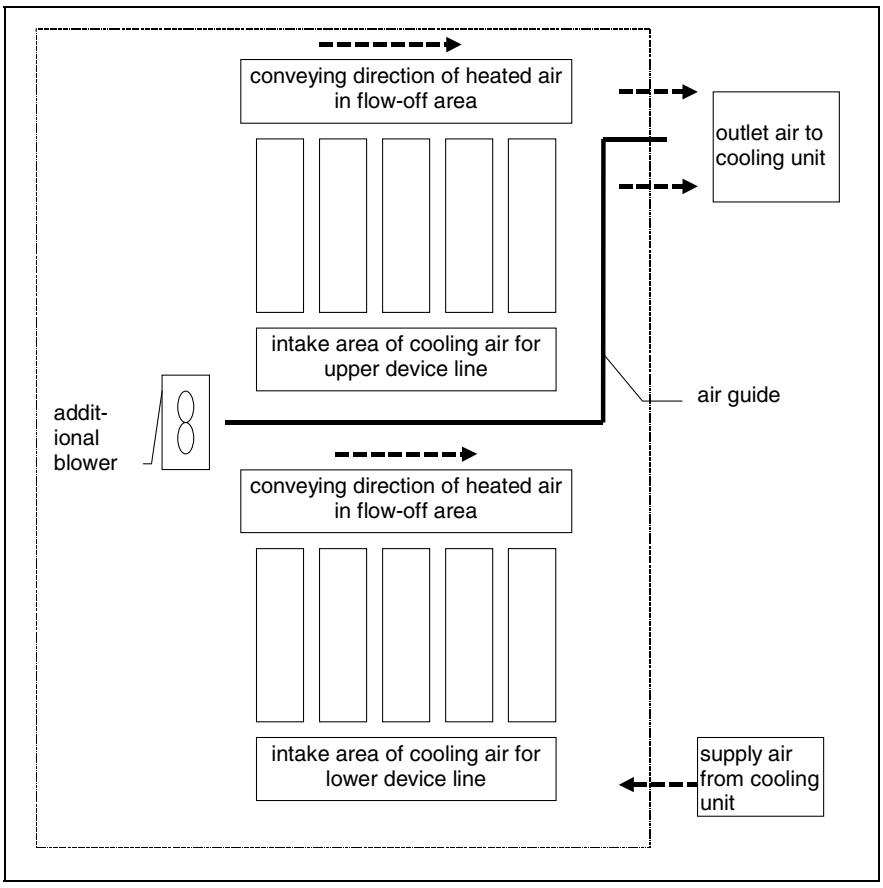


Fig. 5-42: Example of arrangement for multiple-line structure with components

Arrangement of Cooling Units

CAUTION

Possible damage to the drive controller
Operational safety of the machine endangered!
Note the following instructions!

Avoiding Dripping or Sprayed Water

Due to the operating principle, condensation water is formed when cooling units are used. For this reason, please observe the following information:

- Always position cooling units in such a way that condensation water cannot drip onto electronic equipment in the control cabinet.
- Position the cooling unit in such a way that the blower of the cooling unit does not spray accumulated condensation water onto electronic equipment.

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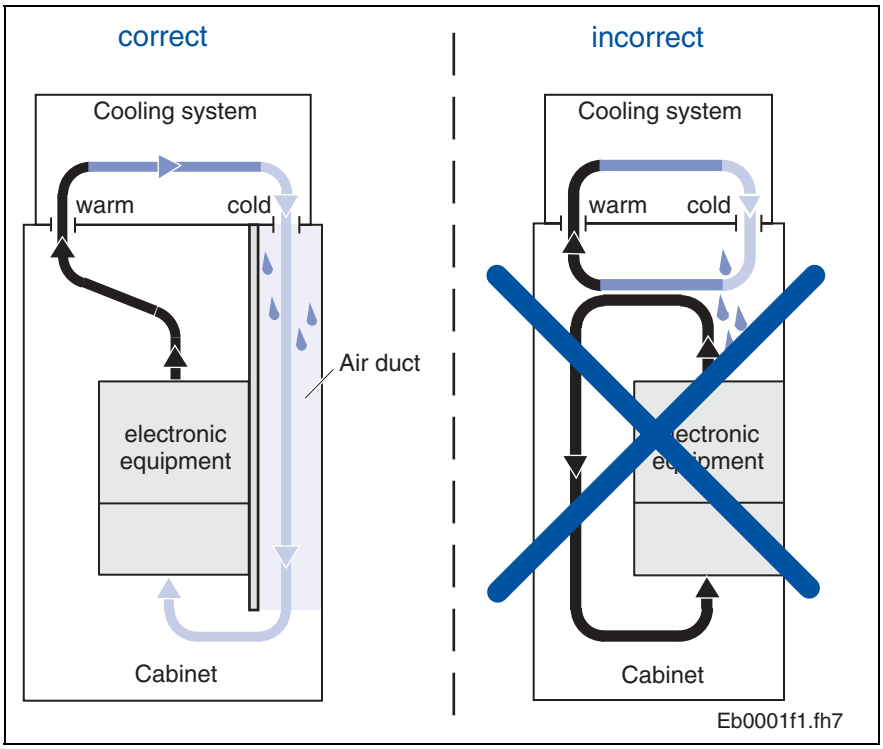


Fig. 5-43: Arranging the cooling unit on the control cabinet

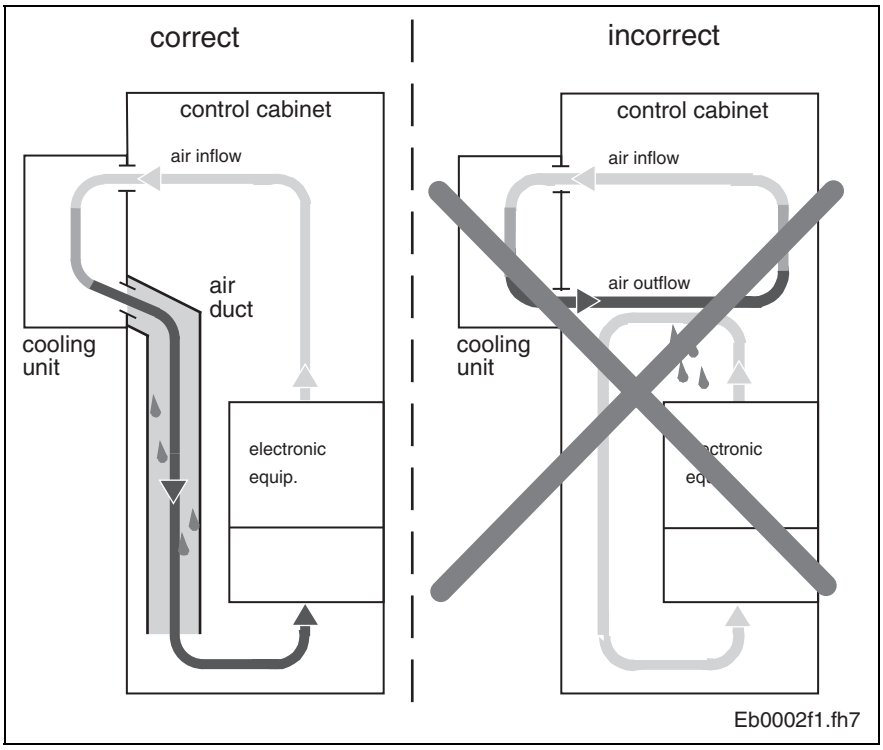


Fig. 5-44: Arranging the cooling unit at the front of the control cabinet

Avoiding Moisture Condensation

Moisture condensation occurs when the temperature of the device is lower than the ambient temperature.

- Set cooling units with temperature adjustment to the maximum surrounding temperature and not lower!
- Set cooling units with follow-up temperature in such a way that the interior temperature of the control cabinet is no lower than the temperature of the surrounding air. Set the temperature limitation to the maximum surrounding temperature!

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- Only use well-sealed control cabinets so that moisture condensation cannot arise as a result of warm and moist external air entering the cabinet.

In the event that control cabinets are operated with the doors open (commissioning, servicing etc.) it is essential to ensure that after the doors are closed the drive controllers cannot at any time be cooler than the air in the control cabinet, as otherwise moisture condensation can occur. For this reason sufficient circulation must be provided inside the control cabinet to avoid pockets of heat.

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6 Appendix

6.1 Discharging of DC Bus Capacitors

In the drive system Rexroth IndraDrive capacitors are used in the DC bus as energy stores. In the drive controllers and particularly in the supply units such capacitors have already been integrated.

Energy stores maintain their energy even when energy supply has been cut off and have to be discharged before somebody gets in contact with them.

Discharging devices have been integrated in the components of the drive system Rexroth IndraDrive; within the indicated discharging time these devices discharge the voltage below the allowed 50 V.

If additional capacitances in the form of

- DC bus capacitor units or
- additional capacitors

are connected, make sure that these capacitors, too, are discharged before somebody gets in contact with them.

Due to the operating principle, the discharging time is the longer

- the bigger the energy store (the capacitance value)
- the higher the voltage to which the energy store has been charged
- the greater the resistance for discharging the capacitors.

Components of the drive system Rexroth IndraDrive have been dimensioned in such a way that after the energy supply was cut off the voltage value falls below 50 V within a discharging time of a maximum of 30 minutes.



WARNING

Lethal electric shock caused by live parts with more than 50 V!

⇒ Wait at least 30 minutes after switching off power to allow discharging.

⇒ Check whether voltage has fallen below 50 V before touching live parts!

To shorten the waiting time until voltage has fallen below 50 V you can take the following measures:

- Activate the function “ZKS” (DC bus short circuit) when using HMV01 supply units.



WARNING

Lethal electric shock caused by live parts with more than 50 V!

⇒ Before touching live parts check whether the voltage has fallen below 50 V!

- Use the discharging device described below.

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6.2 Discharging Device



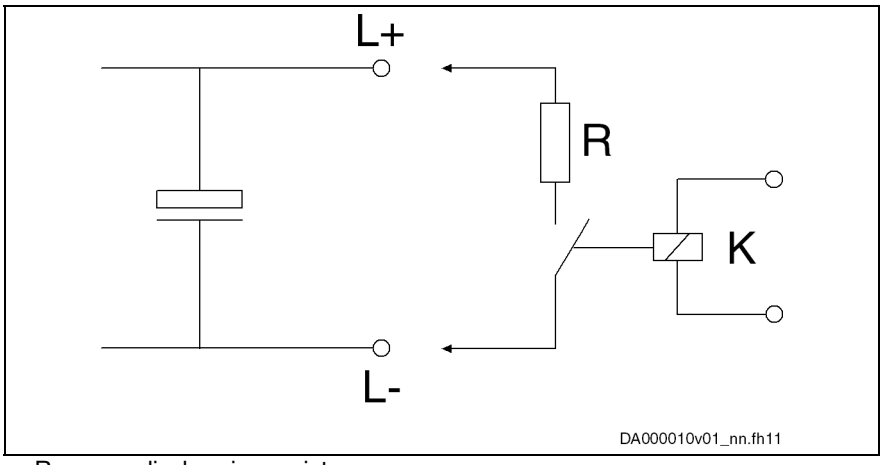
WARNING

Lethal electric shock caused by live parts with more than 50 V!

⇒ Before touching live parts check in any case whether the voltage between the DC bus terminals L+ and L- has fallen below 50 V!

Operating Principle

A contactor is installed to switch a resistor to the terminals L+ and L- of the DC bus connection to discharge the capacitors. The contactor is activated via a control input which is supplied with appropriate control voltage.



R: discharging resistor
K: contactor contact

Fig. 6-1: Operating principle of discharging device

Dimensioning

The individual components have to be sufficiently dimensioned:

- The value of the discharging resistor has to be dimensioned with 1000 ohm and at least 1000 W.
- The discharging resistor and the contactor contact have to withstand the loads of practical operation (for example in the case of frequent use of the discharging device of the occurring continuous power).
- The contactor contact has to withstand the occurring direct voltage of min. 1000 V.
- The contactor contact has to withstand the occurring discharge current according to the resistance value that is used, i.e. 1 A with 1000 ohm.

How to Proceed for Discharging

Observe the proceeding when using the discharging device:

1. Install discharging device before switching energy supply on for the first time and establish safe electrical connection between discharging device and object to be discharged.
2. On mains side switch off energy supply to drive system before activating discharging device.
3. Activate discharging device.

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