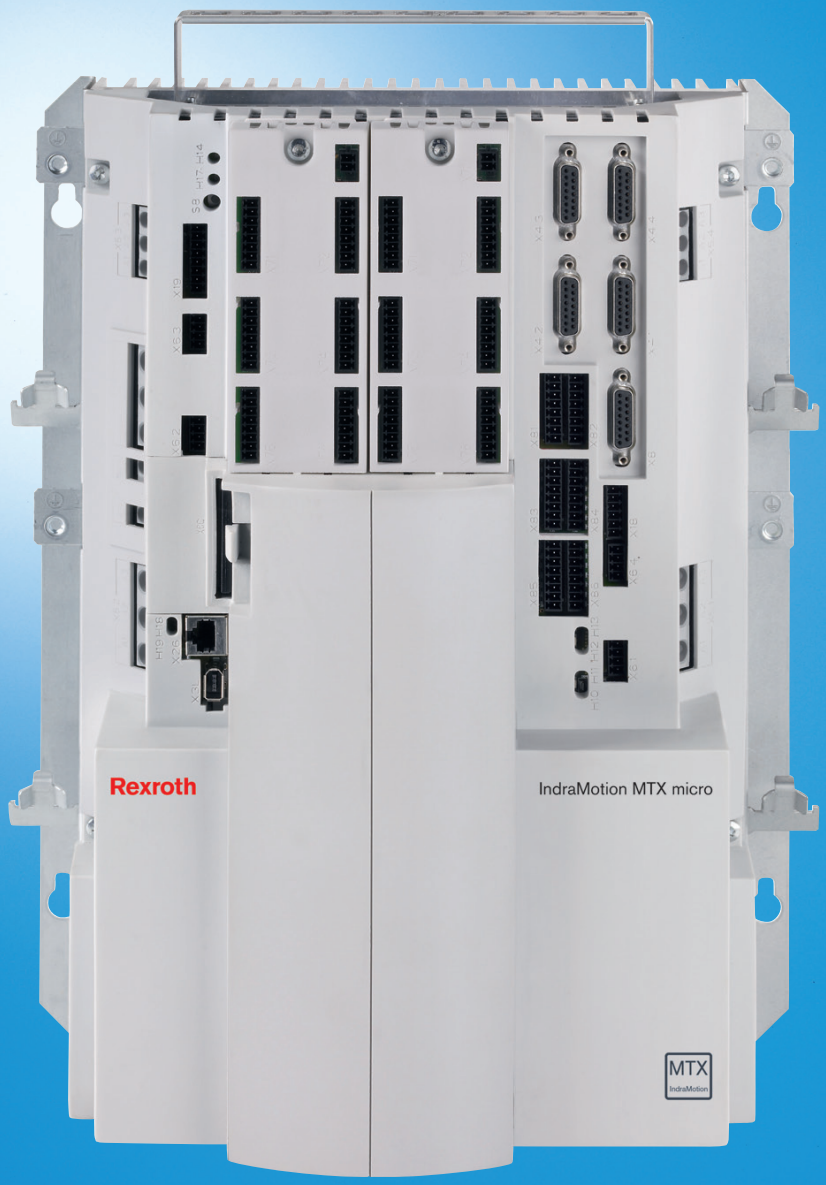
Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

Rexroth
Bosch Group

Rexroth IndraDrive Drive Controllers HCQ, HCT

R911324185
Edition 03

Project Planning Manual



Title

Rexroth IndraDrive
Drive Controllers
HCQ, HCT

Type of Documentation

Project Planning Manual

Document Typecode

DOK-INDRV*-HCQ-T+HMQ-T-PR03-EN-P

Internal File Reference

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Purpose of Documentation

Provides information on the project planning of Rexroth IndraDrive systems considering the components

- HCQ02
- HCT02

Record of Revision

Edition	Release Date	Notes
DOK-INDRV*-HCQ-T+HMQ-T-PR01	2009/10	See index entry "Documentation → Editions"
DOK-INDRV*-HCQ-T+HMQ-T-PR02	2011/07	See index entry "Documentation → Editions"
DOK-INDRV*-HCQ-T+HMQ-T-PR03	2012/04	See index entry "Documentation → Editions"

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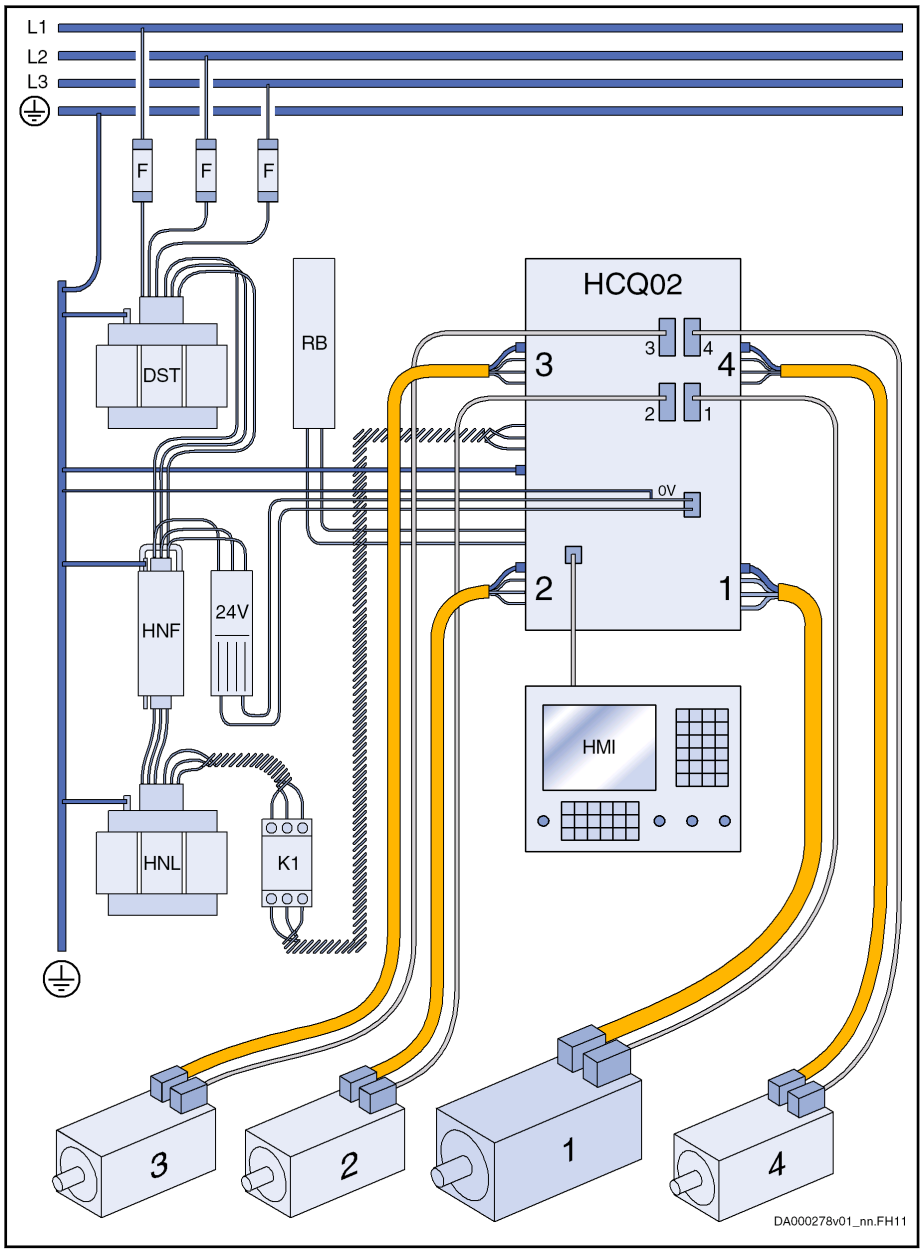
Drive System Rexroth IndraDrive C with 4-Axis Converter HCQ02



1 … 4	Motors (1: Powerful main drive; 2–4: Secondary drives)
24V	24V supply
DST	Transformer (optional)
F	Fuses
HCQ02	4-axis converter
HMI	External operator panel
HNF	Mains filter (optional)
HNL	Mains choke (optional; you can do without mains choke in the case of reduced performance)
K1	Mains contactor
RB	External charging resistor

Fig. 1-1: Drive System Rexroth IndraDrive C with 4-Axis Converter HCQ02

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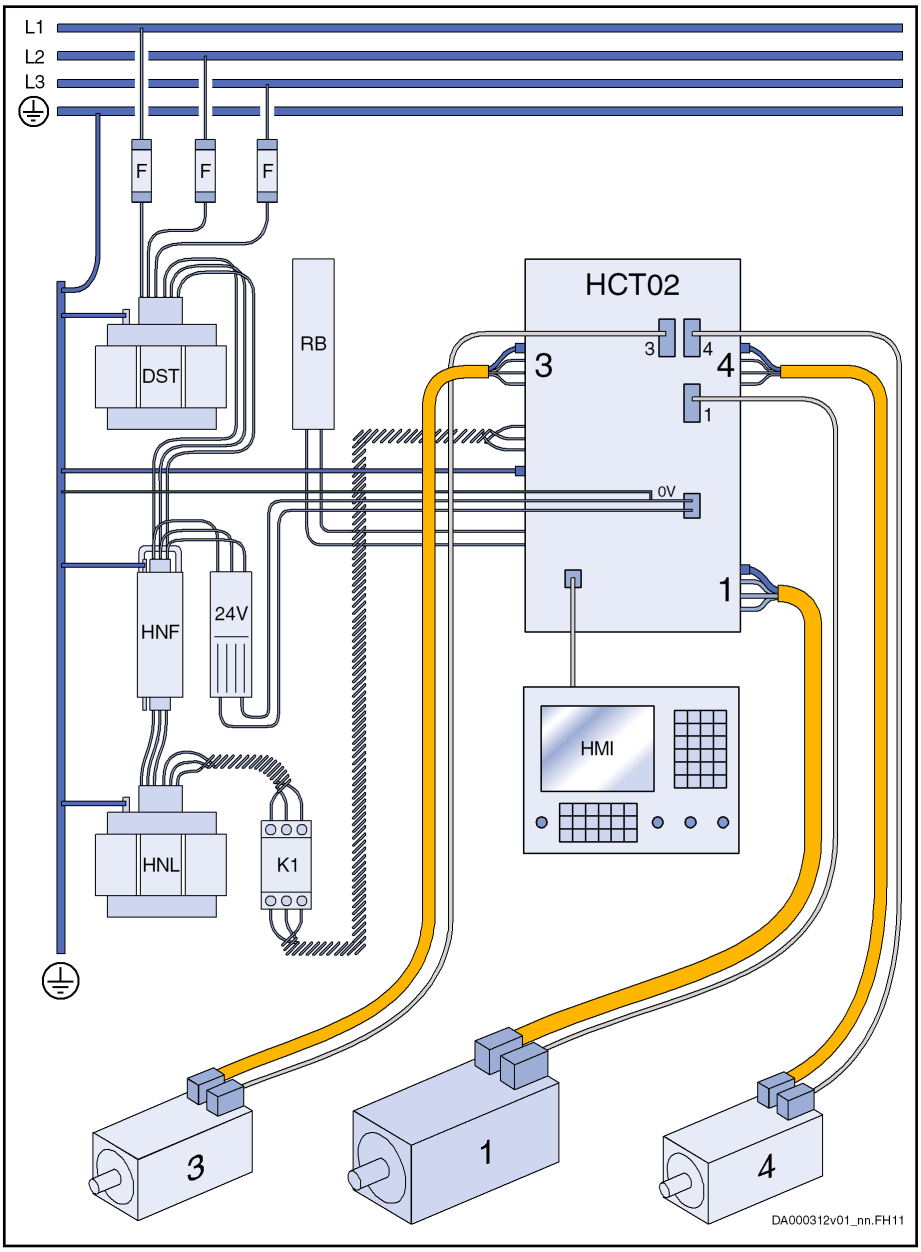
Drive System Rexroth IndraDrive C with 3-Axis Converter HCT02



1 … 4	Motors (1: Powerful main drive; 3–4: Secondary drives)
24V	24V supply
DST	Transformer (optional)
F	Fuses
HCT02	3-axis converter
HMI	External operator panel
HNF	Mains filter (optional)
HNL	Mains choke (optional; you can do without mains choke in the case of reduced performance)
K1	Mains contactor
RB	External charging resistor

Fig. 1-2: Drive System Rexroth IndraDrive C with 3-Axis Converter HCT02

1.2 Drive Controllers HCQ02, HCT02

Main Features

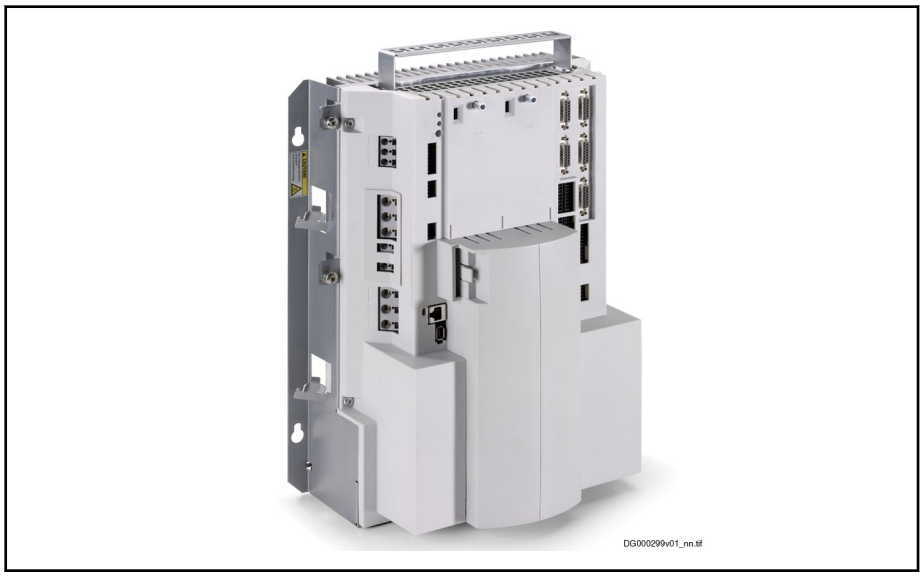


Fig.1-3: View of a Drive Controller

- Multi-axis converter (HCQ02, HCT02) in flat type of construction with forced-ventilated cooling
- Degree of protection IP20
- Voltage range mains connection nominal 3 AC 200 … 500 V
- 4 (HCQ02) or 3 (HCT02) integrated inverters
- Integrated brake chopper to operate an external braking resistor
- External 24V supply
- 2 slots for optional extensions (e.g. digital inputs/outputs)
- Interface to operate external operator panels (HMI)
- Changeable programming module in CompactFlash format with firmware and parameters

Properties

Property	HCQ02	HCT02
Type of drive controller	Converter, multi-axis	
Number of axes	4	3
Mains connection	■	
DC bus connection	-	
Number of encoder evaluations	5	4
Configurable	■	
Number of configurable slots	2	
Configurable slots for safety technology	-	
Braking resistor	External, required as charging resistor, too	
DC bus short circuit input	■	
Interface to operator panel (LVDS + USB)	■	

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Property	HCQ02	HCT02
EtherNet Engineering Port	■	
sercos III Master Port	■	
Master communication		
Embedded PC	■	
Multi-protocol EtherNet	-	
PROFIBUS	-	
Inputs / outputs		
Digital inputs 1)	32	
Thereof probes	4	
Digital outputs 1)	16	
Analog inputs	0	
Analog outputs	0	
Relay contacts	1 N/O	
Switching frequencies		
4 kHz	■	
8 kHz	■	

■ Available
- Not available
1) On-board connection points; can be extended with optional modules

Fig.1-4: Properties

1.3 Type Code

1.3.1 HCQ02

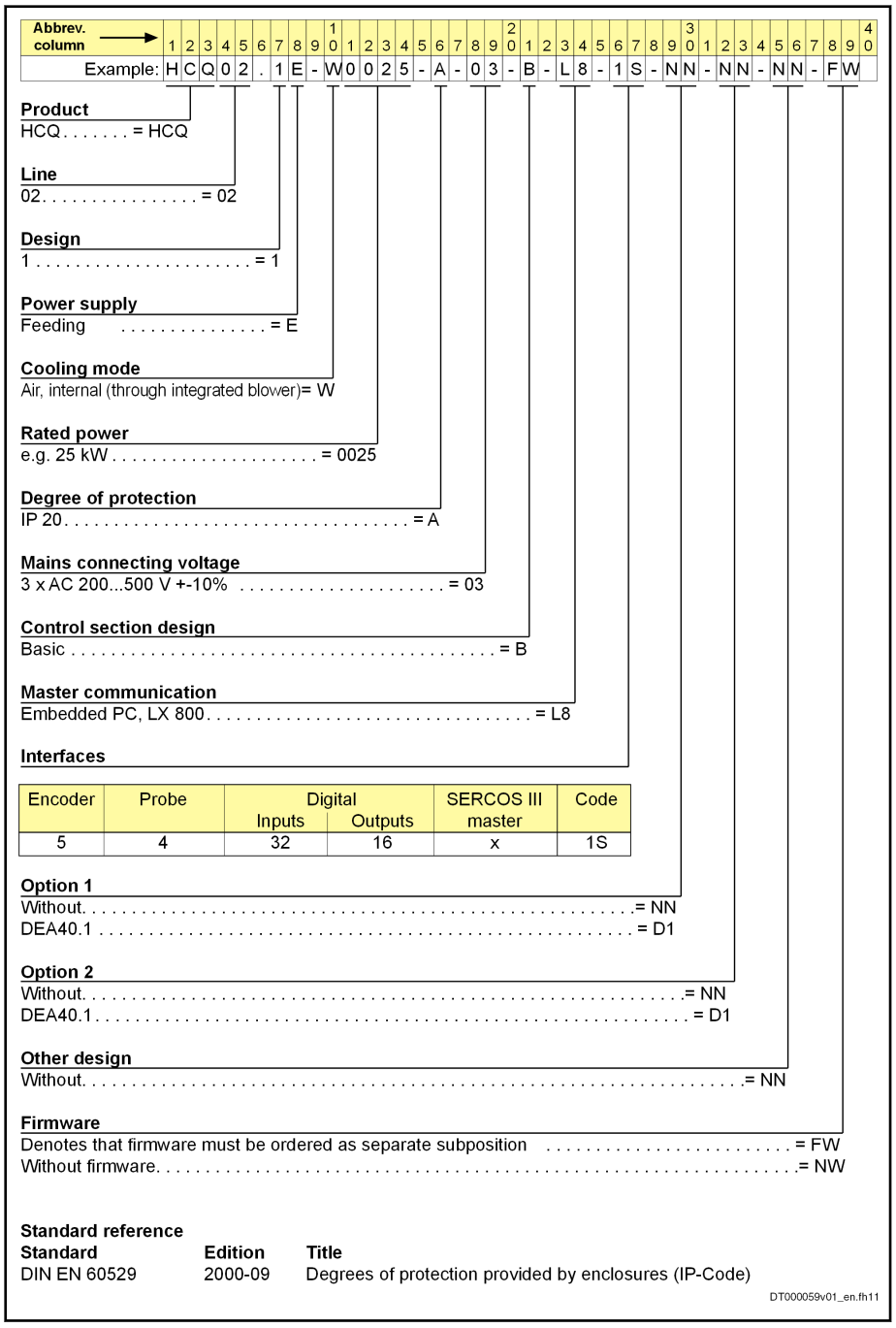

Fig. 1-5: Type Code HCQ02

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

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1.3.2 HCT02

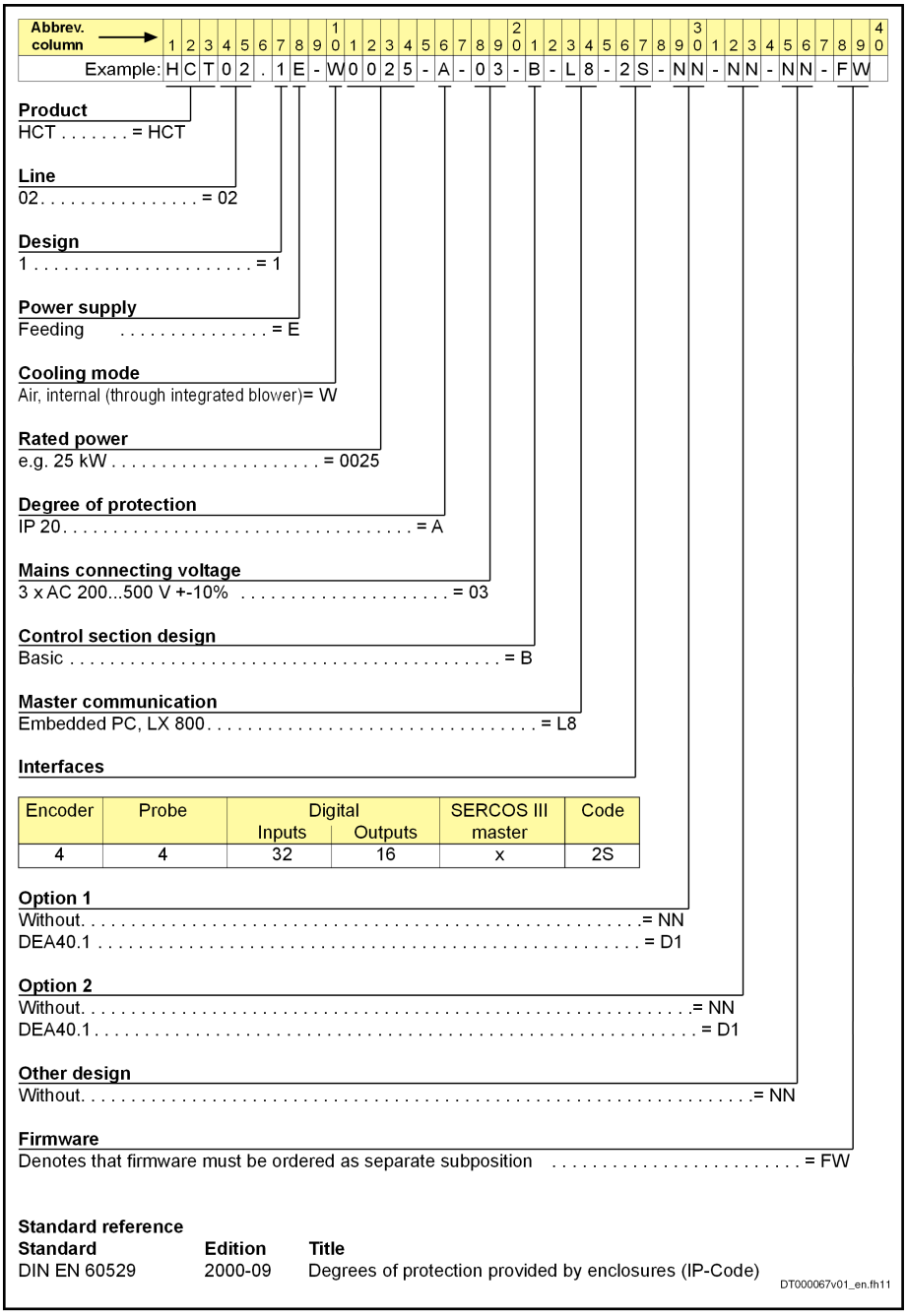

Fig.1-6: Type Code HCT02

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

1.4 Firmware

Required Firmware **FWA-MICRO*-MTX-12VRS-NN** or higher version

1.5 Operator Panels

Allowed operator panels: **VDP80.1**

1.6 About This Documentation

1.6.1 Purpose

⚠ WARNING **Personal injury and property damage caused by incorrect project planning for applications, machines and installations!**

Observe the contents of the documentations relevant to your drive system (see chapter "Documentations").

This documentation provides information on

- the project planning of Rexroth IndraDrive systems
- considering the components
  - HCQ02
  - HCT02

1.6.2 Editions

Edition	Release date	Notes
01	2009/10	First edition
02	2011/07	*Changes* • HCT02.1E-W00**20** device removed • HCT02.1E-W00**25** device included • Technical data and dimensional drawing updated • Notes on project planning for mains connection included • Chapter "Environmental Protection and Disposal" revised • Shield connection of the motor cables updated • Accessory HAS09 updated • Cover picture updated
03	2012/04	*Changes* • Chapter "Project Planning of Cooling System" removed • Chapter "General Data and Specifications → Installation Conditions": New subchapter "Control Cabinet Design and Cooling" included • Technical data (mains voltage) updated • New diagnostic displays of drive firmware MPM-17VRS included • Chapter "Service and Support" revised • Spelling of "SERCOS" changed to "sercos"

Fig. 1-7: Editions

System Presentation

1.6.3 Documentations

Drive Systems, System Components

Drive Systems with Multi-Axis Drive Controllers

Title	Kind of documentation	Document typecode[1)]	Part number R911…
Rexroth IndraDrive Drive Controllers HCQ02, HCT02	Project Planning Manual	DOK-INDRV*-HCQ-T+HMQ-T-PRxx-EN-P	324185
Rexroth IndraDrive Additional Components and Accessories	Project Planning Manual	DOK-INDRV*-ADDCOMP****-PRxx-EN-P	306140
Rexroth IndraControl VDP 80.1 Machine Operator Panel Operator Display	Project Planning Manual	DOK-SUPPL*-VDP*80.1***-PRxx-EN-P	329156

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. 1-8: Documentations – Drive Systems, System Components

Motors

Title Rexroth IndraDyn …	Kind of documentation	Document typecode[1)] DOK-MOTOR*-…	Part number R911…
A Asynchronous Motors MAD / MAF	Project Planning Manual	MAD/MAF****-PRxx-EN-P	295781
H Synchronous Kit Spindle Motors	Project Planning Manual	MBS-H******-PRxx-EN-P	297895
L Synchronous Linear Motors	Project Planning Manual	MLF********-PRxx-EN-P	293635
L Coreless Linear Motors MCL	Project Planning Manual	MCL********-PRxx-EN-P	330592
S Synchronous Motors MKE	Project Planning Manual	MKE*GEN2***-PRxx-EN-P	297663
S Synchronous Motors MSK	Project Planning Manual	MSK********-PRxx-EN-P	296289
S Synchronous Motors MSM	Data Sheet	MSM********-DAxx-EN-P	329338
S Synchronous Motors QSK	Project Planning Manual	QSK********-PRxx-EN-P	330321
T Synchronous Torque Motors	Project Planning Manual	MBT********-PRxx-EN-P	298798

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. 1-9: Documentations – Motors

Cables

Title	Kind of documentation	Document typecode[1)] DOK-CONNEC-…	Part number R911…
Rexroth Connection Cables	Selection Data	CABLE*INDRV-CAxx-EN-P	322949

1) In the document typecodes, "xx" is a wild card for the current edition of the documentation (example: CA02 is the second edition of the documentation "Selection Data")

Fig. 1-10: Documentations – Cables

Control Unit

Title Rexroth IndraMotion MTX micro	Kind of documentation	Document typecode[1)] DOK-MTXMIC-…	Part number R911…
Easy setup for Standard Turning and Milling Machines	Commissioning Manual	EASY*******-COxx-EN-P	332281
12VRS System Description	Manual	SYS*DES*V12-RExx-EN-P	334369
12VRS Functional Description	Manual	NC*FUNC*V12-APxx-EN-P	334357
12VRS Machine Parameters	Reference Book	MA*PAR**V12-RExx-EN-P	334365
12VRS Programming Manual	Manual	NC**PRO*V12-RExx-EN-P	334361

1) In the document typecodes, "xx" is a wild card for the current edition of the documentation (example: RE02 is the second edition of a Reference Book)

Fig. 1-11: Documentations – Control Unit

1.6.4 Your Feedback

Your experience is important for our improvement processes of products and documentations.

Inform us about mistakes you discovered in this documentation and changes you suggest; we would be grateful for your feedback.

Please send your remarks to:

Address for Your Feedback

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E-mail: dokusupport@boschrexroth.de

2 Important Directions for Use

2.1 Appropriate Use

2.1.1 Introduction

Rexroth products reflect the state-of-the-art in their development and their manufacture. They are tested prior to delivery to ensure operating safety and reliability.

⚠ WARNING **Personal injury and property damage caused by incorrect use of the products!**

The products have been designed for use in industrial environments and may only be used in the appropriate way. If they are not used in the appropriate way, situations resulting in property damage and personal injury can occur.

☞ Rexroth as manufacturer is not liable for any damages resulting from inappropriate use. In such cases, the guarantee and the right to payment of damages resulting from inappropriate use are forfeited. The user alone carries all responsibility of the risks.

Before using Rexroth products, the following pre-requisites must be met to ensure appropriate use of the products:

- Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with their appropriate use.
- 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.
- Damaged or faulty products may not be installed or put into operation.
- Make sure that the products have been installed in the manner described in the relevant documentation.

2.1.2 Areas of Use and Application

Drive controllers made by Rexroth are designed to control electrical motors and monitor their operation.

Control and monitoring of the Drive controllers may require additional sensors and actors.

☞ The drive controllers may only be used with the accessories and parts specified in this documentation. If a component has not been specifically named, then it may neither be mounted nor connected. The same applies to cables and lines.

Operation is only permitted in the specified configurations and combinations of components using the software and firmware as specified in the relevant Functional Descriptions.

Drive controllers have to be programmed before commissioning to ensure that the motor executes the specific functions of an application.

Drive controllers of the Rexroth IndraDrive line have been developed for use in single- and multi-axis drive and control tasks.

To ensure application-specific use of Drive controllers, device types of different drive power and different interfaces are available.

Typical applications include, for example:

- Handling and mounting systems,
- Packaging and food machines,
- Printing and paper processing machines and
- Machine tools.

Drive controllers may only be operated under the assembly and installation conditions described in this documentation, in the specified position of normal use and under the ambient conditions as described (temperature, degree of protection, humidity, EMC, etc.).

2.2 Inappropriate Use

Using the Drive controllers outside of the operating conditions described in this documentation and outside of the technical data and specifications given is defined as "inappropriate use".

Drive controllers may not be used, if ...

- they are subject to operating conditions that do not meet the specified ambient conditions. This includes, for example, operation under water, under extreme temperature fluctuations or extremely high maximum temperatures.
- Furthermore, Drive controllers may not be used in applications which have not been expressly authorized by Rexroth. Please carefully follow the specifications outlined in the general Safety Instructions!

Components of the Rexroth IndraDrive system are **products of category C3** (with limited availability) according to IEC 61800-3. To ensure that this category (limit values) is maintained, suitable line filters must be used in the drive system.

These components are not provided for use in a public low-voltage network supplying residential areas with power. If these components are used in such a public network, high-frequency interference is to be expected. This can require additional measures of radio interference suppression.

3 Safety Instructions for Electric Drives and Controls

3.1 Definitions of Terms

Application Documentation Application documentation comprises the entire documentation used to inform the user of the product about the use and safety-relevant features for configuring, integrating, installing, mounting, commissioning, operating, maintaining, repairing and decommissioning the product. The following terms are also used for this kind of documentation: User Guide, Operation Manual, Commissioning Manual, Instruction Manual, Project Planning Manual, Application Manual, etc.

Component A component is a combination of elements with a specified function, which are part of a piece of equipment, device or system. Components of the electric drive and control system are, for example, supply units, drive controllers, mains choke, mains filter, motors, cables, etc.

Control System A control system comprises several interconnected control components placed on the market as a single functional unit.

Device A device is a finished product with a defined function, intended for users and placed on the market as an individual piece of merchandise.

Electrical Equipment Electrical equipment encompasses all devices used to generate, convert, transmit, distribute or apply electrical energy, such as electric motors, transformers, switching devices, cables, lines, power-consuming devices, circuit board assemblies, plug-in units, control cabinets, etc.

Electric Drive System An electric drive system comprises all components from mains supply to motor shaft; this includes, for example, electric motor(s), motor encoder(s), supply units and drive controllers, as well as auxiliary and additional components, such as mains filter, mains choke and the corresponding lines and cables.

Installation An installation consists of several devices or systems interconnected for a defined purpose and on a defined site which, however, are not intended to be placed on the market as a single functional unit.

Machine A machine is the entirety of interconnected parts or units at least one of which is movable. Thus, a machine consists of the appropriate machine drive elements, as well as control and power circuits, which have been assembled for a specific application. A machine is, for example, intended for processing, treatment, movement or packaging of a material. The term "machine" also covers a combination of machines which are arranged and controlled in such a way that they function as a unified whole.

Manufacturer The manufacturer is an individual or legal entity bearing responsibility for the design and manufacture of a product which is placed on the market in the individual's or legal entity's name. The manufacturer can use finished products, finished parts or finished elements, or contract out work to subcontractors. However, the manufacturer must always have overall control and possess the required authority to take responsibility for the product.

Product Examples of a product: Device, component, part, system, software, firmware, among other things.

Project Planning Manual A project planning manual is part of the application documentation used to support the sizing and planning of systems, machines or installations.

Qualified Persons In terms of this application documentation, qualified persons are those persons who are familiar with the installation, mounting, commissioning and operation of the components of the electric drive and control system, as well as with the hazards this implies, and who possess the qualifications their work

requires. To comply with these qualifications, it is necessary, among other things,

1) to be trained, instructed or authorized to switch electric circuits and devices safely on and off, to ground them and to mark them

2) to be trained or instructed to maintain and use adequate safety equipment

3) to attend a course of instruction in first aid

User A user is a person installing, commissioning or using a product which has been placed on the market.

3.2 General Information

3.2.1 Using the Safety Instructions and Passing Them on to Others

Do not attempt to install and operate the components of the electric drive and control system without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation prior to working with these components. If you do not have the user documentation for the components, contact your responsible Rexroth sales partner. Ask for these documents to be sent immediately to the person or persons responsible for the safe operation of the components.

If the component is resold, rented and/or passed on to others in any other form, these safety instructions must be delivered with the component in the official language of the user's country.

Improper use of these components, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, could result in property damage, injury, electric shock or even death.

3.2.2 Requirements for Safe Use

Read the following instructions before initial commissioning of the components of the electric drive and control system in order to eliminate the risk of injury and/or property damage. You must follow these safety instructions.

- Rexroth is not liable for damages resulting from failure to observe the safety instructions.
- Read the operating, maintenance and safety instructions in your language before commissioning. If you find that you cannot completely understand the application documentation in the available language, please ask your supplier to clarify.
- Proper and correct transport, storage, mounting and installation, as well as care in operation and maintenance, are prerequisites for optimal and safe operation of the component.
- Only qualified persons may work with components of the electric drive and control system or within its proximity.
- Only use accessories and spare parts approved by Rexroth.
- Follow the safety regulations and requirements of the country in which the components of the electric drive and control system are operated.
- Only use the components of the electric drive and control system in the manner that is defined as appropriate. See chapter "Appropriate Use".
- The ambient and operating conditions given in the available application documentation must be observed.
- Applications for functional safety are only allowed if clearly and explicitly specified in the application documentation "Integrated Safety Technolo-

gy". If this is not the case, they are excluded. Functional safety is a safety concept in which measures of risk reduction for personal safety depend on electrical, electronic or programmable control systems.

- The information given in the application documentation with regard to the use of the delivered components contains only examples of applications and suggestions.

  The machine and installation manufacturers must

  – make sure that the delivered components are suited for their individual application and check the information given in this application documentation with regard to the use of the components,

  – make sure that their individual application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.

- Commissioning of the delivered components is only allowed once it is sure that the machine or installation in which the components are installed complies with the national regulations, safety specifications and standards of the application.
- Operation is only allowed if the national EMC regulations for the application are met.
- The instructions for installation in accordance with EMC requirements can be found in the section on EMC in the respective application documentation.

  The machine or installation manufacturer is responsible for compliance with the limit values as prescribed in the national regulations.

- The technical data, connection and installation conditions of the components are specified in the respective application documentations and must be followed at all times.

National regulations which the user must take into account

- European countries: In accordance with European EN standards
- United States of America (USA):
  – National Electrical Code (NEC)
  – National Electrical Manufacturers Association (NEMA), as well as local engineering regulations
  – Regulations of the National Fire Protection Association (NFPA)
- Canada: Canadian Standards Association (CSA)
- Other countries:
  – International Organization for Standardization (ISO)
  – International Electrotechnical Commission (IEC)

3.2.3 Hazards by Improper Use

- High electrical voltage and high working current! Danger to life or serious injury by electric shock!
- High electrical voltage by incorrect connection! Danger to life or injury by electric shock!
- Dangerous movements! Danger to life, serious injury or property damage by unintended motor movements!
- Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electric drive systems!

Safety Instructions for Electric Drives and Controls

- Risk of burns by hot housing surfaces!
- Risk of injury by improper handling! Injury by crushing, shearing, cutting, hitting!
- Risk of injury by improper handling of batteries!
- Risk of injury by improper handling of pressurized lines!

3.3 Instructions with Regard to Specific Dangers

3.3.1 Protection Against Contact With Electrical Parts and Housings

☞ This section concerns components of the electric drive and control system with voltages of **more than 50 volts**.

Contact with parts conducting voltages above 50 volts can cause personal danger and electric shock. When operating components of the electric drive and control system, it is unavoidable that some parts of these components conduct dangerous voltage.

High electrical voltage! Danger to life, risk of injury by electric shock or serious injury!

- Only qualified persons are allowed to operate, maintain and/or repair the components of the electric drive and control system.
- Follow the general installation and safety regulations when working on power installations.
- Before switching on, the equipment grounding conductor must have been permanently connected to all electric components in accordance with the connection diagram.
- Even for brief measurements or tests, operation is only allowed if the equipment grounding conductor has been permanently connected to the points of the components provided for this purpose.
- Before accessing electrical parts with voltage potentials higher than 50 V, you must disconnect electric components from the mains or from the power supply unit. Secure the electric component from reconnection.
- With electric components, observe the following aspects:

  Always wait **30 minutes** after switching off power to allow live capacitors to discharge before accessing an electric component. Measure the electrical voltage of live parts before beginning to work to make sure that the equipment is safe to touch.
- Install the covers and guards provided for this purpose before switching on.
- Never touch electrical connection points of the components while power is turned on.
- Do not remove or plug in connectors when the component has been powered.
- Under specific conditions, electric drive systems can be operated at mains protected by residual-current-operated circuit-breakers sensitive to universal current (RCDs/RCMs).
- Secure built-in devices from penetrating foreign objects and water, as well as from direct contact, by providing an external housing, for example a control cabinet.

High housing voltage and high leakage current! Danger to life, risk of injury by electric shock!

- Before switching on and before commissioning, ground or connect the components of the electric drive and control system to the equipment grounding conductor at the grounding points.

- Connect the equipment grounding conductor of the components of the electric drive and control system permanently to the main power supply at all times. The leakage current is greater than 3.5 mA.
- Establish an equipment grounding connection with a minimum cross section according to the table below. With an outer conductor cross section smaller than 10 mm^2 (8 AWG), the alternative connection of two equipment grounding conductors is allowed, each having the same cross section as the outer conductors.

Cross section outer conductor	Minimum cross section equipment grounding conductor Leakage current ≥ 3.5 mA	
	1 equipment grounding conductor	2 equipment grounding conductors
1,5 mm^2 (AWG 16)	10 mm^2 (AWG 8)	2 × 1,5 mm^2 (AWG 16)
2,5 mm^2 (AWG 14)		2 × 2,5 mm^2 (AWG 14)
4 mm^2 (AWG 12)		2 × 4 mm^2 (AWG 12)
6 mm^2 (AWG 10)		2 × 6 mm^2 (AWG 10)
10 mm^2 (AWG 8)		-
16 mm^2 (AWG 6)	16 mm^2 (AWG 6)	-
25 mm^2 (AWG 4)		-
35 mm^2 (AWG 2)		-
50 mm^2 (AWG 1/0)	25 mm^2 (AWG 4)	-
70 mm^2 (AWG 2/0)	35 mm^2 (AWG 2)	-
...	...	...

Fig.3-1: Minimum Cross Section of the Equipment Grounding Connection

3.3.2 Protective Extra-Low Voltage as Protection Against Electric Shock

Protective extra-low voltage is used to allow connecting devices with basic insulation to extra-low voltage circuits.

On components of an electric drive and control system provided by Rexroth, all connections and terminals with voltages between 5 and 50 volts are PELV ("Protective Extra-Low Voltage") systems. It is allowed to connect devices equipped with basic insulation (such as programming devices, PCs, notebooks, display units) to these connections.

Danger to life, risk of injury by electric shock! High electrical voltage by incorrect connection!

If extra-low voltage circuits of devices containing voltages and circuits of more than 50 volts (e.g., the mains connection) are connected to Rexroth products, the connected extra-low voltage circuits must comply with the requirements for PELV ("Protective Extra-Low Voltage").

3.3.3 Protection Against Dangerous Movements

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

- Improper or wrong wiring or cable connection
- Operator errors
- Wrong input of parameters before commissioning
- Malfunction of sensors and encoders
- Defective components
- Software or firmware errors

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

The monitoring functions in the components of the electric drive and control system will normally be sufficient to avoid malfunction in the connected drives. Regarding personal safety, especially the danger of injury and/or property 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.

Dangerous movements! Danger to life, risk of injury, serious injury or property damage!

A **risk assessment** must be prepared for the installation or machine, with its specific conditions, in which the components of the electric drive and control system are installed.

As a result of the risk assessment, the user must provide for monitoring functions and higher-level measures on the installation side for personal safety. The safety regulations applicable to the installation or machine must be taken into consideration. Unintended machine movements or other malfunctions are possible if safety devices are disabled, bypassed or not activated.

To avoid accidents, injury and/or property damage:

- Keep free and clear of the machine’s range of motion and moving machine parts. Prevent personnel from accidentally entering the machine’s range of motion by using, for example:
  - Safety fences
  - Safety guards
  - Protective coverings
  - Light barriers
- Make sure the safety fences and protective coverings are strong enough to resist maximum possible kinetic energy.
- Mount emergency stopping switches in the immediate reach of the operator. Before commissioning, verify that the emergency stopping equipment works. Do not operate the machine if the emergency stopping switch is not working.
- Prevent unintended start-up. Isolate the drive power connection by means of OFF switches/OFF buttons or use a safe starting lockout.
- Make sure that the drives are brought to 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 counterbalancing of the vertical axes.
- The standard equipment **motor holding brake** or an external holding brake controlled by the drive controller is **not sufficient to guarantee personal safety**!
- Disconnect electrical power to the components of the electric drive and control system using the master switch and secure them from reconnection ("lock out") 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 components of the electric drive and control system and their supply leads. If the use of these devices cannot be avoided, check the machine or installation, at initial commissioning of the electric drive and control system, for possible malfunctions when operating such high-frequency, remote control and radio equipment in its possible positions of normal use. It might possibly be necessary to perform a special electromagnetic compatibility (EMC) test.

3.3.4 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated by current-carrying conductors or permanent magnets of electric motors represent a serious danger to persons with heart pacemakers, metal implants and hearing aids.

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

- Persons with heart pacemakers and metal implants are not allowed to enter the following areas:
  - Areas in which components of the electric drive and control systems are mounted, commissioned and operated.
  - Areas in which parts of motors with permanent magnets are stored, repaired or mounted.
- If it is necessary for somebody with a heart pacemaker to enter such an area, a doctor must be consulted prior to doing so. The noise immunity of implanted heart pacemakers differs so greatly 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.

3.3.5 Protection Against Contact With Hot Parts

Hot surfaces of components of the electric drive and control system. Risk of burns!

- Do not touch hot surfaces of, for example, braking resistors, heat sinks, supply units and drive controllers, motors, windings and laminated cores!
- According to the operating conditions, temperatures of the surfaces can be **higher than 60 °C** (140 °F) during or after operation.
- Before touching motors after having switched them off, let them cool down for a sufficient period of time. Cooling down can require **up to 140 minutes**! The time required for cooling down is approximately five times the thermal time constant specified in the technical data.
- After switching chokes, supply units and drive controllers off, wait **15 minutes** to allow them to cool down before touching them.
- Wear safety gloves or do not work at hot surfaces.
- For certain applications, and in accordance with the respective safety regulations, the manufacturer of the machine or installation must take measures to avoid injuries caused by burns in the final application. These measures can be, for example: Warnings at the machine or installation, guards (shieldings or barriers) or safety instructions in the application documentation.

3.3.6 Protection During Handling and Mounting

Risk of injury by improper handling! Injury by crushing, shearing, cutting, hitting!

- Observe the relevant statutory regulations of accident prevention.
- Use suitable equipment for mounting and transport.
- Avoid jamming and crushing by appropriate measures.
- Always use suitable tools. Use special tools if specified.
- Use lifting equipment and tools in the correct manner.
- Use suitable protective equipment (hard hat, safety goggles, safety shoes, safety gloves, for example).
- Do not stand under hanging loads.
- Immediately clean up any spilled liquids from the floor due to the risk of falling!

3.3.7 Battery Safety

Batteries consist of active chemicals in a solid housing. Therefore, improper handling can cause injury or property damage.

Risk of injury by improper handling!

- Do not attempt to reactivate low batteries by heating or other methods (risk of explosion and cauterization).
- Do not attempt to recharge the batteries as this may cause leakage or explosion.
- Do not throw batteries into open flames.
- Do not dismantle batteries.
- When replacing the battery/batteries, do not damage the electrical parts installed in the devices.
- Only use the battery types specified for the product.

☞ Environmental protection and disposal! The batteries contained in the product are considered dangerous goods during land, air, and sea transport (risk of explosion) in the sense of the legal regulations. Dispose of used batteries separately from other waste. Observe the national regulations of your country.

3.3.8 Protection Against Pressurized Systems

According to the information given in the Project Planning Manuals, motors and components cooled with liquids and compressed air can be partially supplied with externally fed, pressurized media, such as compressed air, hydraulics oil, cooling liquids and cooling lubricants. Improper handling of the connected supply systems, supply lines or connections can cause injuries or property damage.

Risk of injury by improper handling of pressurized lines!

- Do not attempt to disconnect, open or cut pressurized lines (risk of explosion).
- Observe the respective manufacturer's operating instructions.
- Before dismounting lines, relieve pressure and empty medium.
- Use suitable protective equipment (safety goggles, safety shoes, safety gloves, for example).
- Immediately clean up any spilled liquids from the floor due to the risk of falling!

☞ Environmental protection and disposal! The agents (e.g., fluids) used to operate the product might not be environmentally friendly. Dispose of agents harmful to the environment separately from other waste. Observe the national regulations of your country.

3.4 Explanation of Signal Words and the Safety Alert Symbol

The Safety Instructions in the available application documentation contain specific signal words (DANGER, WARNING, CAUTION or NOTICE) and, where required, a safety alert symbol (in accordance with ANSI Z535.6-2011).

The signal word is meant to draw the reader's attention to the safety instruction and identifies the hazard severity.

The safety alert symbol (a triangle with an exclamation point), which precedes the signal words DANGER, WARNING and CAUTION, is used to alert the reader to personal injury hazards.

⚠ DANGER

In case of non-compliance with this safety instruction, death or serious injury **will** occur.

⚠ WARNING

In case of non-compliance with this safety instruction, death or serious injury **could** occur.

⚠ CAUTION

In case of non-compliance with this safety instruction, minor or moderate injury could occur.

NOTICE

In case of non-compliance with this safety instruction, property damage could occur.

4 General Data and Specifications

4.1 Acceptance Tests and Approvals

Declaration of Conformity

Declarations of conformity confirm that the components comply with the valid EN standards and EC directives. If required, our sales representative can provide you with the declarations of conformity for components.

CE DX000011v01_nn.FH11	**Drive controllers, Supply units**	**Motors**
CE conformity regarding Low-Voltage Directive	EN 61800-5-1 (IEC 61800-5-1:2007)	EN 60034-1 (IEC 60034-1:2010) EN 60034-5 (IEC 60034-5:2000 + Corrigendum 2001+A1:2006)
CE conformity regarding EMC product standard	EN 61800-3 (IEC 61800-3:2004)	

Fig.4-1: CE - Applied Standards

C-UL-US Listing

The components are listed by **UL** (Underwriters Laboratories Inc.®). You can find the evidence of certification on the Internet under http://www.ul.com under "Certifications" by entering the file number or the "Company Name: Rexroth".

c UL us **Listed** **POW. CONV. EQ.** **97Y4** DX000009v01_nn.tif	• UL standard: UL 508 C • CSA standard: Canadian National Standard C22.2 No. 14-10
	Company Name BOSCH REXROTH ELECTRIC DRIVES & CONTROLS GMBH Category Name: Power Conversion Equipment
	File numbers Rexroth IndraDrive components: • E134201 • E227957

Fig.4-2: C-UL Listing

UL ratings

For using the component in the scope of CSA / UL, take the UL ratings of the individual components into account.

Make sure that the indicated **short circuit current rating SCCR** is not exceeded, e.g. by appropriate fuses in the mains supply of the supply unit.

General Data and Specifications

Wiring material UL

In the scope of CSA / UL, use copper 60/75 °C only; class 1 or equivalent only.

Allowed pollution degree

Comply with the allowed pollution degree of the components (see "Ambient and Operating Conditions").

C-UR-US Listing

The motors are listed by **UL** ("Underwriters Laboratories Inc.®"). You can find the evidence of certification on the Internet under http://www.ul.com under "Certifications" by entering the file number or the "Company Name: Rexroth".

- UL standard: UL 1004-1
- CSA standard: Canadian National Standard C22.2 No. 100

Company Name

BOSCH REXROTH ELECTRIC DRIVES & CONTROLS GMBH

Category Name:

Servo and Stepper Motors - Component

File numbers

MSK, MSM motors: E335445

Fig.4-3: C-UR Listing

Wiring material UL (ready-made cables by Rexroth)

In the scope of CSA / UL, use copper 60/75 °C only; class 6 or equivalent only.

Allowed pollution degree

Comply with the allowed pollution degree of the components (see "Ambient and Operating Conditions").

CCC (China Compulsory Certification)

The CCC test symbol comprises a compulsory certification of safety and quality for certain products mentioned in the product catalog "First Catalogue of Products Subject to Compulsory Certification" and in the CNCA document "Application Scope for Compulsory Certification of Products acc. first Catalogue" and put in circulation in China. This compulsory certification has been existing since 2003.

CNCA is the Chinese authority responsible for certification directives. When a product is imported in China, the certification will be checked at the customs by means of entries in a database. For the requirement of certification three criteria are normally relevant:

1. Customs tariff number (HS code) according to CNCA document "Application Scope for Compulsory Certification of Products acc. first Catalogue".
2. Scope of application according to CNCA document "Application Scope for Compulsory Certification of Products acc. first Catalogue".

3. For the IEC product standard used, the corresponding Chinese GB standard must exist.

For the drive components by Rexroth described in this documentation, **certification is not required at present**, thus they are not CCC certified. Negative certifications will not be issued.

4.2 Transport and Storage

4.2.1 Transport of the Components

Ambient and Operating Conditions - Transport

Description	Symbol	Unit	Value	
Temperature range	T_{a_tran}	°C	Supply units and drive controllers: -25 … +70	Motors: -20 … +80
Relative humidity		%	5 … 95	
Absolute humidity		g/m^3	1 … 60	
Climatic category (IEC 721)			2K3	
Moisture condensation			Not allowed	
Icing			Not allowed	

Fig.4-4: Ambient and operating conditions - transport

4.2.2 Storage of the Components

NOTICE **Damage to the component caused by long storage periods!**

Some components contain electrolytic capacitors which may deteriorate during storage.

When storing the following components for a longer period of time, operate them **once a year for at least 1 hour**:

- Converters and supply units: operation with mains voltage U_{LN}
- Inverters and DC bus capacitor units: operation with DC bus voltage U_{DC}

Ambient and operating conditions - storage

Description	Symbol	Unit	Value	
Temperature range	T_{a_store}	°C	Supply units and drive controllers: -25 … 55	Motors: -20 … +60
Relative humidity		%	5 … 95	
Absolute humidity		g/m^3	1 … 29	
Climatic category (IEC 721)			1K3	
Moisture condensation			Not allowed	
Icing			Not allowed	

Fig.4-5: Ambient and operating conditions - storage

General Data and Specifications

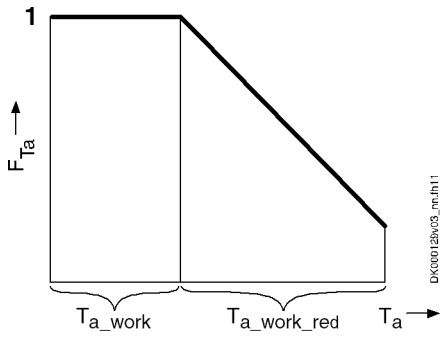
4.3 Installation Conditions

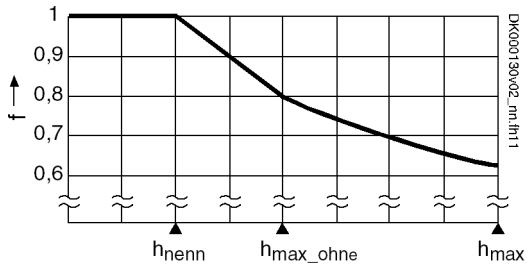
4.3.1 Ambient and Operating Conditions

☞ Check that the ambient conditions, in particular the control cabinet temperature, are complied with by calculating the heat levels in the control cabinet. Afterwards, make the corresponding measurements to verify that the ambient conditions have actually been complied with.

In the technical data of the individual components, the power dissipation is indicated as an important input value for calculating the heat levels.

Ambient and operating conditions (HCS, HMV, HMS, HMD, HCQ, HCT, KCU)

Description	Symbol	Unit	Value
Conductive dirt contamination			Not allowed Protect the devices against conductive dirt contamination by mounting them in control cabinets with protection degree IP54 (in accordance with IEC 60529).
Protection degree of the device (IEC 60529)			IP20
Use within the scope of CSA / UL			For use in NFPA 79 applications only.
Temperature during storage			See index entry "Storage → Of the components"
Temperature during transport			See index entry "Transport → Of the components"
Allowed mounting position Definition of mounting positions: See index entry "Mounting positions"			G1
Installation altitude	h_{nenn}	m	1000
Ambient temperature range	T_{a_work}	°C	0 … 40
Derating vs. ambient temperature: In the ambient temperature range $T_{a\_work\_red}$, the performance data is reduced by factor F_{Ta}: $F_{Ta} = 1 - [(T_a - 40) \times f_{Ta}]$ Example: With an ambient temperature T_a = 50 °C and a capacity utilization factor f_{Ta} = 2 %/K, the rated power is reduced to $P_{DC\_cont\_red} = P_{DC\_cont} \times F_{Ta} =$ $P_{DC\_cont} \times (1 - [(50 - 40) \times 0.02]) = P_{DC\_cont} \times 0.8$ Operation at ambient temperatures outside of T_{a_work} and $T_{a\_work\_red}$ is not allowed!			
	$T_{a\_work\_red}$	°C	40 … 55
	f_{Ta}	%/K	2,0

Description	Symbol	Unit	Value
Derating vs. installation altitude: With installation altitudes h > h_{nenn} and higher, the available performance data is reduced by **factor f**[3) 4)]. With installation altitudes in the range of h_{max_ohne} to h_{max}, an **overvoltage limiter** against transient overvoltage must be installed in the system. Operation above h_{max} is not allowed!			
	h_{max_ohne}	m	2000
	h_{max}	m	4000
Simultaneous derating for ambient temperature **and** installation altitude	Allowed; reduce performance data with the product f × F_{Ta}		
Relative humidity		%	5 … 95
Absolute humidity		g/m^3	1 … 29
Climatic category (IEC 721)			3K3
Allowed pollution degree (IEC 60664-1)			2
Maximum concentration of corrosive gases			EN 50178 Table A.2
Vibration sine: amplitude (peak-peak) at 10 … 57 Hz[1)]		mm	0,15 ±15%
Vibration sine: acceleration at 57 … 150 Hz[1)]		g	1 ±15%
Vibration noise (random) frequency[1)]		Hz	20 … 150
Vibration noise (random) spectral acceleration density, amplitude[1)]		g^2/Hz	0.005 ±3 dB
Vibration noise (random) rms value of total acceleration [1)]		g	1
Vibration sine: axial Acceleration at 10 … 2,000 Hz[2)]		g	-
Vibration sine: radial Acceleration at 10 … 2,000 Hz[2)]		g	-
Overvoltage category			III (according to IEC 60664-1)

1) According to EN 60068-2-64
2) According to EN 60068-2-6
3) Reduced performance data for drive controllers: allowed DC bus continuous power, braking resistor continuous power, continuous current; for HCS01, HCQ, HCT drive controllers additionally: allowed line voltage
4) Reduced performance data for motors: Performance, torque S1 and S3

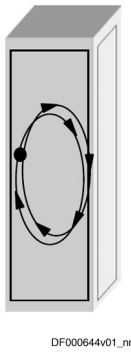
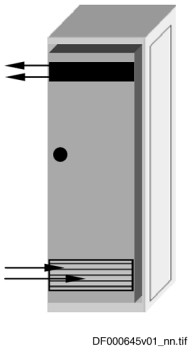
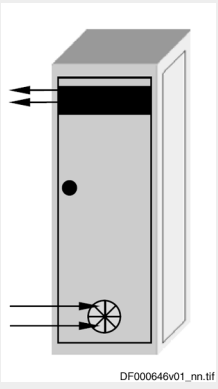
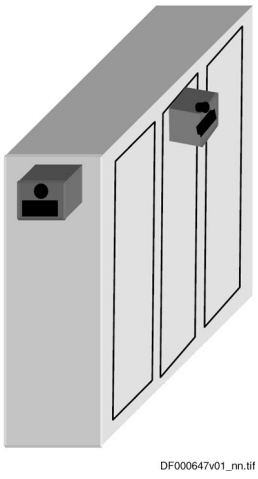
Fig.4-6: Ambient and operating conditions (HCS, HMV, HMS, HMD, HCQ, HCT, KCU)

4.3.2 Control Cabinet Design and Cooling

☞ The only mounting position allowed for supply units and drive controllers to be installed in control cabinets is G1.

General Data and Specifications

Possibilities of Heat Dissipation

Closed control cabinet with air circulation	Closed control cabinet with heat exchanger	Control cabinet with fan	Closed control cabinet with air conditioning unit
 DF000644v01_nn.tif	 DF000645v01_nn.tif	 DF000646v01_nn.tif	 DF000647v01_nn.tif
P_Q ~ 400 W	P_Q ~ 1700 W	P_Q ~ 2700 W	P_Q ~ 4000 W

P_Q Dissipated heat output

Fig.4-7: Possibilities of Heat Dissipation

The section below describes the "control cabinet with fan".

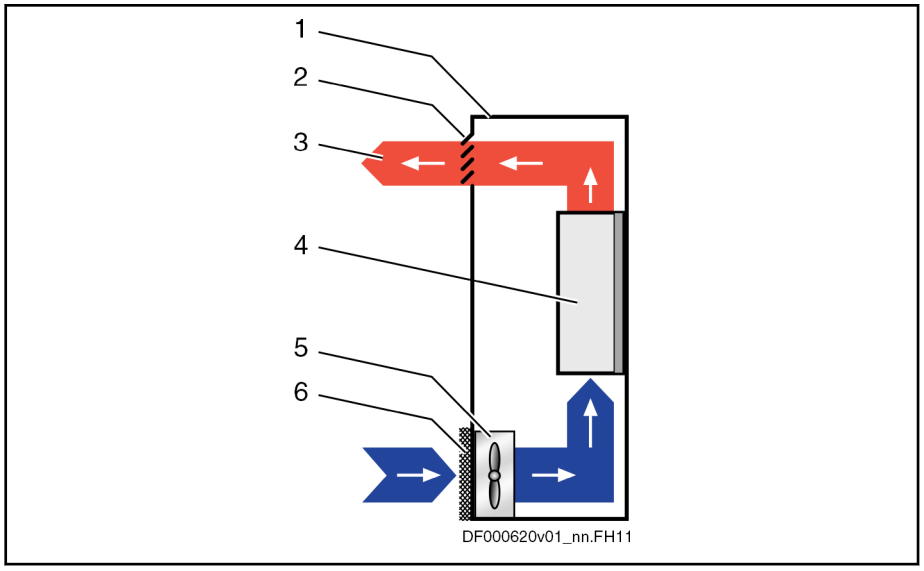
Requirements for Control Cabinets with Fan

NOTICE **Risk of damage by unclean air in the control cabinet!**

Operating a control cabinet with a fan, but without the corresponding filters, can damage the devices or cause malfunction.

- Install filters at the air intake opening of the control cabinet so that impure air cannot get into the control cabinet.
- Service the filters at regular intervals according to the dust loading in the environment.
- Only replace the filters when the fan has been switched off, because otherwise the fan sucks in the dirt coming off the filter and the dirt gets into the control cabinet.

Control Cabinet Ventilation (Schematic Diagram)



1	Control cabinet
2	Air outlet opening
3	Heat discharge
4	Device in control cabinet
5	Control cabinet fan
6	Filter at air intake opening

Fig.4-8: Control Cabinet Ventilation (Schematic Diagram)

Only clean air gets into the control cabinet through the filter at the air intake opening. The control cabinet fan behind the air intake opening delivers the air into the control cabinet and generates overpressure in the control cabinet. This overpressure prevents unclean air from entering into the control cabinet through potentially leaky points (leaky cable passages, damaged seals, etc.).

4.3.3 Mounting Position

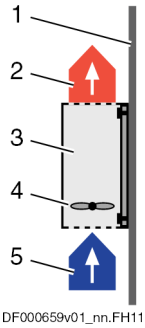
Mounting Positions of Components

NOTICE **Risk of damage to the components by incorrect mounting position!**

Only operate the components in their allowed mounting positions.

For supply units and drive controllers installed in control cabinets, only the mounting position G1 is allowed.

Mounting Position G1



The air that is heated inside the component can flow out of the component in a vertical upward direction. The natural convection supports the forced cooling air current. This avoids the generation of pockets of heat in the component.

1. Mounting surface in control cabinet
2. Outgoing, heated air
3. Component
4. Fan within the component (forces the cooling air current)
5. Cooling air

Fig.4-9: Mounting Position G1

4.3.4 Compatibility With Foreign Matters

All Rexroth controls and drives are developed and tested according to the state-of-the-art technology.

As it is impossible to follow the continuing development of all materials (e.g. lubricants in machine tools) which may interact with the controls and drives, it cannot be completely ruled out that any reactions with the materials we use might occur.

For this reason, before using the respective material a compatibility test has to be carried out for new lubricants, cleaning agents etc. and our housings/ materials.

4.4 Voltage Test and Insulation Resistance Test

According to standard, the **components** of the Rexroth IndraDrive range are tested with voltage.

Test	Test rate
Voltage test	100% (EN 61800-5-1)
Insulation resistance test	100% (EN 60204-1)

Fig.4-10: Applied Standards

4.5 Control Voltage (24V Supply)

PELV[1] for 24V power supply unit

For the 24V supply of the devices of the Rexroth IndraDrive range, use a power supply unit or a control-power transformer with protection by PELV according to IEC 60204-1 (section 6.4).

In the scope of CSA/UL, the data of the control-power transformer are limited to:

- Max. output voltage: 42.4 V_{peak} or 30 V_{ac}
- Max. output power: 10000 VA

The data in the table below generally apply to the 24V supply of the devices of the Rexroth IndraDrive range. For other data, such as power consumption and inrush currents, see the technical data of the respective device.

The specified values apply at the connections (+24V, 0V) to the "24V supply" of the devices!

Description	Symbol	Unit	Value
Control voltage for drive systems **without** operation of **motor holding brakes** in Rexroth motors	U_{N3}	V	**19,2 … 30** (see also "Max. ripple content")
Control voltage for drive systems **with** operation of **motor holding brakes** in Rexroth motors	U_{N3}	V	Observe the following aspects when selecting the control voltage: • Voltage drop on the line between drive controller and motor (current consumption, copper cross section, cable length) • Allowed voltage tolerance of the brake (see data sheet of brake) When using Rexroth cables up to a cable length of 40 m: 24 V ±5%
Max. ripple content	w	-	The amplitudes of the alternating component on U_{N3} must be within the specified voltage range.
Maximum allowed overvoltage	U_{N3max}	V	33 (max. 1 ms)

Fig.4-11: Control Voltage

Overvoltage

Overvoltage greater than 33 V has to be discharged by means of the appropriate electrical equipment of the machine or installation.

This includes:

- 24V power supply units that reduce incoming overvoltage to the allowed value.
- Overvoltage limiters at the control cabinet input that limit existing overvoltage to the allowed value. This, too, applies to long 24V lines that have been run in parallel to power cables and mains cables and can absorb overvoltage by inductive or capacitive coupling.

1) Protective Extra Low Voltage

5 Technical Data of the Components

5.1 HCQ02

5.1.1 Brief Description, Use and Design

Brief Description

The compact multi-axis converters HCQ02 are part of the Rexroth IndraDrive C product range and are used to operate one powerful axis and three auxiliary axes.

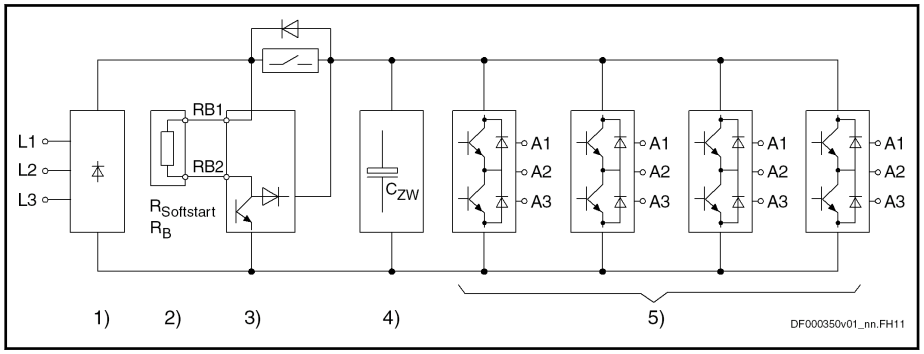
Use

The different types are used as follows:

Type	Use
HCQ02.1E-W0025-A-03-…	Operation of up to four three-phase a.c. motors (asynchronous or synchronous motor)

Fig.5-1: Use of HCQ02

Design, Block Diagram



1) Mains input with rectifier
2) External resistor
3) Braking resistor circuit; charging current limitation; external resistor required at X9 (RB1, RB2)
4) DC bus capacitors
5) Inverter stages with output to motors

Fig.5-2: HCQ02.1E-W0025-A-03-… Block Diagram

5.1.2 Technical Data

Ambient and Operating Conditions

General Information

Conditions for transport and storage: See index entry "Transport → Of the components" or "Storage → Of the components".

Installation conditions: See index entry "Installation conditions".

This chapter contains:

- Limit values for use in the scope of C-UL
- Applied standards (CE conformity, UL listing)

Technical Data of the Components

UL Data

Ambient and Operating Conditions - UL Ratings

Description	Sym-bol	Unit	HCQ02.1E-W0025-_-03			
			X5.1	X5.2	X5.3	X5.4
Short circuit current rating (UL)	SCCR	A rms	42000			
Rated input voltage, power (UL) [1]	U_{LN_nenn}	V	3 x AC 200...500			
Rated input current (UL)	I_{LN}	A	44,0			
Output voltage (UL)	U_{out}	V	3 x AC 0...500			
Continuous output current at f_s = 4 kHz	I_{out_cont} [4]	A	35,0	20,0	14,0	
						Last modification: 2009-10-21

1) DC bus L+, L-; mains input L1, L2, L3

Fig.5-3: HCQ - Ambient and Operating Conditions - UL Ratings

Information on Standards

Applied Standards

Description	Symbol	Unit	HCQ02.1E-W0025-_-03
Listing according to UL standard (UL)			UL 508 C
UL files (UL)			E 134201
Listing according to CSA standard (UL)			Canadian National Standard(s) C22.2 No. 14-10
			Last modification: 2011-03-30

Fig.5-4: HCQ - Applied Standards

Mechanical System and Mounting

Dimensions, Mass, Insulation, Sound Pressure Level

For the dimensional drawing of the drive controller, see index entry "Dimensional drawing".

Data for Mass, Dimensions, Sound Pressure Level, Insulation

Description	Symbol	Unit	HCQ02.1E-W0025-_-03
Mass	m	kg	11,70
Device height (UL)[1]	H	mm	455
Device depth (UL)[2]	T	mm	191
Device width (UL)[3]	B	mm	320
Insulation resistance at DC 500 V	R_{is}	Mohm	8,00
			Last modification: 2010-05-26

Description	Symbol	Unit	HCQ02.1E-W0025-_-03
Capacitance against housing	C_Y	nF	2 x 470
Average sound pressure level (accuracy class 2) at P_{DC_cont} [4)]	L_P	dB (A)	Less than 70
			Last modification: 2010-05-26

1) 2) 3) Housing dimension; see also related dimensional drawing
4) According to DIN EN ISO 11205; comparative value at distance 1 m, out of cabinet; HCS types with order code -L***: load-dependent

Fig.5-5: HCQ - Data for Mass, Dimensions, Sound Pressure Level, Insulation

Power Dissipation, Cooling

Data for Cooling and Power Dissipation

Description	Symbol	Unit	HCQ02.1E-W0025-_-03
Ambient temperature range for operation with nominal data	T_{a_work}	°C	0...40
Ambient temperature range for operation with reduced nominal data	$T_{a\_work\_red}$	°C	0...55
Derating of P_{DC_cont}; P_{BD}; I_{out_cont} at $T_{a\_work} < T_a < T_{a\_work\_red}$	f_{Ta}	%/K	2
Allowed mounting position			G1
Cooling type			Forced ventilation
Volumetric capacity of forced cooling	V	m^3/h	310,00
Power dissipation at continuous current and continuous DC bus power respectively (UL) [1)]	P_{Diss_cont}	W	1100,00
Minimum distance on the top of the device [2)]	d_{top}	mm	100
Minimum distance on the bottom of the device [3)]	d_{bot}	mm	80
Horizontal spacing on the device [4)]	d_{hor}	mm	90
Temperature rise with minimum distances d_{bot}; d_{top}; P_{BD}	ΔT	K	30
			Last modification: 2011-07-06

1) Plus dissipation of braking resistor and control section
2) 3) 4) See fig. "Air Intake and Air Outlet at Device"

Fig.5-6: HCQ - Data for Cooling and Power Dissipation

Dissipation of control section: See description of connection point X18.

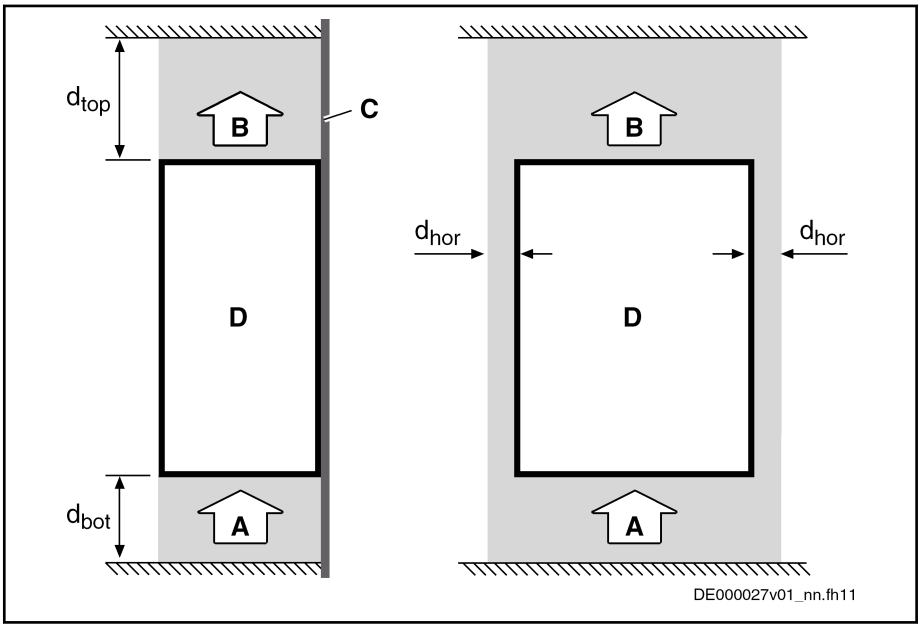
Technical Data of the Components

NOTICE **Property damage due to temperatures higher than 105 °C!**

Observe the indicated minimum distances!

Above the devices there may only be such materials which

- are not combustible
- are insensitive to the occurring high temperatures



A	Air intake
B	Air outlet
C	Mounting surface in control cabinet
D	Housing of the device (without parts such as shielding plates on top and bottom of device)
d_{top}	Minimum distance on the top of the device
d_{bot}	Minimum distance on the bottom of the device
d_{hor}	Minimum distance on the side of the device

Fig.5-7: Air Intake and Air Outlet at Device

Basic Data Power Section HCQ02

General Information

This section contains

- Data for control voltage supply
- Data for mains voltage supply
- Data of DC bus
- Data of inverter
- Requirements on an external braking resistor

☞ The order of the data tables below follows the energy flow in the drive controller – from mains connection to motor output.

Control Voltage

Project planning 24V supply

For the 24V supply, take the data on the dimensioning of the power supply unit into account (see index entry "24V supply → Notes on project planning").

Data for Control Voltage Supply

Description	Symbol	Unit	HCQ02.1E-W0025-_-03
Rated control voltage input (UL)[1)]	U_{N3}	V	24 ± 20%
Maximum inrush current at 24V supply	I_{EIN3_max}	A	13,80
Pulse width of I_{EIN3}	$t_{EIN3Lade}$	ms	Less than 10
Input capacitance	C_{N3}	mF	2,64
			Last modification: 2009-10-12

1) Observe supply voltage for motor holding brakes

Fig.5-8: HCQ - Data for Control Voltage Supply

Overvoltage

Overvoltage greater than 33 V has to be discharged by means of the appropriate electrical equipment of the machine or installation.

This includes:

- 24V power supply units that reduce incoming overvoltage to the allowed value.
- Overvoltage limiters at the control cabinet input that limit existing overvoltage to the allowed value. This, too, applies to long 24V lines that have been run in parallel to power cables and mains cables and can absorb overvoltage by inductive or capacitive coupling.

Mains Voltage

The single-phase mains connection is **not** allowed!

Data for Mains Voltage Supply

Description	Symbol	Unit	HCQ02.1E-W0025-_-03
Input frequency (UL)	f_{LN}	Hz	50...60
Tolerance input frequency (UL)		Hz	±2
Maximum allowed mains frequency change	$\Delta f_{LN}/\Delta t$	Hz/s	-
Rotary field condition			None
Short circuit current rating (UL)	SCCR	A rms	42000
Nominal mains voltage	U_{LN_nenn}	V	3 AC 400
			Last modification: 2011-11-30

Technical Data of the Components

Description	Symbol	Unit	HCQ02.1E-W0025-_-03
Mains voltage three-phase at TN-S, TN-C, TT mains	U_{LN}	V	200...500
Mains voltage three-phase at IT mains[1)]	U_{LN}	V	200...230
Mains voltage three-phase at Corner-grounded-Delta mains[2)]	U_{LN}	V	200...230
Tolerance rated input voltage (UL)		%	±10
Minimum inductance of the mains supply (inductance of mains phase)[3)]	L_{min}	µH	40
Assigned type of mains choke			HNL01.1E-0400-N0051-A-480
Minimum short circuit power of the mains for failure-free operation	S_{k_min}	MVA	1,6
Assigned type of mains filter			NFD03.1-480-055; HNF01.1A-F240-E0051-A480
Inrush current	$I_{L\_trans\_max\_on}$	A	25,5 ... 77,8
Maximum allowed ON-OFF cycles per minute[4)]			1
Power factor TPF (λ_L) at P_{DC_cont} with mains choke; U_{LN_nenn}	TPF		0,82
Power factor TPF (λ_L) at P_{DC_cont} without mains choke; U_{LN_nenn}[5)]	TPF		0,64
Power factor TPF (λ_L) at 10% P_{DC_cont} without mains choke; U_{LN_nenn}[6)]	$TPF_{10\%}$		0,40
Power factor of fundam. component DPF at P_{DC_cont} with mains choke	$cos\varphi^{h1}$		0,97
Power factor of fundam. component DPF at P_{DC_cont} without mains choke	$cos\varphi^{h1}$		0,97
Mains connection power at P_{DC_cont}; U_{LN_nenn} with mains choke	S_{LN}	kVA	30,00
Mains connection power at P_{DC_cont}; U_{LN_nenn} without mains choke	S_{LN}	kVA	23,50
Rated input current (UL)	I_{LN}	A	44,0
Nominal current AC1 for mains contactor at nom. data			I LN
Mains fuse according to EN 60204-1		A	50
			Last modification: 2011-11-30

Description	Symbol	Unit	HCQ02.1E-W0025-_-03
Required wire size according to EN 60204-1[7)]	A_{LN}	mm^2	10
Required wire size according to UL 508 A (internal wiring); (UL)[8)]	A_{LN}	AWG	AWG 8
			Last modification: 2011-11-30

1) 2) Mains voltage > ULN: Use a transformer with grounded neutral point, don´t use autotransformers!
3) Otherwise use mains choke HNL
4) Observe allowed number of switch-on processes; without external capacitors at the DC bus
5) 6) Find interim values by interpolation
7) Copper wire; PVC-insulation (conductor temperature 70 °C); installation method B1; table 6
8) Copper wire; PVC-insulation (conductor temperature 90 °C); table 28.1; Ta ≤ 40 °C

Fig.5-9: HCQ - Data for Mains Voltage Supply

DC Bus

Data of Power Section - DC Bus

Description	Symbol	Unit	HCQ02.1E-W0025-_-03
DC bus voltage	U_{DC}	V	ULNx1,41
Capacitance in DC bus	C_{DC}	mF	1,18
DC resistance in DC bus (L+ to L-)	R_{DC}	kohm	80,00
Rated power (t > 10 min) at f_s = 4 kHz; U_{LN_nenn}; control factor a_0 > 0.8; with mains choke	P_{DC_cont}	kW	25,00
Rated power (t > 10 min) at f_s = 4 kHz; U_{LN_nenn}; control factor a_0 > 0.8; without mains choke	P_{DC_cont}	kW	15,00
P_{DC_cont} and P_{DC_max} vs. mains input voltage; $U_{LN} \le U_{LN\_nenn}$		%/V	0,25
P_{DC_cont} and P_{DC_max} vs. mains input voltage; $U_{LN} > U_{LN\_nenn}$		%/V	0,20
Energy to output within one load cycle; with mains choke	W_{Cyc_max}	kWs	4500
Energy to output within one load cycle; without mains choke	W_{Cyc_max}	kWs	2700
Maximum allowed DC bus power at U_{LN_nenn}; with mains choke	P_{DC_max}	kW	37,50
Maximum allowed DC bus power at U_{LN_nenn}; without mains choke	P_{DC_max}	kW	22,50
Monitoring value maximum DC bus voltage, switch-off threshold	$U_{DC\_limit\_max}$	V	900
			Last modification: 2011-07-06

Technical Data of the Components

Description	Symbol	Unit	HCQ02.1E-W0025-_-03
Charging resistor continuous power	P_{DC_Start}	kW	External resistor required
Allowed external DC bus capacitance (nom.) at U_{LN_nenn} 1)	C_{DCext}	mF	-
			Last modification: 2011-07-06

1) Use assigned type of mains choke

Fig.5-10: HCQ - Data of Power Section - DC Bus

Braking Resistor

Use external resistor!

To limit the charging current when the mains voltage is connected, the drive controller needs an external resistor ($R_{Softstart}$).

After the mains voltage has been connected, the external resistor is used as a braking resistor ($R_{DC\_Bleeder}$).

Project Planning of External Braking Resistor

1. Determine the occurring continuous power and regenerative power at the external braking resistor.
2. For this purpose, select an appropriate braking resistor; its resistance value must be in the range of $R_{DC\_Bleeder}$.
3. Via the control unit, parameterize the data of the selected braking resistor to protect the drive controller and the braking resistor against overload:

   NC configuration ▸ SCSP ▸ Global ▸ ExtBrakingResistors ▸ BrakResist[x]

Limit Values Operating Data - External Braking Resistor

Description	Symbol	Unit	HCQ02.1E-W0025-_-03
Resistance value of external braking resistor 1)	$R_{DC\_Bleeder}$	ohm	10 ... 17
Continuous power of external braking resistor 2)	P_{BD}	kW	5,00
Regenerative power to be absorbed	W_{R_max}	kWs	100,00
			Last modification: 2009-10-19

1) 2) See Parameter Description "P-0-0858, Data of external braking resistor"

Fig.5-11: HCQ - Limit Values Operating Data - External Braking Resistor

HLR The following HLR braking resistors are suitable:

- HLR01.1N-0470-N11R7-A-007-NNNN
- HLR01.1N-02K0-N15R0-A-007-NNNN
- HLR01.1N-05K0-N15R0-A-007-NNNN

Inverter

Data of Inverter Outputs

Description	Sym-bol	Unit	HCQ02.1E-W0025-_-03			
			X5.1	X5.2	X5.3	X5.4
Allowed switching frequencies [1]	f_s	kHz	4, 8			
Output voltage, fundamental wave with open-loop operation	U_{out_eff}	V	~UDC*0.71			
Output voltage, fundamental wave with closed-loop operation	U_{out_eff}	V	~UDC*0.71			
Rise of voltage at output with U_{LN_nenn} and 15 m motor cable length phase-phase (10-90%)[2]	dv/dt	kV/µs	5,00			
Rise of voltage at output with U_{LN_nenn} and 15 m motor cable length phase-ground (10-90%)[3]	dv/dt	kV/µs	5,00			
Output frequency range at f_s = 4 kHz	f_{out_4k}	Hz	0...400			
Output frequency range at f_s = 8 kHz	f_{out_8k}	Hz	0...800			
Output frequency threshold to detect motor standstill[4]	f_{out_still}	Hz	2...4			
Maximum output current at f_s = 4 kHz	$I_{out\_max\_4}$	A	55,0	50,0	31,0	
Maximum output current at f_s = 8 kHz	$I_{out\_max\_8}$	A	34,1	34,3	23,1	
Continuous output current at f_s = 4 kHz	$I_{out\_cont\_4}$	A	35,0	20,0	14,0	
Continuous output current at f_s = 8 kHz	$I_{out\_cont\_8}$	A	19,2	16,4	14,0	
Continuous output current at f_s = 4 kHz; output frequency $f_{out} < f_{out\_still}$	$I_{out\_cont\_0Hz\_4}$	A	19,9	17,7	12,4	
Continuous output current at f_s = 8 kHz; output frequency $f_{out} < f_{out\_still}$	$I_{out\_cont\_0Hz\_8}$	A	9,1	8,6	7,3	
Last modification: 2009-10-21						

1) Also depending on firmware and control section; see parameter description "P-0-0001, Switching frequency of the power output stage"; see "P-0-4058, Amplifier type data"

2) 3) Guide value, see following note

4) See following note regarding reduction output current

Fig.5-12: HCQ - Data of Inverter Outputs

Guide value "Rise of voltage at output"

Observe that the voltage load at the motor is almost independent of the power section used.

Especially when using **standard motors**, make sure that they comply with the occurring voltage load.

Reduced output current at motor standstill

Depending on the electric output frequency, the output current is reduced for thermal protection of the power section.

The output current is reduced, when the electric output frequency has fallen below the threshold to detect motor standstill.

5.2 HCT02

5.2.1 Brief Description, Use and Design

Brief Description

The compact multi-axis converters HCT02 are part of the Rexroth IndraDrive C product range and are used to operate one powerful axis and two auxiliary axes.

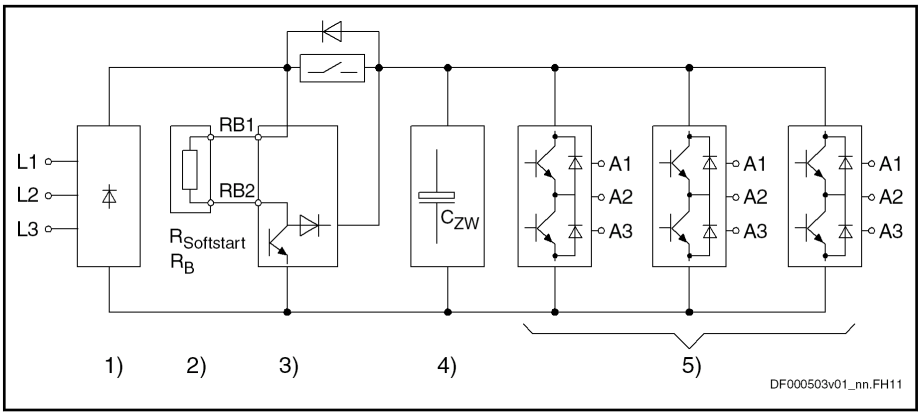
Use

The different types are used as follows:

Type	Use
HCT02.1E-W0025-A-03-…	Operation of up to three three-phase a.c. motors (asynchronous or synchronous motor)

Fig.5-13: Use of HCT02

Design, Block Diagram



1) Mains input with rectifier
2) External resistor
3) Braking resistor circuit; charging current limitation; external resistor required at X9 (RB1, RB2)
4) DC bus capacitors
5) Inverter stages with output to motors

Fig.5-14: HCT02.1E-W0025-A-03-… Block Diagram

5.2.2 Technical Data

Ambient and Operating Conditions

General Information

Conditions for transport and storage: See index entry "Transport → Of the components" or "Storage → Of the components".

Installation conditions: See index entry "Installation conditions".

This chapter contains:

- Limit values for use in the scope of C-UL
- Applied standards (CE conformity, UL listing)

UL Data

Ambient and Operating Conditions - UL Ratings

Description	Symbol	Unit	HCT02.1E-W0025-_-03		
			X5.1	X5.3	X5.4
Short circuit current rating (UL)	SCCR	A rms	42000		
Rated input voltage, power (UL) 1)	U_{LN_nenn}	V	3 x AC 200...500		
Rated input current (UL)	I_{LN}	A	44,0		
Output voltage (UL)	U_{out}	V	3 x AC 0...500		
Continuous output current at f_s = 4 kHz	I_{out_cont4}	A	35,0	14,0	
Last modification: 2010-01-29					

1) DC bus L+, L-; mains input L1, L2, L3

Fig.5-15: HCT - Ambient and Operating Conditions - UL Ratings

Information on Standards

Applied Standards

Description	Symbol	Unit	HCT02.1E-W0025-_-03
Listing according to UL standard (UL)			UL 508 C
UL files (UL)			E 134201
Listing according to CSA standard (UL)			Canadian National Standard(s) C22.2 No. 14-10
Last modification: 2011-05-11			

Fig.5-16: HCT - Applied Standards

Mechanical System and Mounting

Dimensions, Mass, Insulation, Sound Pressure Level

For the dimensional drawing of the drive controller, see index entry "Dimensional drawing".

Data for Mass, Dimensions, Sound Pressure Level, Insulation

Description	Symbol	Unit	HCT02.1E-W0025-_-03
Mass	m	kg	11,70
Device height (UL)1)	H	mm	455
Device depth (UL)2)	T	mm	191
Device width (UL)3)	B	mm	320
Insulation resistance at DC 500 V	R_{is}	Mohm	8,00
Last modification: 2010-05-26			

Technical Data of the Components

Description	Symbol	Unit	HCT02.1E-W0025-_-03
Capacitance against housing	C_Y	nF	2 x 470
Average sound pressure level (accuracy class 2) at P_{DC_cont} [4)]	L_P	dB (A)	Less than 70
			Last modification: 2010-05-26

1) 2) 3) Housing dimension; see also related dimensional drawing
4) According to DIN EN ISO 11205; comparative value at distance 1 m, out of cabinet; HCS types with order code -L***: load-dependent

Fig.5-17: HCT - Data for Mass, Dimensions, Sound Pressure Level, Insulation

Power Dissipation, Cooling

Data for Cooling and Power Dissipation

Description	Symbol	Unit	HCT02.1E-W0025-_-03
Ambient temperature range for operation with nominal data	T_{a_work}	°C	0...40
Ambient temperature range for operation with reduced nominal data	$T_{a\_work\_red}$	°C	0...55
Derating of P_{DC_cont}; P_{BD}; I_{out_cont} at $T_{a\_work} < T_a < T_{a\_work\_red}$	f_{Ta}	%/K	2
Allowed mounting position			G1
Cooling type			Forced cooling
Volumetric capacity of forced cooling	V	m^3/h	310,00
Power dissipation at continuous current and continuous DC bus power respectively (UL)[1)]	P_{Diss_cont}	W	850,00
Minimum distance on the top of the device[2)]	d_{top}	mm	100
Minimum distance on the bottom of the device[3)]	d_{bot}	mm	80
Horizontal spacing on the device[4)]	d_{hor}	mm	90
Temperature rise with minimum distances d_{bot}; d_{top}; P_{BD}	ΔT	K	30
			Last modification: 2010-06-30

1) Plus dissipation of braking resistor and control section
2) 3) 4) See fig. "Air Intake and Air Outlet at Device"

Fig.5-18: HCT - Data for Cooling and Power Dissipation

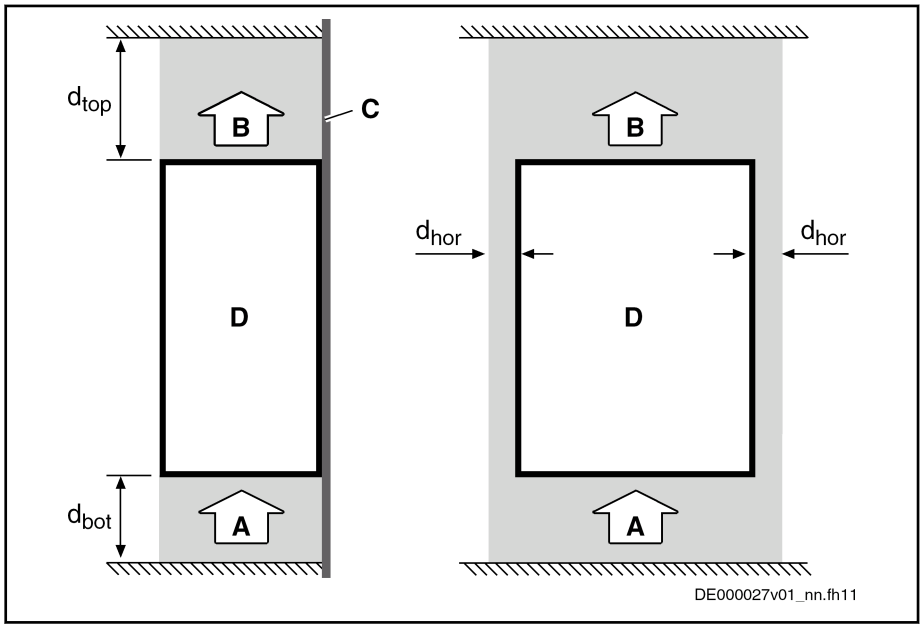
Dissipation of control section: See description of connection point X18.

NOTICE **Property damage due to temperatures higher than 105 °C!**

Observe the indicated minimum distances!

Above the devices there may only be such materials which

- are not combustible
- are insensitive to the occurring high temperatures



A	Air intake
B	Air outlet
C	Mounting surface in control cabinet
D	Housing of the device (without parts such as shielding plates on top and bottom of device)
d_{top}	Minimum distance on the top of the device
d_{bot}	Minimum distance on the bottom of the device
d_{hor}	Minimum distance on the side of the device

Fig.5-19: Air Intake and Air Outlet at Device

Basic Data Power Section HCT02

General Information

This section contains

- Data for control voltage supply
- Data for mains voltage supply
- Data of DC bus
- Data of inverter
- Requirements on an external braking resistor

☞ The order of the data tables below follows the energy flow in the drive controller – from mains connection to motor output.

Technical Data of the Components

Control Voltage

Project planning 24V supply

For the 24V supply, take the data on the dimensioning of the power supply unit into account (see index entry "24V supply → Notes on project planning").

Data for Control Voltage Supply

Description	Symbol	Unit	HCT02.1E-W0025-_-03
Rated control voltage input (UL)[1)]	U_{N3}	V	19,2...30V
Maximum inrush current at 24V supply	I_{EIN3_max}	A	13,80
Pulse width of I_{EIN3}	$t_{EIN3Lade}$	ms	Less than 10
Input capacitance	C_{N3}	mF	2,64
			Last modification: 2011-07-06

1) Observe supply voltage for motor holding brakes

Fig.5-20: HCT - Data for Control Voltage Supply

Overvoltage

Overvoltage greater than 33 V has to be discharged by means of the appropriate electrical equipment of the machine or installation.

This includes:

- 24V power supply units that reduce incoming overvoltage to the allowed value.
- Overvoltage limiters at the control cabinet input that limit existing overvoltage to the allowed value. This, too, applies to long 24V lines that have been run in parallel to power cables and mains cables and can absorb overvoltage by inductive or capacitive coupling.

Mains Voltage

The single-phase mains connection is **not** allowed!

Data for Mains Voltage Supply

Description	Symbol	Unit	HCT02.1E-W0025-_-03
Input frequency (UL)	f_{LN}	Hz	50...60
Tolerance input frequency (UL)		Hz	±2
Maximum allowed mains frequency change	$\Delta f_{LN}/\Delta t$	Hz/s	-
Rotary field condition			None
Short circuit current rating (UL)	SCCR	A rms	42000
Nominal mains voltage	U_{LN_nenn}	V	3 AC 400
			Last modification: 2011-11-30

Description	Symbol	Unit	HCT02.1E-W0025-_-03
Mains voltage three-phase at TN-S, TN-C, TT mains	U_{LN}	V	200...500
Mains voltage three-phase at IT mains[1)]	U_{LN}	V	200...230
Mains voltage three-phase at Corner-grounded-Delta mains[2)]	U_{LN}	V	200...230
Tolerance rated input voltage (UL)		%	±10
Minimum inductance of the mains supply (inductance of mains phase)[3)]	L_{min}	µH	40
Assigned type of mains choke			HNL01.1E-0400-N0051-A-480
Minimum short circuit power of the mains for failure-free operation	S_{k_min}	MVA	1,6
Assigned type of mains filter			NFD03.1-480-055; HNF01.1A-F240-E0051-A480
Inrush current	$I_{L\_trans\_max\_on}$	A	25,5...77,8
Maximum allowed ON-OFF cycles per minute[4)]			1
Power factor TPF (λ_L) at P_{DC_cont} with mains choke; U_{LN_nenn}	TPF		0,82
Power factor TPF (λ_L) at P_{DC_cont} without mains choke; U_{LN_nenn}[5)]	TPF		0,64
Power factor TPF (λ_L) at 10% P_{DC_cont} without mains choke; U_{LN_nenn}[6)]	$TPF_{10\%}$		0,40
Power factor of fundam. component DPF at P_{DC_cont} with mains choke	$cos\varphi^{h1}$		0,97
Power factor of fundam. component DPF at P_{DC_cont} without mains choke	$cos\varphi^{h1}$		0,97
Mains connection power at P_{DC_cont}; U_{LN_nenn} with mains choke	S_{LN}	kVA	30,00
Mains connection power at P_{DC_cont}; U_{LN_nenn} without mains choke	S_{LN}	kVA	23,50
Rated input current (UL)	I_{LN}	A	44,0
Nominal current AC1 for mains contactor at nom. data			I LN
Mains fuse according to EN 60204-1		A	50
			Last modification: 2011-11-30

Technical Data of the Components

Description	Symbol	Unit	HCT02.1E-W0025-_-03
Required wire size according to EN 60204-1[7)]	A_{LN}	mm^2	10
Required wire size according to UL 508 A (internal wiring); (UL)[8)]	A_{LN}	AWG	AWG 8
			Last modification: 2011-11-30

1) 2) Mains voltage > ULN: Use a transformer with grounded neutral point, don´t use autotransformers!
3) Otherwise use mains choke HNL
4) Observe allowed number of switch-on processes; without external capacitors at the DC bus
5) 6) Find interim values by interpolation
7) Copper wire; PVC-insulation (conductor temperature 70 °C); installation method B1; table 6
8) Copper wire; PVC-insulation (conductor temperature 90 °C); table 28.1; Ta ≤ 40 °C

Fig.5-21: HCT - Data for Mains Voltage Supply

DC Bus

Data of Power Section - DC Bus

Description	Symbol	Unit	HCT02.1E-W0025-_-03
DC bus voltage	U_{DC}	V	ULNx1,41
Capacitance in DC bus	C_{DC}	mF	1,18
DC resistance in DC bus (L+ to L-)	R_{DC}	kohm	80,00
Rated power (t > 10 min) at f_s = 4 kHz; U_{LN_nenn}; control factor a_0 > 0.8; with mains choke	P_{DC_cont}	kW	25,00
Rated power (t > 10 min) at f_s = 4 kHz; U_{LN_nenn}; control factor a_0 > 0.8; without mains choke	P_{DC_cont}	kW	15,00
P_{DC_cont} and P_{DC_max} vs. mains input voltage; $U_{LN} \le U_{LN\_nenn}$		%/V	0,25
P_{DC_cont} and P_{DC_max} vs. mains input voltage; $U_{LN} > U_{LN\_nenn}$		%/V	0,20
Energy to output within one load cycle; with mains choke	W_{Cyc_max}	kWs	4500
Energy to output within one load cycle; without mains choke	W_{Cyc_max}	kWs	2700
Maximum allowed DC bus power at U_{LN_nenn}; with mains choke	P_{DC_max}	kW	37,50
Maximum allowed DC bus power at U_{LN_nenn}; without mains choke	P_{DC_max}	kW	22,50
			Last modification: 2011-07-06

Description	Symbol	Unit	HCT02.1E-W0025-_-03
Monitoring value maximum DC bus voltage, switch-off threshold	$U_{DC\_limit\_max}$	V	900
Charging resistor continuous power	P_{DC_Start}	kW	External resistor required
Allowed external DC bus capacitance (nom.) at U_{LN_nenn} 1)	C_{DCext}	mF	-
			Last modification: 2011-07-06

1) Use assigned type of mains choke

Fig.5-22: HCT - Data of Power Section - DC Bus

Braking Resistor

Use external resistor!

To limit the charging current when the mains voltage is connected, the drive controller needs an external resistor ($R_{Softstart}$).

After the mains voltage has been connected, the external resistor is used as a braking resistor ($R_{DC\_Bleeder}$).

Project Planning of External Braking Resistor

1. Determine the occurring continuous power and regenerative power at the external braking resistor.
2. For this purpose, select an appropriate braking resistor; its resistance value must be in the range of $R_{DC\_Bleeder}$.
3. Via the control unit, parameterize the data of the selected braking resistor to protect the drive controller and the braking resistor against overload:

   NC configuration ▸ SCSP ▸ Global ▸ ExtBrakingResistors ▸ BrakResist[x]

Limit Values Operating Data - External Braking Resistor

Description	Symbol	Unit	HCT02.1E-W0025-_-03
Resistance value of external braking resistor1)	$R_{DC\_Bleeder}$	ohm	10...17
Continuous power of external braking resistor2)	P_{BD}	kW	5,00
Regenerative power to be absorbed	W_{R_max}	kWs	100,00
			Last modification: 2010-06-29

1) 2) See Parameter Description "P-0-0858, Data of external braking resistor"

Fig.5-23: HCT - External Braking Resistor

HLR The following HLR braking resistors are suitable:

- HLR01.1N-0470-N11R7-A-007-NNNN
- HLR01.1N-02K0-N15R0-A-007-NNNN
- HLR01.1N-05K0-N15R0-A-007-NNNN

Technical Data of the Components

Inverter

HCT02 drive controllers do not have the output X5.2.

Data of Inverter Outputs

Description	Symbol	Unit	HCT02.1E-W0025-_-03		
			X5.1	X5.3	X5.4
Allowed switching frequencies [1]	f_s	kHz	4, 8		
Output voltage, fundamental wave with open-loop operation	U_{out_eff}	V	~UDC*0.71		
Output voltage, fundamental wave with closed-loop operation	U_{out_eff}	V	~UDC*0.71		
Rise of voltage at output with U_{LN_nenn} and 15 m motor cable length phase-phase (10-90%)[2]	dv/dt	kV/µs	5,00		
Rise of voltage at output with U_{LN_nenn} and 15 m motor cable length phase-ground (10-90%)[3]	dv/dt	kV/µs	5,00		
Output frequency range at f_s = 4 kHz	f_{out_4k}	Hz	0...400		
Output frequency range at f_s = 8 kHz	f_{out_8k}	Hz	0...800		
Output frequency threshold to detect motor standstill[4]	f_{out_still}	Hz	2...4		
Maximum output current at f_s = 4 kHz	I_{out_max4}	A	55,0	31,0	
Maximum output current at f_s = 8 kHz	I_{out_max8}	A	34,1	23,1	
Continuous output current at f_s = 4 kHz	I_{out_cont4}	A	35,0	14,0	
Continuous output current at f_s = 8 kHz	I_{out_cont8}	A	19,2	14,0	
Continuous output current at f_s = 4 kHz; output frequency $f_{out} < f_{out\_still}$	$I_{out\_cont0Hz\_4}$	A	19,9	12,4	
Continuous output current at f_s = 8 kHz; output frequency $f_{out} < f_{out\_still}$	$I_{out\_cont0Hz\_8}$	A	9,1	7,3	
Last modification: 2010-01-26					

1) Also depending on firmware and control section; see parameter description "P-0-0001, Switching frequency of the power output stage"; see "P-0-4058, Amplifier type data"
2) 3) Guide value, see following note
4) See following note regarding reduction output current
Fig.5-24: HCT - Data of Inverter Outputs

Guide value "Rise of voltage at output"

Observe that the voltage load at the motor is almost independent of the power section used.

Especially when using **standard motors**, make sure that they comply with the occurring voltage load.

Reduced output current at motor standstill

Depending on the electric output frequency, the output current is reduced for thermal protection of the power section.

The output current is reduced, when the electric output frequency has fallen below the threshold to detect motor standstill.

6 Electrical Connection Points

6.1 Connection Diagrams

6.1.1 Connection Diagram HCQ02

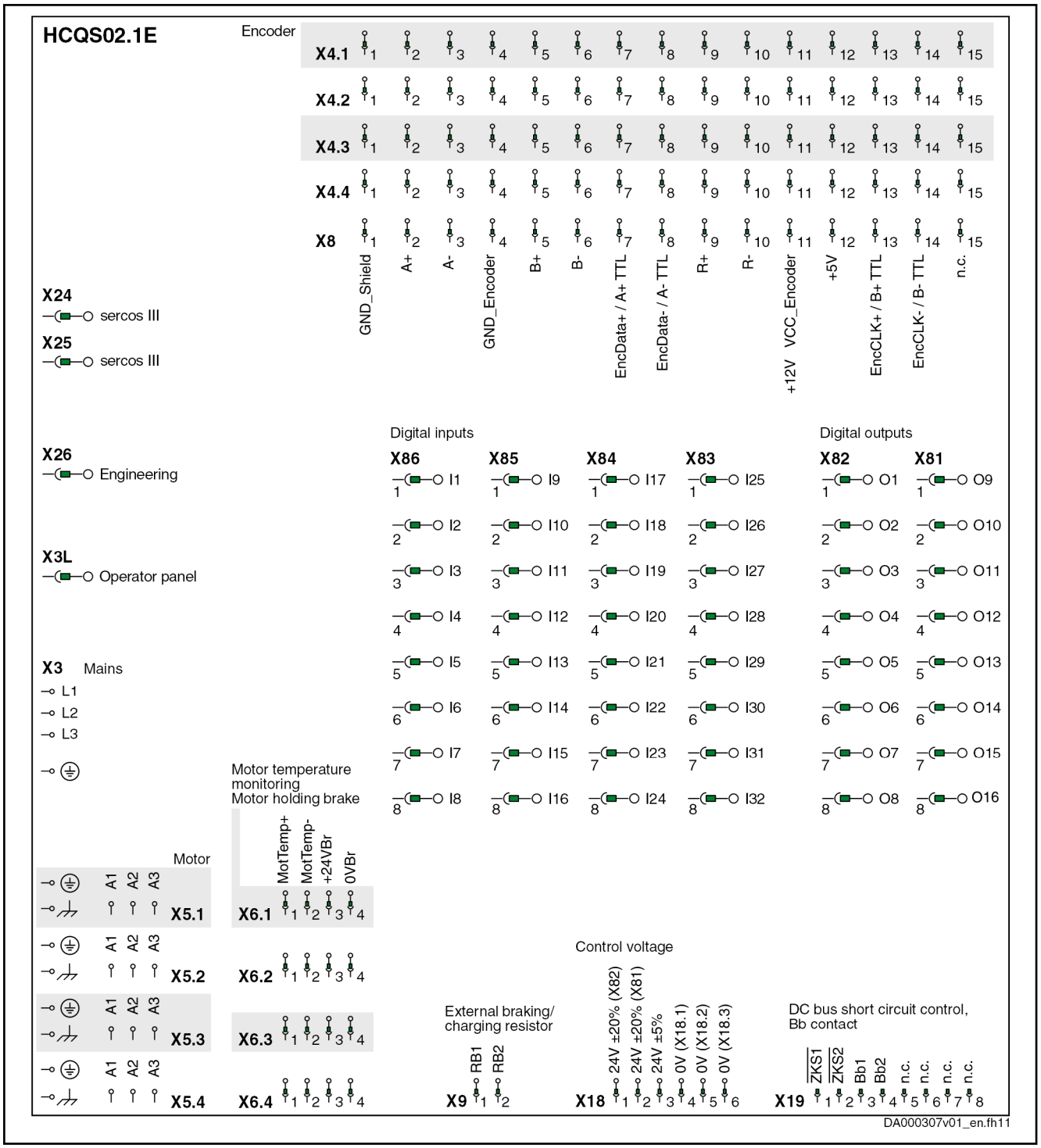


Fig.6-1: Overall Connection Diagram HCQ02

Electrical Connection Points

6.1.2 Connection Diagram HCT02

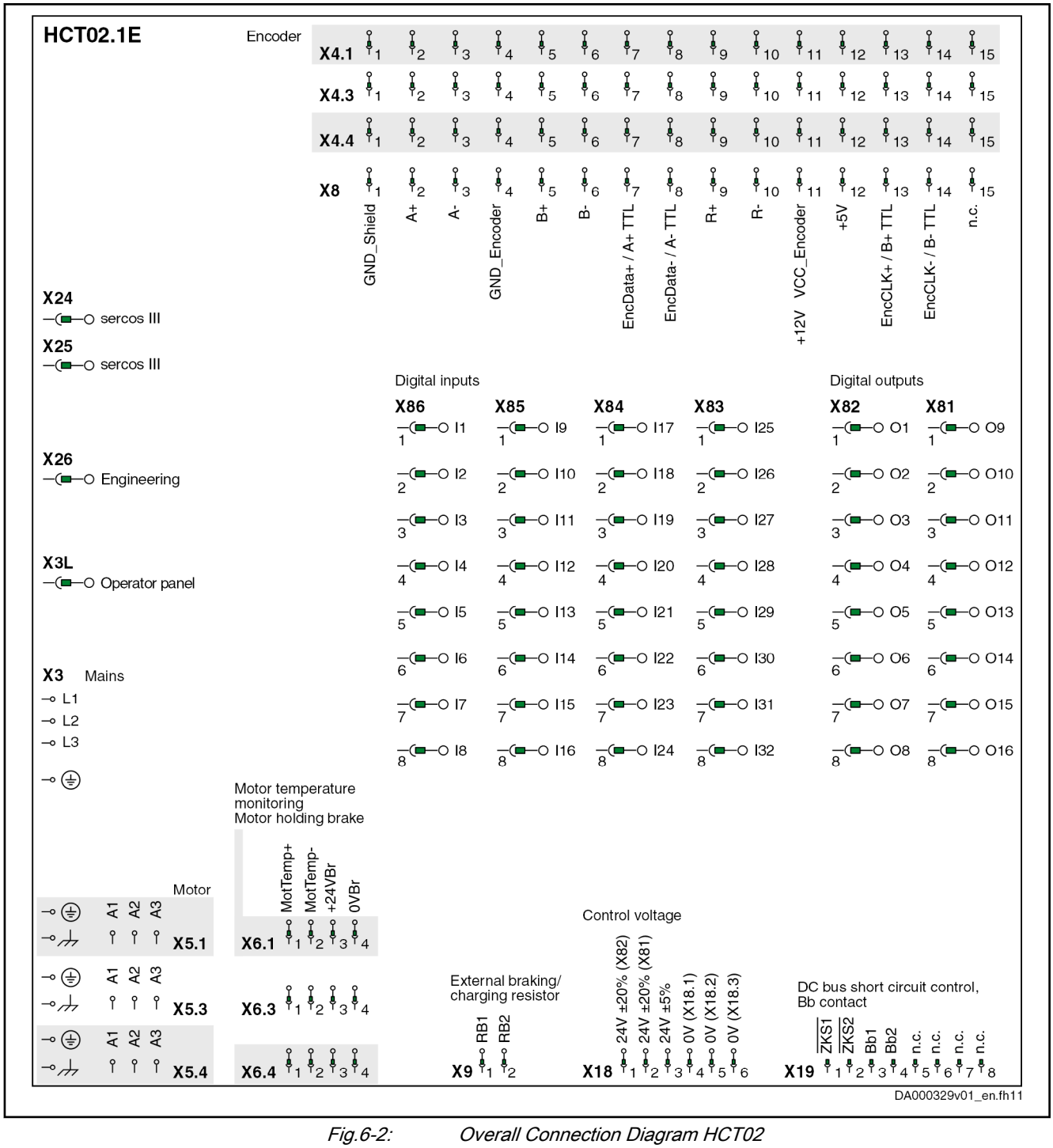


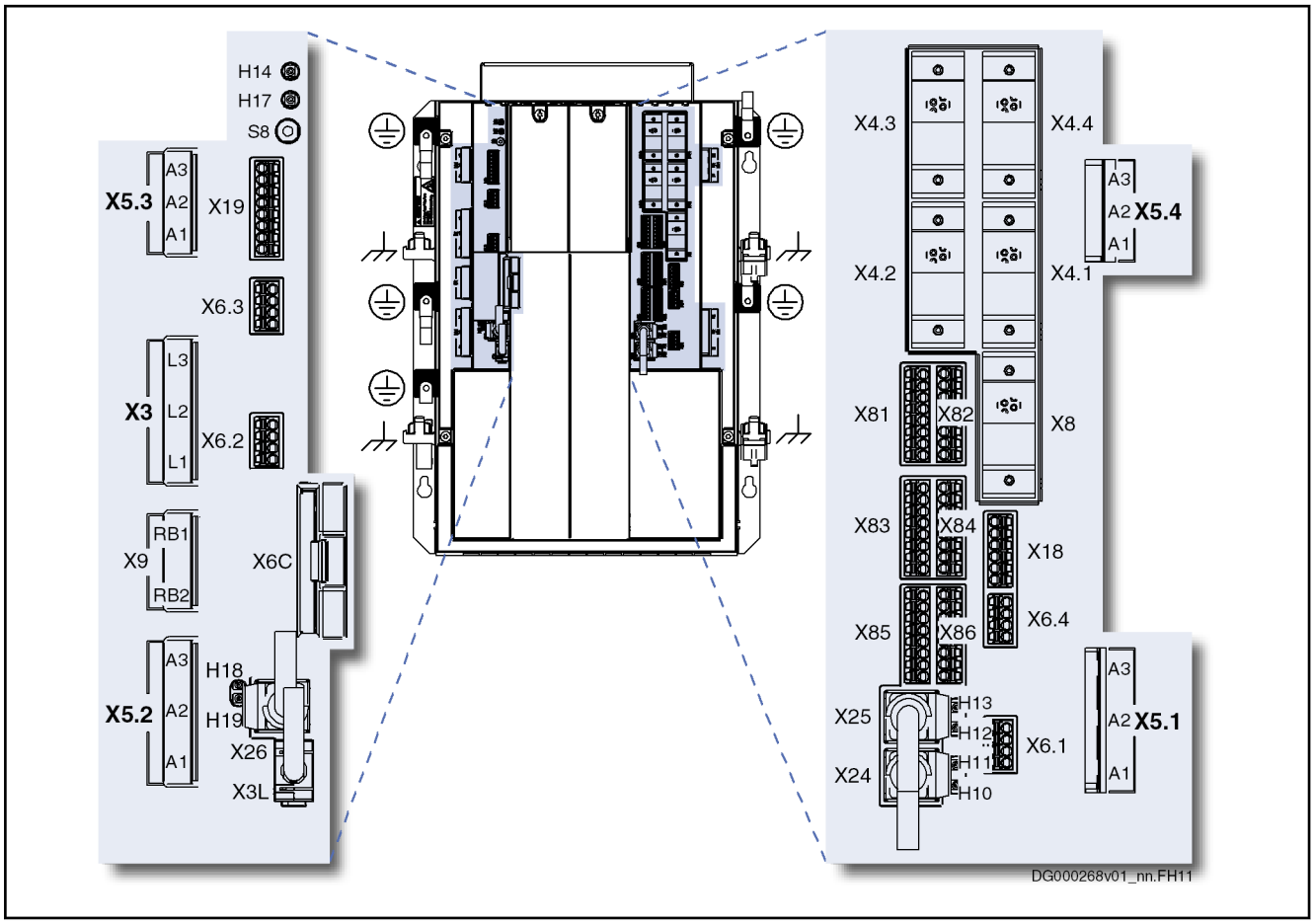
Fig.6-2: Overall Connection Diagram HCT02

6.2 Arrangement of the Connection Points

⚠ WARNING **Lethal electric shock by live parts with more than 50 V!**

Connect the drive controller to the equipment grounding system via the connection points ⏚.

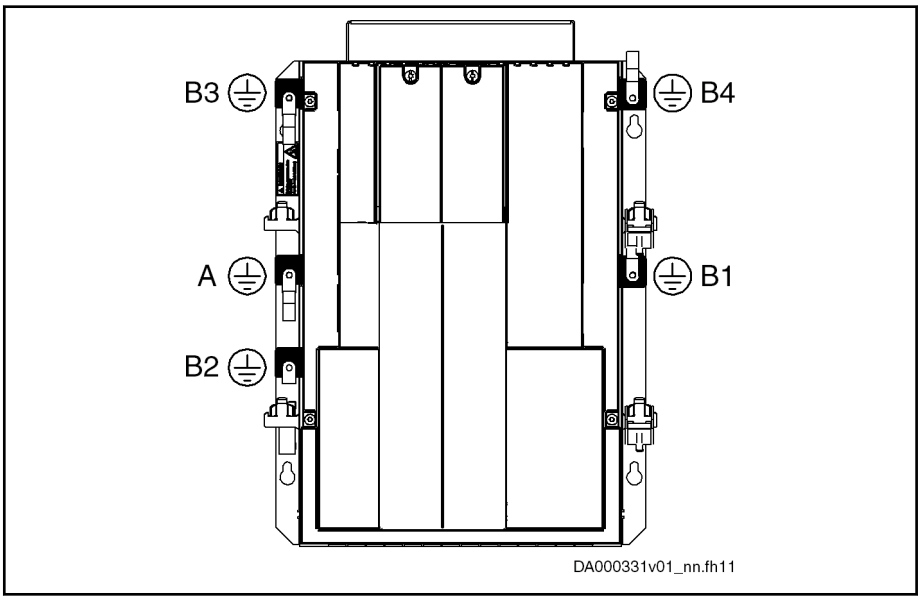
Connection Points



X3	Mains connection
X3L	Interface for operator panels
X4.1…4.4	Encoder evaluation; X4.2 does not exist at 3-axis devices
X5.1…5.4	Motor connection (output inverter); X5.2 does not exist at 3-axis devices
X6.1…6.4	Motor temperature monitoring and motor holding brake; X6.2 does not exist at 3-axis devices
X6C	Extension of memory with CompactFlash memory card
X8	Optional encoder evaluation
X9 (RB1, RB2)	External braking and charging resistor
X18	24V supply (for control voltage and brake voltage)
X19	Bb contact, DC bus short circuit control
X24, X25	Communication
X26	Engineering interface
X81, X82	Digital outputs
X83…86	Digital inputs

Fig.6-3: Connection Points

6.3 Connection of Equipment Grounding Conductor



A Mains
B1…B4 Motors (B2: Does not exist at 3-axis devices)
Fig.6-4: Connection Points of Equipment Grounding Conductor

⚠ WARNING **Lethal electric shock by live parts with more than 50 V!**

Exclusively operate the device with connected equipment grounding conductors!

Connect the equipment grounding conductor connections to the equipment grounding system of the control cabinet.

Check the continuity of the equipment grounding conductors from the mains connection to the connected motors.

☞ **Equipment grounding conductor: Material and cross section**

For the equipment grounding conductor, use the same metal (e.g. copper) as for the outer conductors.

For the connections from the equipment grounding conductor connection of the device to the equipment grounding conductor system in the control cabinet, make sure the cross sections of the lines are sufficient.

Observe the safety instruction: Protection Against Contact With Electrical Parts and Housings, page 23

6.4 Ground Connection

The ground connection of the housing is used to provide functional safety of the drive controllers and protection against contact in conjunction with the equipment grounding conductor.

Ground the housings of the drive controllers:

1. Connect the bare metal back panel of the drive controller in conductive form to the mounting surface in the control cabinet. To do this, use the supplied mounting screws.

2. Connect the mounting surface of the control cabinet in conductive form to the equipment grounding system.
3. For the ground connection, observe the maximum allowed ground resistance.

6.5 X3, Mains Connection

View	Identification	Function
	L1	Connection to supply mains phase 1 (L1)
	L2	Connection to supply mains phase 2 (L2)
	L3	Connection to supply mains phase 3 (L3)
	⏚	Connection of equipment grounding conductor (at housing of device)

Spring terminal	Unit	Min.	Max.
Connection cable Stranded wire	mm^2	10	16
	AWG	6	6
Stripped length	mm	12	13
Occurring current load and minimum required connection cross section	A	See technical data of device used (I_{LN} and A_{LN})	
Occurring voltage load	V	See technical data of device used (U_{LN} or U_{LN_nenn})	

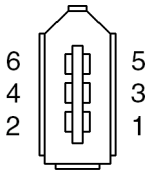
Fig.6-5: Function, Pin Assignment, Properties

Notes on Installation

- **Fuse**
  Fuse each phase with **> 44 A**
- **Mains contactor**
  Dimension mains contactor for a rated current of **65 A**
- **Equipment grounding conductor**
  See index entry "Connection → Equipment grounding conductor"

6.6 X3L, Interface for Operator Panels

Function, Pin Assignment Operator panels are connected via the connection point X3L.

Pin assignment	Connection	Signal name	Function
 DG000270v01_nn.FH11	1	0V	
	2	0V	
	3	USB-	USB interface to operator panel
	4	USB+	
	5	LVDS-	LVDS interface to operator panel
	6	LVDS+	

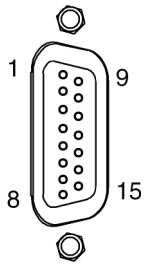
Electrical Connection Points

Properties	
Type	Female (device); FireWire IEEE1394a, 6-pin
Connection cable	RKB0030 Maximum cable length: 10 m

Fig.6-6: Function, Pin Assignment, Properties

6.7 X4.1 … X4.4, Encoder Evaluation

The connection points X4.1 to X4.4 have an identical design. The identifiers ".1" to ".4" refer to the respective axis number.

View	Identification	Function
 DA000053v01_nn.FH9	X4.1	Encoder evaluation axis 1
	X4.2	Encoder evaluation axis 2
	X4.3	Encoder evaluation axis 3
	X4.4	Encoder evaluation axis 4

D-Sub, 15-pin, female	Unit	Min.	Max.
Connection cable Stranded wire	mm^2	0,25	0.5 mm^2
Kind of encoder evaluation	ES Technical data: See index entry "Standard encoder evaluation ES"		

Fig.6-7: Function, Pin Assignment, Properties

6.8 X5.1 and X5.2, Motor Connection

The connection points X5.1 to X5.2 have an identical design. The identifiers ".1" and ".2" refer to the respective axis number.

View	Identification	Function
	A1	For power connection U1 at motor
	A2	For power connection V1 at motor
	A3	For power connection W1 at motor
	⏚	Connection of equipment grounding conductor (at housing of device)

Spring terminal	Unit	Min.	Max.

Connection cable Stranded wire	mm^2	1	16
	AWG	16	6
Stripped length	mm	11	12
Occurring current load and minimum required connection cross section	A	See technical data of device used (I_{out})	
Occurring voltage load	V	See technical data of device used (U_{out})	
Short circuit protection		A1, A2, A3 against each other and each of them against ground	

Fig.6-8: Function, Pin Assignment, Properties

Notes on Installation

- **Motor cable length**

  Maximum allowed motor cable length: **40 m**

- **Shield connection**

  Connect the shields of the motor cables via the individual shield connections at the housing of the device.

6.9 X5.3 and X5.4, Motor Connection

The connection points X5.3 to X5.4 have an identical design. The identifiers ".3" and ".4" refer to the respective axis number.

View	Identification	Function
	A1	For power connection U1 at motor
	A2	For power connection V1 at motor
	A3	For power connection W1 at motor
	⏚	Connection of equipment grounding conductor (at housing of device)

Spring terminal	**Unit**	**Min.**	**Max.**
Connection cable Stranded wire	mm^2	1	6
	AWG	17	10
Stripped length	mm	11	12
Occurring current load and minimum required connection cross section	A	See technical data of device used (I_{out})	
Occurring voltage load	V	See technical data of device used (U_{out})	
Short circuit protection		A1, A2, A3 against each other and each of them against ground	

Fig.6-9: Function, Pin Assignment, Properties

Notes on Installation

- **Motor cable length**

  Maximum allowed motor cable length: **40 m**

- **Shield connection**

Connect the shields of the motor cables via the individual shield connections at the housing of the device.

6.10 X6.1 … X6.4, Motor Temperature Monitoring and Motor Holding Brake

⚠ WARNING **Dangerous movements! Danger to persons from falling or dropping axes!**

The standard motor holding brake provided or an external motor holding brake controlled directly by the drive controller are not sufficient on their own to guarantee personal safety!

Personal safety must be achieved using higher-level, fail-safe measures:

- Block off danger zones with safety fences or safety guards
- Additionally secure vertical axes against falling or dropping after switching off the motor power by, for example,
  - mechanically securing the vertical axes
  - adding external braking/arrester/clamping mechanisms
  - ensuring sufficient counterbalancing of the vertical axes

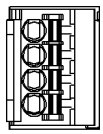
Function

The connection points X6.1 to X6.4 have an identical design. The identifiers ".1" to ".4" refer to the respective axis number.

The connection points contain the connections for

- monitoring the motor temperature
- controlling the motor holding brake

☞ Via an integrated contact element (BR), the power section switches the voltage of the **external** 24V supply to the output for controlling the motor holding brake.

View	Connection	Signal name	Function
 DG000260.FH11	1	MotTemp+	Input motor temperature monitoring
	2	MotTemp-	
	3	+24VBr	Output for controlling the motor holding brake
	4	0VBr	

Spring terminal (connector)	Unit	Min.	Max.
Connection cable Stranded wire	mm^2	0,2	1,5
	AWG	24	16
Current carrying capacity of outputs for controlling motor holding brakes	A	-	1,3
Time constant of load	ms	-	50

Number of switching actions at maximum time constant of load		250.000	
Switching frequency	Hz	-	0,5
Short circuit protection		Available	
Overload protection		Available	
Integrated contact element for controlling the motor holding brake		Electronic contact	

Fig.6-10: Function, Pin Assignment

Notes on Installation

- Make sure the **power supply** for the motor holding brake at the motor is sufficient. You have to take into account that voltage drops on the supply line. Use **connection lines** with the highest possible cross section of the single strands.
- An external contact element is required, if **motor holding brakes with higher currents** than the allowed current load are to be supplied at X6.n.

Connection Diagram

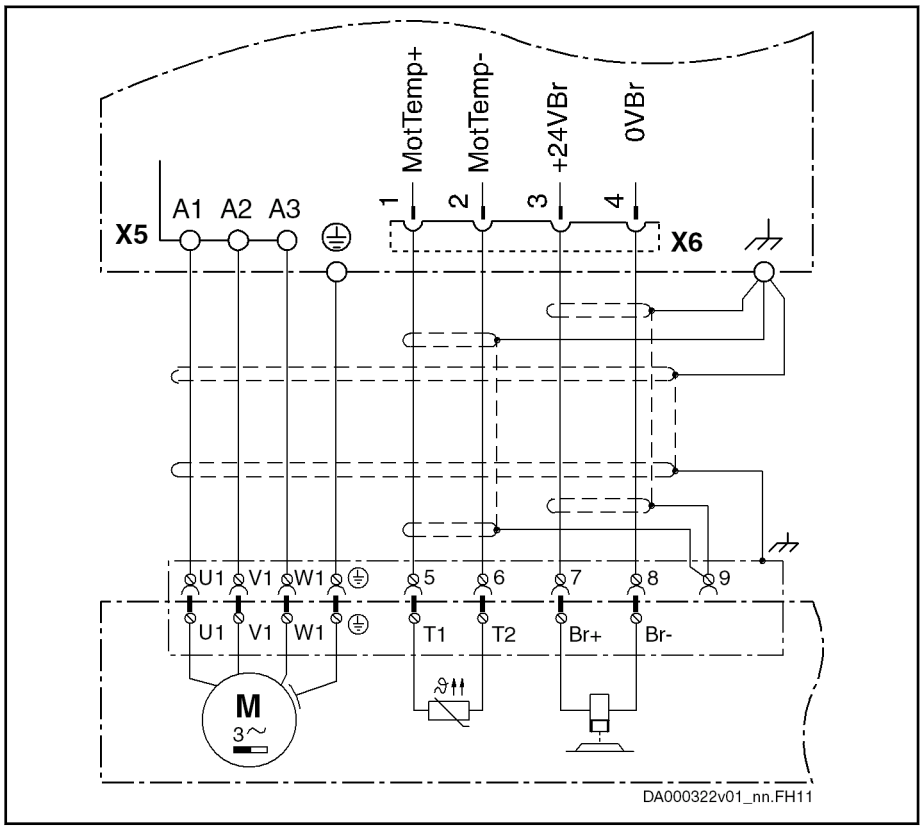


Fig.6-11: Connection of Motor Temperature Monitoring and Motor Holding Brake

Electrical Connection Points

Brake Supply (4-Axis Device)

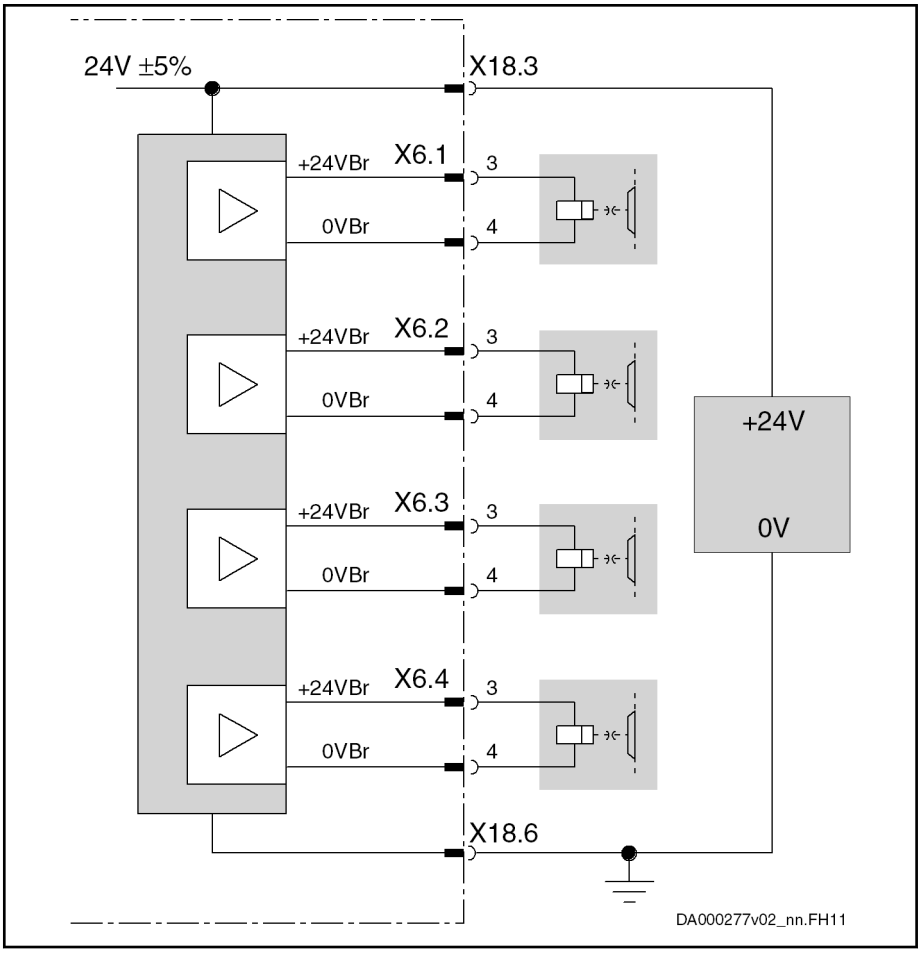


Fig.6-12: Design of Brake Supply (4-Axis Device)

Brake Supply (3-Axis Device)

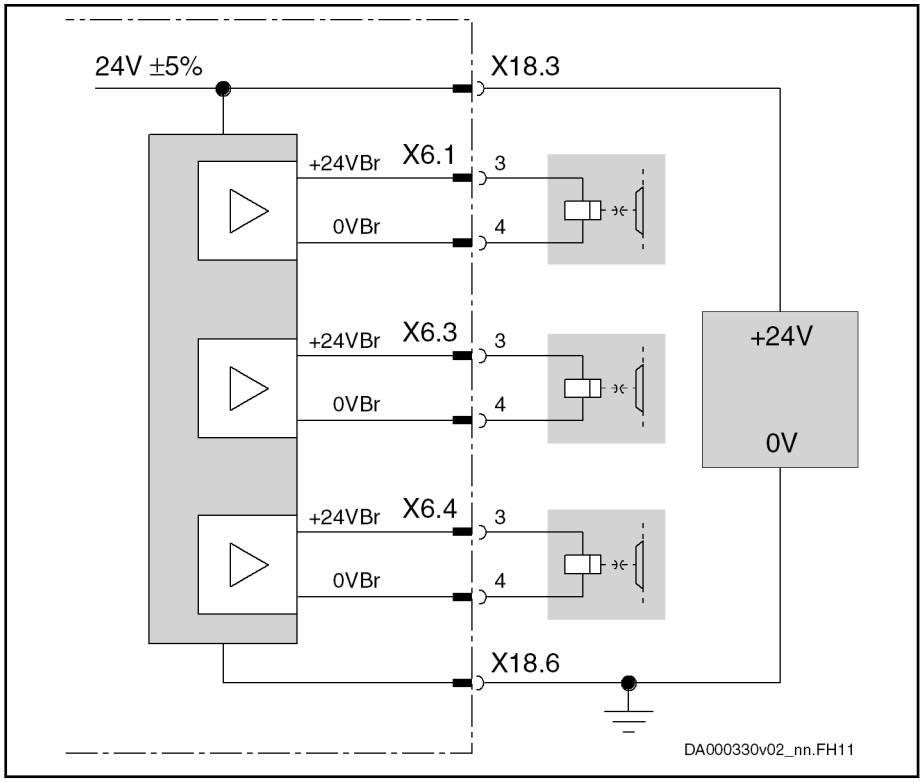


Fig.6-13: Design of Brake Supply (3-Axis Device)

6.11 X6C, Memory Card

Function, Pin Assignment

The connection point X6C is used as a plug-in slot for CompactFlash memory cards. The memory cards are used to save the firmware, the parameters and the PLC programs.

6.12 X8, Optional Encoder Evaluation

An optional encoder (standard encoder ES) can be connected at connection X8.

Data: See index entry "Encoder evaluation → X4.1, X4.2, X4.3, X4.4"

6.13 X9, External Braking and Charging Resistor

Function

X9 is used to connect an external braking and charging resistor. An internal switch connects the braking and charging resistor to the DC bus.

View	Connection	Signal name	Function
	RB1	n.s.	Connection braking and charging resistor
	RB2	n.s.	Connection braking and charging resistor

Electrical Connection Points

Spring terminal	Unit	Min.	Max.
Connection cable Stranded wire	mm^2	2,5	6
	AWG	14	10
Stripped length	mm	11	12
Current load	A	Peak value: 32 r.m.s. value: 15	
Voltage load	V	630	
Short circuit protection		To be ensured by means of appropriate fusing elements	

n.s. Not specified

Fig.6-14: Function, Pin Assignment

Notes on Installation

Maximum allowed line length to external braking and charging resistor: **5 m**

Twist unshielded lines.

NOTICE **Danger by insufficient installation!**

Protect the lines with the appropriate fusing elements in the supply feeder.

For the connection lines at X9, use at least the cross section of the lines for mains connection at X3.

Notes on Project Planning

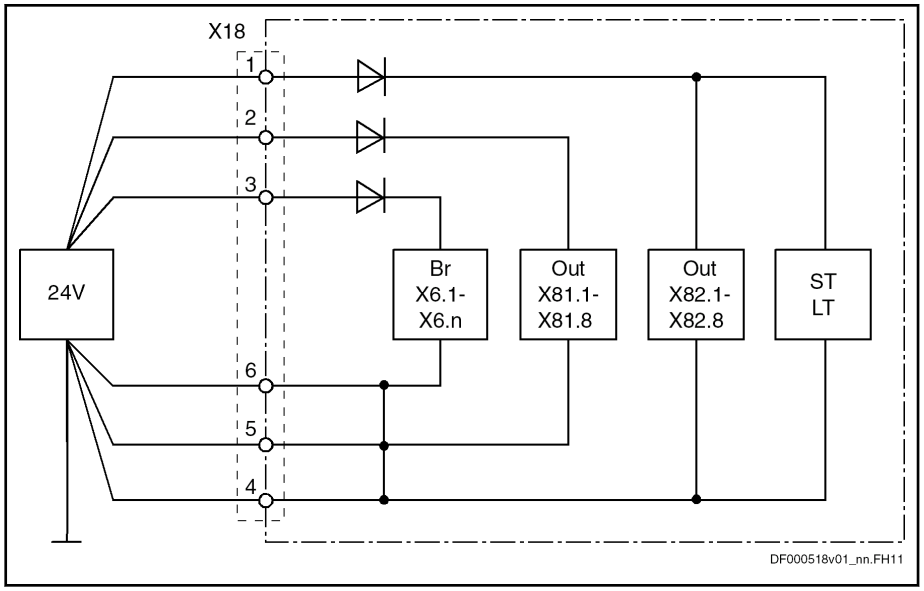
See index entry "Braking resistor → Data, HCQ02" or "Braking resistor → Data, HCT02"

6.14 X18, 24V Supply (Control Voltage)

Function, Pin Assignment

The external 24V supply is applied via connection point X18 for:

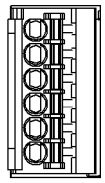
- Control section and power section
- Device-internal fan
- Brake control via X6
- Digital outputs at X81 and X82



24V	External power supply unit for 24V supply
Br	Circuit for brake control
Out	Digital outputs
ST, LT	Control section and power section of basic device
X18.4…6	0V connections (jumpered in the drive controller)

Fig.6-15: Block Diagram of Internal Control Voltage

Electrical Connection Points

View	Connection	Data	Function
 DG000269.FH11	1	19.2 … 30 V	Supply basic device (power section and control section, encoder supply, fan)
		< 5.6 A	Inrush current limited to 13.8 A; minimum pulse width 5.2 ms
		108 W	Constant over input voltage range (internally controlled voltage)
		19.2 … 30 V	Supply of digital outputs X82.1…8
		< 2 A	Max. 0.5 A at one output
		58 W	At 25.2 V; load-dependent
	2	19.2 … 30 V	Supply of digital outputs X81.1…8
		< 2 A	Max. 0.5 A at one output
		58 W	At 25.2 V; load-dependent
	3	24 V ±5%	Supply of motor holding brakes
		< 5.2 A	The current carrying capacity of the individual outputs for controlling the motor holding brakes is limited to 1.3 A. The current for controlling all motor holding brakes is limited to 4.5 A.
		113 W	At 25.2 V; load-dependent
	4	0 V	Reference potential for power supply (X18.1)
	5	0 V	Reference potential for power supply (X18.2)
	6	0 V	Reference potential for power supply of motor holding brakes (X18.3)

Spring terminal (connector)	Unit	Min.	Max.
Connection cable Stranded wire	mm^2	1,5	1,5
	AWG	16	16
Power consumption	W	108	337 Depending on the load at X81 (X18.1), X82 (X18.2), as well as on the operation of motor holding brakes (X18.3)
Polarity reversal protection		Within the allowed voltage range by internal protective diode	

Fig.6-16: Function, Pin Assignment, Properties

Project planning 24V supply

For the 24V supply, take the data on the dimensioning of the power supply unit into account (see index entry "24V supply → Notes on project planning").

6.15 X19, Bb Contact, DC Bus Short Circuit Control

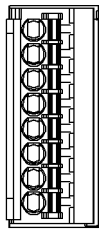
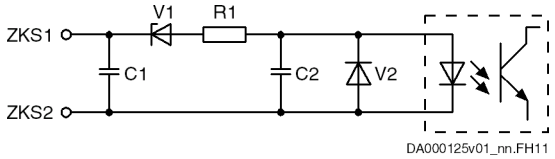
NOTICE **Risk of fire caused by the "sacrificing behavior" of the ZKS stage!**

The "ZKS" input activates the function "DC bus short circuit", when there hasn't any voltage been applied and when there isn't any current flowing to the input. This status occurs both in the case of wire break and when the 24V supply fails.

When the 24V supply fails in applications in which energy does not only get to the DC bus via the mains connection, but also via regeneratively operated motors (e.g. following-on rollers), the ZKS stage converts this energy into heat until it is destroyed ("sacrificing behavior").

Counter measures with such applications:

Buffer the 24V supply (e.g. by means of a UPS) to evaluate the monitor and switch off the energy flow in the case of error.

View	Connection	Signal name	Function
 DG000261.FH11	1	ZKS1	Controls the ZKS stage: • **ZKS active** /ZKS1: n.c. • **ZKS not active** – /ZKS1: Connected to 24 V and – /ZKS2: Connected to 0 V
	2	ZKS2	
	3	Bb1	N/O contact signals readiness for connecting the external mains contactor **Closed with:** Readiness for operation of supply unit **Open with:** • Error messages F2800 to F2899 • Error messages F8069 and F8070 • Warnings E2800 to E2899
	4	Bb2	
	5	n. c.	
	6	n. c.	
	7	n. c.	
	8	n. c.	
DC bus short circuit input:	 DA000125v01_nn.FH11		
Spring terminal (connector)	**Unit**	**Min.**	**Max.**

Electrical Connection Points

Connection cross section solid wire	mm^2	0,5	1,5
Connection cross section stranded wire	mm^2	0,5	1,5
Connection cross section	AWG	24	16
Type of contact		Relay Contact Type 2 For technical data, see index entry "Relay contact → Type 2"	

Fig.6-17: Function, Pin Assignment, Properties

☞ Integrate the Bb contact (Bb1, Bb2) in the control circuit for the mains connection. When the Bb contact opens, the mains contactor must interrupt the power supply.

6.16 X24 and X25, sercos III Master

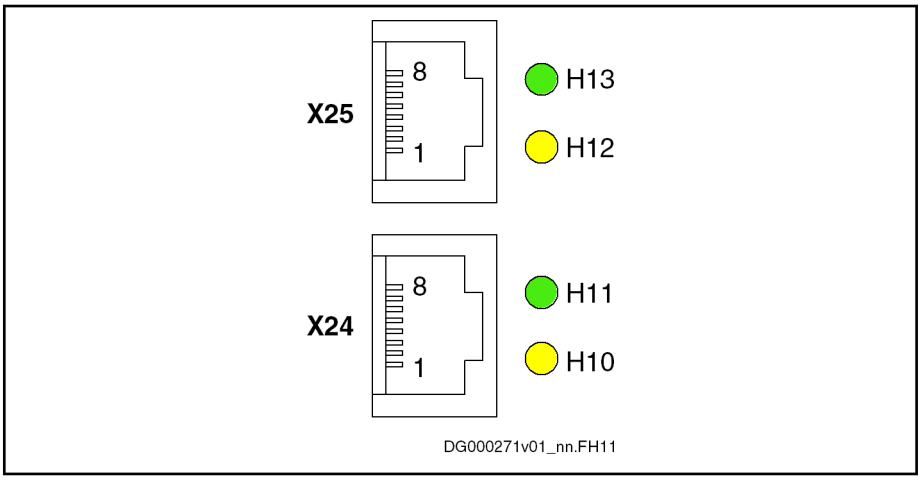
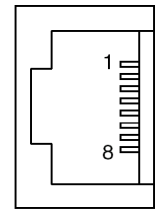


Fig.6-18: sercos III Master Connection Points

View	Connection	Signal name	Function
 DA000041v01_nn.FH	1	TD+	Transmit, differential output A
	2	TD-	Transmit, differential output B
	3	RD+	Receive, differential input A
	4	n. c.	-
	5	n. c.	-
	6	RD-	Receive, differential input B
	7	n. c.	-
	8	n. c.	-
	Housing		Shield connection
Properties			
Standard	• Ethernet • Type: RJ-45, 8-pin		

Compatibility	100Base-TX according to IEEE 802.3u
Recommended cable type	• According to **CAT5e**; type of shield ITP (Industrial Twisted Pair) • Ready-made cables which can be ordered: – **RKB0011** Long cables (no more than 100 m) to connect the drive system to the higher-level control unit or remoter communication users. Minimum bending radius: – 48.75 mm if laid flexibly – 32.50 mm if laid permanently Order code for a 30 m long cable: RKB0011/030,0 – **RKB0013** Short cables to connect devices arranged side by side in the control cabinet. 4 lengths available: 0.19 m; 0.25 m; 0.35 m; 0.55 m Order code for a 0.55 m long cable: RKB0013/00,55 Minimum bending radius: 30.75 mm

Fig.6-19: Function, Pin Assignment, Properties

H10, H11, H12, H13 Diagnostic LEDs:
See index entry "Diagnostic displays"

6.17 X26, Engineering Interface

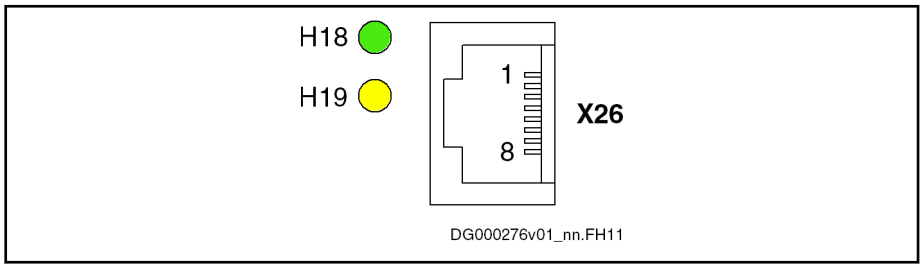
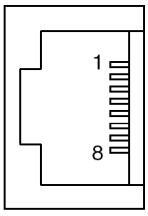


Fig.6-20: X26

View	Connection	Signal name	Function
 DA000041v01_nn.FH	1	TD+	Transmit, differential output A
	2	TD-	Transmit, differential output B
	3	RD+	Receive, differential input A
	4	n. c.	-
	5	n. c.	-
	6	RD-	Receive, differential input B
	7	n. c.	-
	8	n. c.	-
	Housing		Shield connection
Properties			

Electrical Connection Points

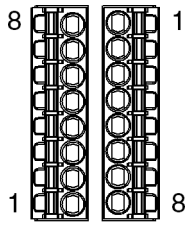
Standard	• Ethernet • Type: RJ-45, 8-pin
Compatibility	100Base-TX according to IEEE 802.3u
Recommended cable type	• According to **CAT5e**; type of shield ITP (Industrial Twisted Pair) • Ready-made cables which can be ordered: – **RKB0011** Long cables (no more than 100 m) to connect the drive system to the higher-level control unit or remoter communication users. Minimum bending radius: – 48.75 mm if laid flexibly – 32.50 mm if laid permanently Order code for a 30 m long cable: RKB0011/030,0 – **RKB0013** Short cables to connect devices arranged side by side in the control cabinet. 4 lengths available: 0.19 m; 0.25 m; 0.35 m; 0.55 m Order code for a 0.55 m long cable: RKB0013/00,55 Minimum bending radius: 30.75 mm

Fig.6-21: Function, Pin Assignment, Properties

H18, H19 Diagnostic LEDs:

See index entry "Diagnostic displays"

6.18 X81 and X82, Digital Outputs

View	Connection X81	Connection X82	Signal X81	Signal X82	Function
 DG000382v01_nn.FH11	8	1	O16	A1	The digital outputs correspond to "IEC 61131, type 1". Power supply 19,2 … 30 V: • X81: X18.2 • X82: X18.1 Reference potential 0 V: • X81: X18.5 • X82: X18.4 Technical data: See index entry "Digital outputs → Technical data"
	7	2	O15	O2	
	6	3	O14	O3	
	5	4	O13	O4	
	4	5	O12	O5	
	3	6	O11	O6	
	2	7	O10	O7	
	1	8	O9	O8	

Spring terminal (connector)	Unit	Min.	Max.
Connection cross section solid wire	mm^2	0,2	1,5
Connection cross section stranded wire	mm^2	0,2	1,5
Connection cross section stranded wire	AWG	24	16

Fig.6-22: Signal Assignment

Electrical Connection Points

6.19 X83 ... X86, Digital Inputs

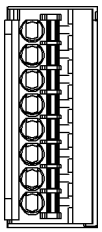
Type	Number of poles	Solid wire [mm²]	Stranded wire [mm²]	AWG	Figure
Spring terminal Female (connector)	8	0,2–1,5	0,2–1,5	24–16	 DG000261.FH11

Fig.6-23: Data of Connection Point

X83, X84

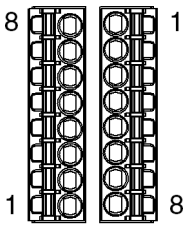
View	Connection X83	Connection X84	Signal X83	Signal X84	Technical Data
 DG000382v01_nn.FH11	8	1	I32	I17	The digital inputs correspond to "IEC 61131, type 1". Reference potential 0 V: X18.4 Technical data: See index entry "Digital inputs → Technical data"
	7	2	I31	I18	
	6	3	I30	I19	
	5	4	I29	I20	
	4	5	I28	I21	
	3	6	I27	I22	
	2	7	I26	I23	
	1	8	I25	I24	

Fig.6-24: Signal Assignment X83, X84

X85

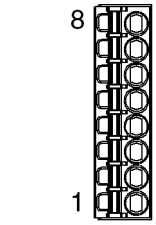
View	Connection X85	Signal X85	Factory setting	Technical Data
 DG000383v01_nn.FH11	8	I16		The digital inputs correspond to "IEC 61131, type 1". Reference potential 0 V: X18.4 Technical data: See index entry "Digital inputs → Technical data"
	7	I15	Travel range limit switch negative axis 4	
	6	I14	Travel range limit switch positive axis 4	
	5	I13	Travel range limit switch negative axis 3	
	4	I12	Travel range limit switch positive axis 3	
	3	I11	Travel range limit switch negative axis 2	
	2	I10	Travel range limit switch positive axis 2	
	1	I9	Travel range limit switch negative axis 1	

Fig.6-25: Signal Assignment X85

X86

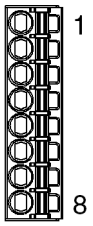
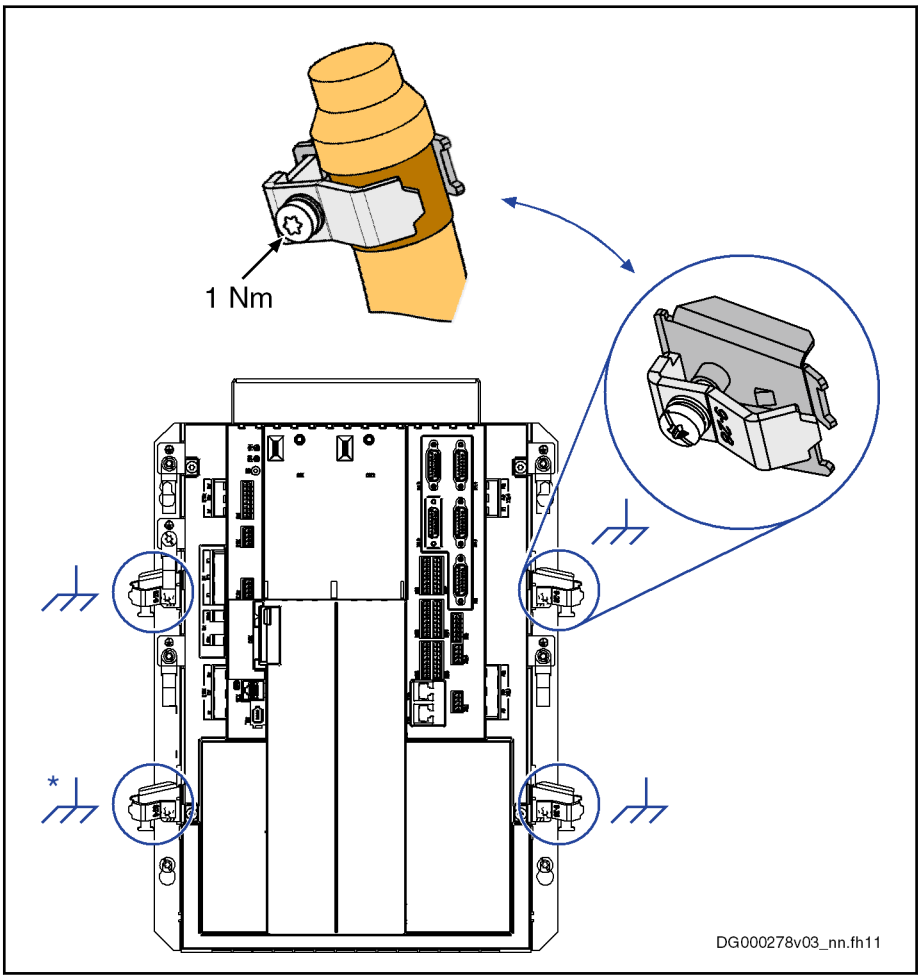
View	Connection X86	Signal X86	Factory setting	Technical Data
 DG000384v01_nn.FH11	1	I1	E-Stop (all axes)	The digital inputs correspond to "IEC 61131, type 1". Can be additionally used as **probes**. Reference potential 0 V: X18.4 Technical data: See index entry "Digital inputs → Probe"
	2	I2	Probe 1 (all axes)	
	3	I3	Probe 2 (all axes)	
	4	I4	Home switch axis 1	
	5	I5	Home switch axis 2	The digital inputs correspond to "IEC 61131, type 1". Reference potential 0 V: X18.4 Technical data: See index entry "Digital inputs → Technical data"
	6	I6	Home switch axis 3	
	7	I7	Home switch axis 4	
	8	I8	Travel range limit switch positive axis 1	

Fig.6-26: Signal Assignment X86

Electrical Connection Points

6.20 Shield Connection

6.20.1 Shield Connection Motor Cable



* Does not exist at 3-axis devices

Fig.6-27: Shielding Plates for Motor Cables

The shields of the motor cables are connected with screw terminals (tightening torque: 1 Nm) to the individual shielding plates at the housing of the device.

6.20.2 Shield Connection Control Lines

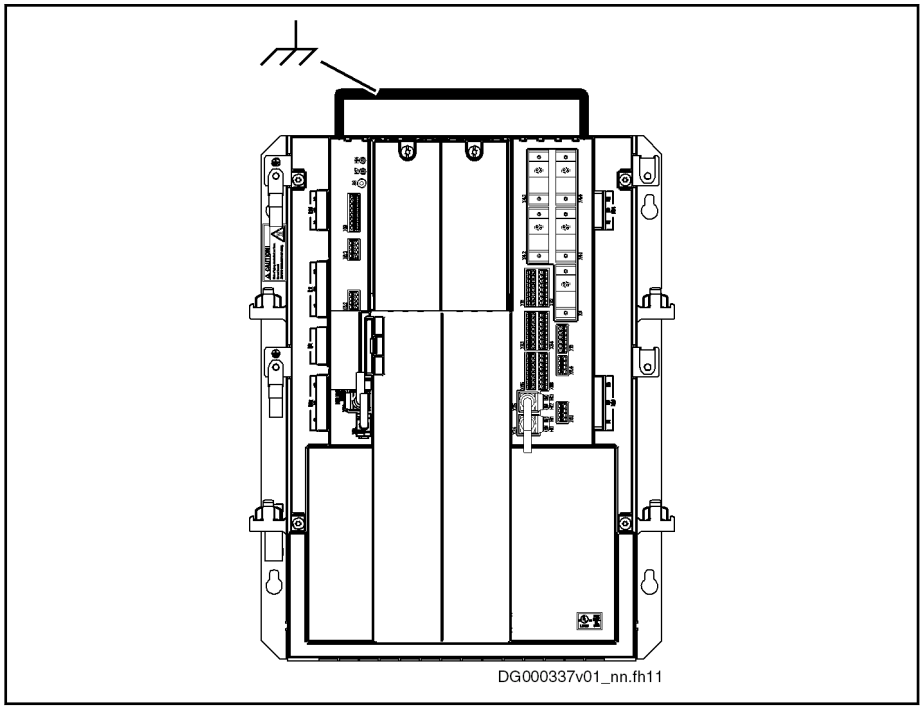


Fig.6-28: Shield Connection Control Lines

The shields of the control lines are connected via the shielding plate at the top of the housing.

For encoder cables, the shields are connected via the D-Sub connector. The shield of the encoder cable mustn't be connected a second time at the shield connection for the control lines.

7 Optional Modules

7.1 OM1 and OM2

Optional extensions are possible at the slots OM1 and OM2.

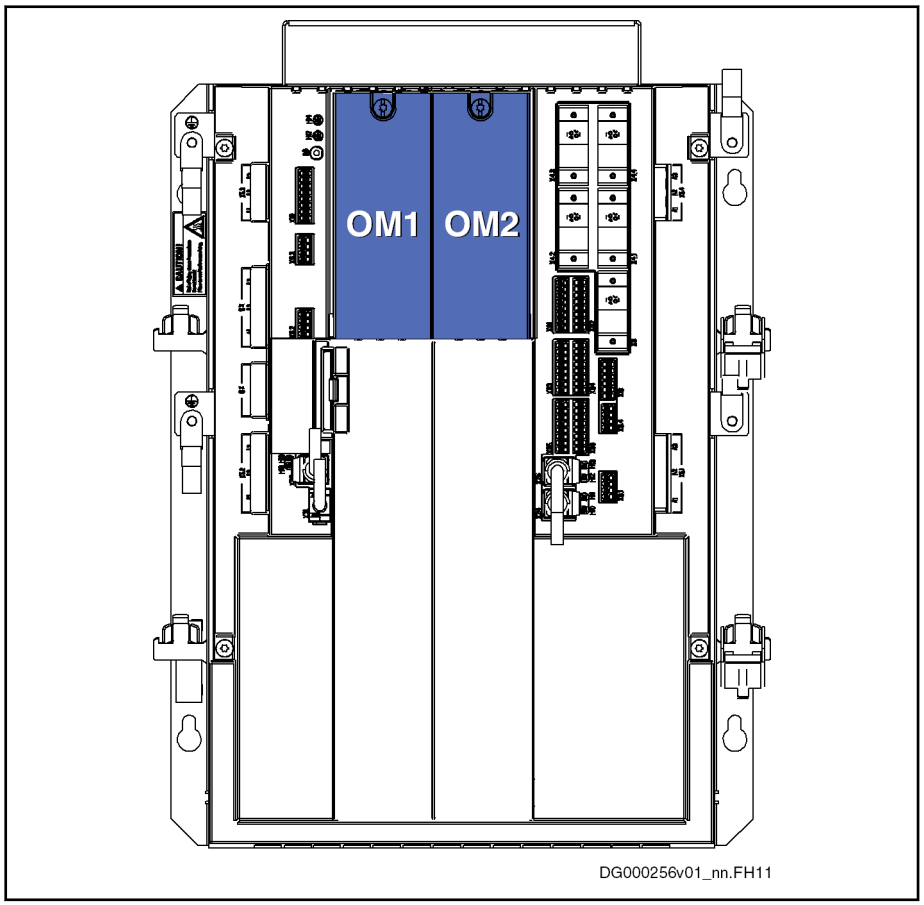


Fig.7-1: Positions of OM1, OM2

Optional extension	OM1	OM2
Digital I/O Extension	■	■

Fig.7-2: Optional Extensions

Optional Modules

7.2 Digital I/O Extension

7.2.1 Interfaces

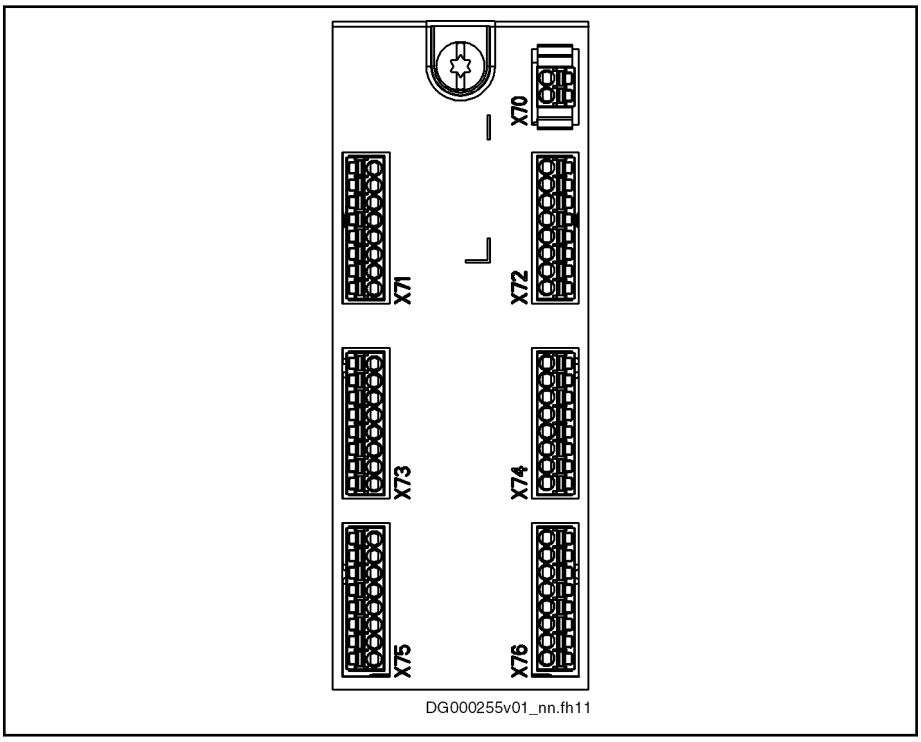


Fig.7-3: Interfaces

Interface	Significance
X70	External 24V supply
X71	2 × 8 digital outputs
X72	
X73	4 × 8 digital inputs
X74	
X75	
X76	

Fig.7-4: Interfaces

7.2.2 X70, External 24V Supply

Description

Connection point	Type	Number of poles	Solid wire [mm²]	Stranded wire [mm²]	AWG	Figure
X70	Spring terminal Female (connector)	2	0,2–1,5	0,2–1,5	24–16	2 1 DG000258.FH11

Fig.7-5: Connections

Pin Assignment

Function	Signal	Connection	Technical data
Power supply	+24V	1	19.2 … 30 V Max. 4 A 2 × 58 W at 25.2 V; load-dependent
Reference potential	0V	2	0 V

Fig.7-6: Signal Assignment

7.2.3 X71 … X72, Digital Outputs

Description

This option provides 2 × 8 digital outputs.

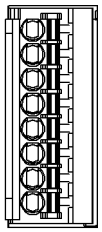
Connection point	Type	Number of poles	Solid wire [mm²]	Stranded wire [mm²]	AWG	Figure
X71 X72	Spring terminal Female (connector)	8	0,2–1,5	0,2–1,5	24–16	 DG000257.FH11

Fig.7-7: Connections

Pin Assignment

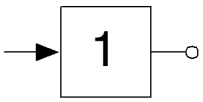
Function	Connection	Technical data
Digital outputs  DX000038v01_nn.fh11	1	The digital outputs correspond to "IEC 61131, type 1". See chapter "Technical Data - Functions" Reference potential 0 V at X70.2
	2	
	3	
	4	
	5	
	6	
	7	
	8	

Fig.7-8: Pin Assignment

Signal Assignment

Connection	Optional module	
	OM1	OM2
X71.1	O25	O41
X71.2	O26	O42
X71.3	O27	O43
X71.4	O28	O44
X71.5	O29	O45

Optional Modules

Connection	Optional module	
	OM1	OM2
X71.6	O30	O46
X71.7	O31	O47
X71.8	O32	O48
X72.1	O17	O33
X72.2	O18	O34
X72.3	O19	O35
X72.4	O20	O36
X72.5	O21	O37
X72.6	O22	O38
X72.7	O23	O39
X72.8	O24	O40

Fig.7-9: Signal Assignment

7.2.4 X73 … X76, Digital Inputs

Description

This option provides 4 × 8 digital inputs.

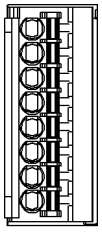
Connection point	Type	Number of poles	Solid wire [mm²]	Stranded wire [mm²]	AWG	Figure
X73 X74 X75 X76	Spring terminal Female (connector)	8	0,2–1,5	0,2–1,5	24–16	 DG000257.FH11

Fig.7-10: Connections

Pin Assignment

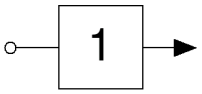
Function	Connection	Technical data
Digital inputs  DX000037v01_nn.fh11	1	The digital inputs correspond to "IEC 61131, type 1". See chapter "Technical Data - Functions" Reference potential 0 V at X70.2
	2	
	3	
	4	
	5	
	6	
	7	
	8	

Fig.7-11: Pin Assignment

Signal Assignment

Connection	Optional module	
	OM1	OM2
X73.1	I57	I89
X73.2	I58	I90
X73.3	I59	I91
X73.4	I60	I92
X73.5	I61	I93
X73.6	I62	I94
X73.7	I63	I95
X73.8	I64	I96
X74.1	I49	I81
X74.2	I50	I82
X74.3	I51	I83
X74.4	I52	I84
X74.5	I53	I85
X74.6	I54	I86
X74.7	I55	I87
X74.8	I56	I88
X75.1	I41	I73
X75.2	I42	I74
X75.3	I43	I75
X75.4	I44	I76
X75.5	I45	I77
X75.6	I46	I78
X75.7	I47	I79
X75.8	I48	I80
X76.1	I33	I65
X76.2	I34	I66
X76.3	I35	I67
X76.4	I36	I68
X76.5	I37	I69
X76.6	I38	I70

Optional Modules

Connection	Optional module	
	OM1	OM2
X76.7	I39	I71
X76.8	I40	I72

Fig.7-12: Signal Assignment

8 Notes on Project Planning

8.1 Mains Connection

Converter	Mains choke	Mains filter	Explanation	EMC limit value class to be achieved[2]: Max. leakage capacitance C_{ab_g}
HCQ02.1E-W0025	Without	NFD03.1-480-055	Operation with reduced performance data up to 80 m of motor cable length [1]	C2: 82 nF
		Without		None
	HNL01.1E-0400-N0051-A-480	NFD03.1-480-055	Standard combination; up to 80 m of motor cable length [1]	C2: 82 nF
		Without		None
	HNL01.1E-0400-N0051-A-480	HNF01.1A-F240-E0051-A-480-NNNN	up to 160 m of motor cable length [1]	C3: 150 nF
		Without		None
HCT02.1E-W0025	Without	NFD03.1-480-055	Operation with reduced performance data up to 80 m of motor cable length [1]	C2: 82 nF
		Without		None
	HNL01.1E-0400-N0051-A-480	NFD03.1-480-055	Standard combination; up to 80 m of motor cable length [1]	C2: 82 nF
		Without		None
	HNL01.1E-0400-N0051-A-480	HNF01.1A-F240-E0051-A-480-NNNN	up to 160 m of motor cable length [1]	C3: 150 nF
		Without		None

[1] Motor cable length: Sum of individual motor cable lengths (example for HCQ: 80 m = 4 × 20 m)

[2] In grounded mains

Fig.8-1: Selecting the Mains Connection

Operation without Mains Choke

For operation without mains choke

- there is less DC bus power P_{DC_cont} available
- the power factor is lower than for operation with mains choke

HCQ02: For standard machine tools, operation without mains choke is possible up to 7.5 kW of spindle power (X5.1) and 12 / 12 / 17 Nm at the feed axes (X5.2 / X5.3 / X5.4).

HCT02: For standard machine tools, operation without mains choke is possible up to 7.5 kW of spindle power (X5.1) and 12 / 12 Nm at the feed axes (X5.3 / X5.4).

8.2 24V Supply

HCQ02, HCT02 need an external 24V supply at

- X18 for
  - Basic device with digital outputs (X81, X82)
  - Encoder X4.n
  - Motor holding brakes

  See index entry "X18 → 24V supply".

- **X70** for the optional modules (OM1, OM2)

  See index entry "X70 → External 24V supply".

When dimensioning the power supply unit, take all power consumptions at X18 and X70 into account.

Observe the reduced tolerance of the 24V voltage when operating motor holding brakes. To supply the motor holding brakes, use separate power supply units, if necessary, or such power supply units with adjustable output voltage.

Notes on Installation

- **Fusing** (recommended fusing for operation under rated conditions)
  - X18.1: 8 A
  - X18.2: 2 A
  - X18.3: 4.5 A
- **Requirements on the connection to the 24V supply**
  - Maximum cable length: 10 m
  - Twist wires
  - Observe specified minimum cross section
  - Maximum allowed inductance: 100 µH (2 twisted single strands, 25 m long)
- **Control voltage (0 V)**

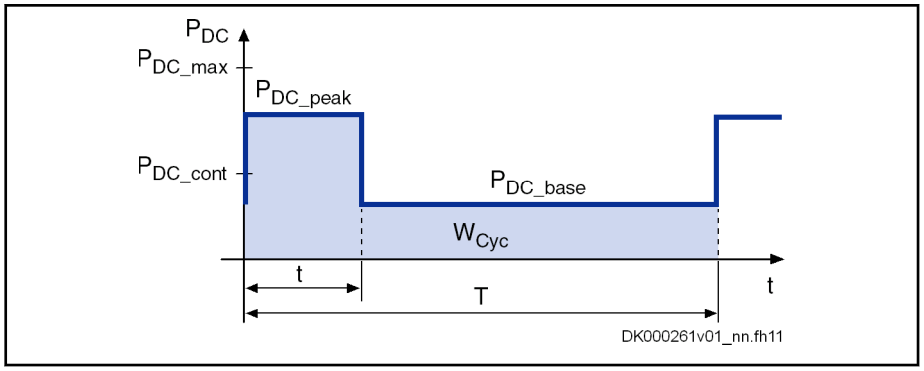
  Ground the control voltage (0 V) as near as possible to the drive controller so that the lowest possible impedance to the ground connection of the drive controller is ensured.

8.3 DC Bus Load

8.3.1 General Information

The DC bus is loaded by the outputs of the inverter. With the given data, allowed performance profiles have to be determined for a cycle. The sum of output loads mustn't exceed the given limit values. Balancing processes by simultaneous infeeding and regenerative processes of the individual axes are taken into account in the data.

8.3.2 Calculation of Performance Profile



P_{DC_cont}	Rated DC bus power (see Technical Data - DC Bus)
P_{DC_max}, P_{DC_cont}	Maximum allowed DC bus power (see Technical Data - DC Bus)
P_{DC_base}	Base load
P_{DC_peak}	Peak load
t	Duration of peak load
T	Cycle time
W_{Cyc}	Energy cyclically drawn from DC bus

Fig.8-2: Performance Profile in DC Bus

1. Make an overall profile which shows the added individual profiles.

   The peak load P_{DC_peak} in the overall profile may at no time exceed the given data P_{DC_max}.

   $$P_{DC\_peak} \leq P_{DC\_max}$$

2. From the profile data of the individual axes, determine the energy cyclically drawn from the DC bus

   $$W_{Cyc} = P_{DC\_peak} \times t + P_{DC\_base} \times (T - t)$$

3. Add the determined values W_{Cyc} and compare the result with the allowed value W_{Cyc_max}

   $$\sum_{n=1}^{axis} W_{Cyc} \leq W_{Cyc\_max}$$

☞ The determined energy sum W_{Cyc_max} mustn't be exceeded for individual processes either.

4. Determine the DC bus continuous power P_{ZWD}, it mustn't exceed P_{DC_cont}.

   $$P_{ZWD} = \frac{\sum_{n=1}^{axis} W_{Cyc}}{T} \leq P_{DC\_cont}$$

Notes on Project Planning

8.4 External Braking Resistor

Braking Resistor, Data

Description	Value
Allowed braking resistance	10 … 17 Ω
Allowed peak regenerative power	< 69 kW
Allowed regenerative power of braking resistor	< 100 kWs
Allowed continuous power load of connection point X9	< 5 kW
Allowed cable length	5 m

Fig.8-3: External Braking Resistor

Notes on Installation

See description of connection point X9.

9 Scope of Supply

Scope of supply:

- 1 × connector each for
  - X6.1…6.4
  - X18
  - X19
  - X81…86
- HAS09.1-002 (accessories for mounting and installation)
- 1 × documentation (in the English language)
- CompactFlash memory card CFM01.1-xxxx-N-LBA-NN-FW (to be ordered separately; there are different memory cards, depending on the firmware used)

10 Identifying and Checking the Delivered Components

10.1 Type Plate

10.1.1 Arrangement

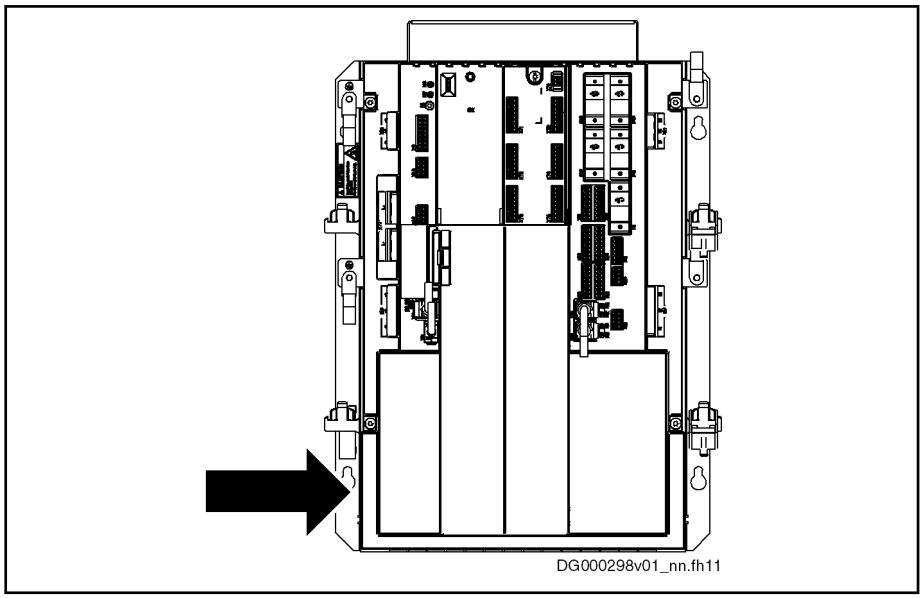
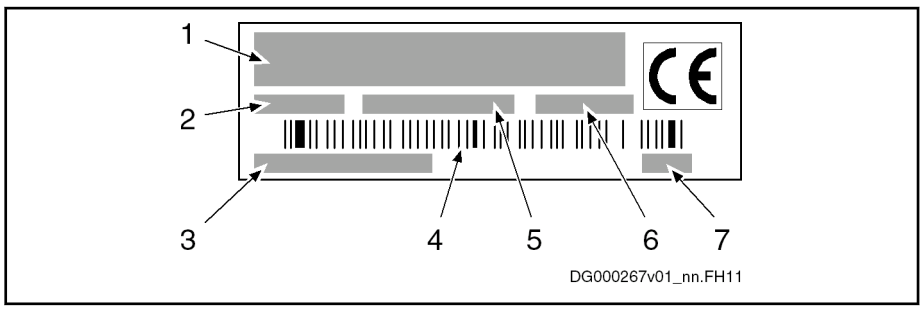


Fig.10-1: Type Plate Arrangement

10.1.2 Design

Type Plate (Power Sections, Supply Units)



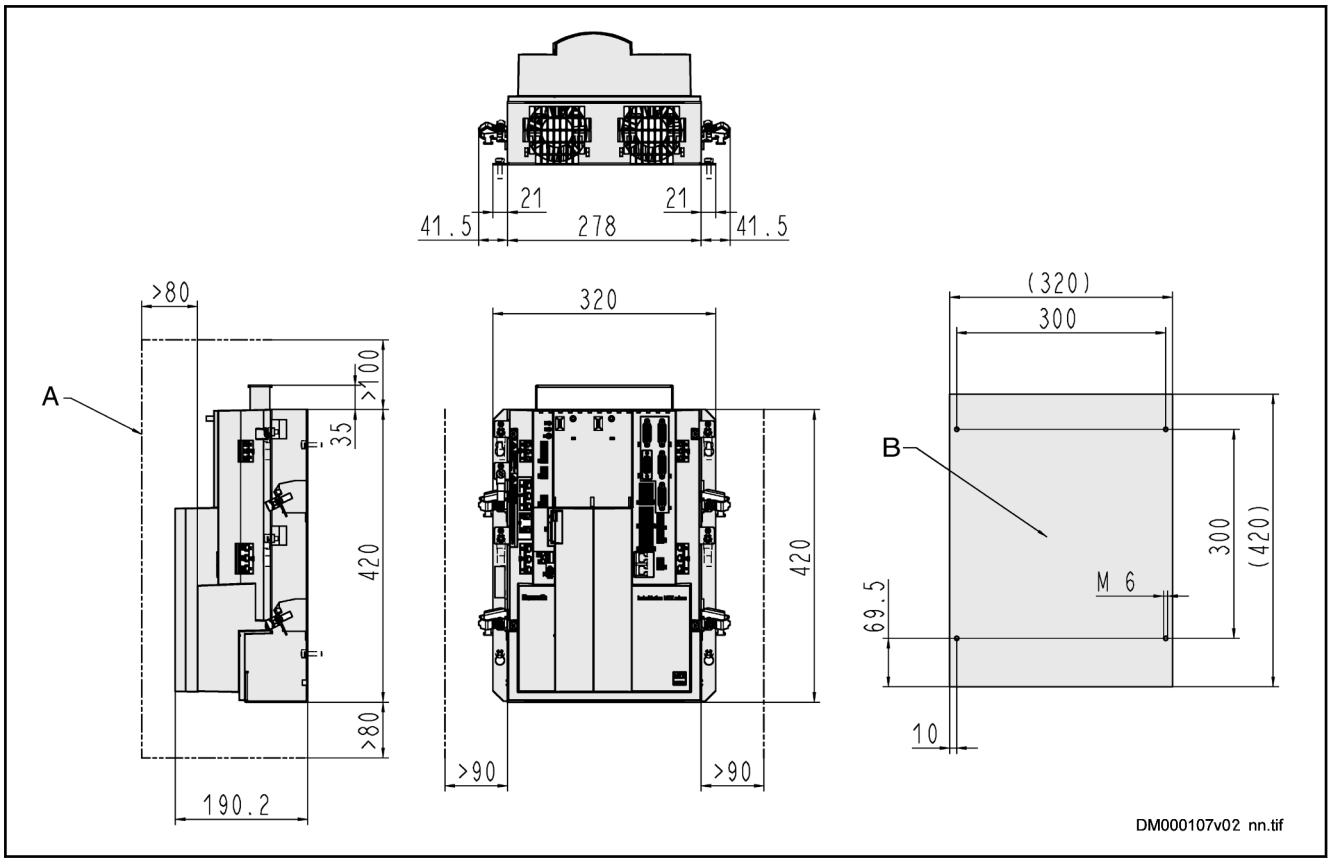
1	Device type
2	Part number
3	Serial number
4	Bar code
5	Country of manufacture
6	Production week; e.g. 08W23 meaning year 2008, week 23
7	Hardware index

Fig.10-2: Type Plate (Power Sections, Supply Units)

11 Mounting and Installation

11.1 Mounting

11.1.1 Dimensional Drawing



A Minimum mounting clearance
B Boring dimensions
Fig.11-1: Dimensional Drawing HCQ02.1E-W0025-A-03 and HCT02.1E-W0025-A-03

11.1.2 Distances

The specified **horizontal minimum distance** at the device refers to the distance to the control cabinet wall and not to the distance to neighboring devices. It is not necessary to comply with a minimum distance to neighboring devices.

NOTICE **Property damage due to temperatures higher than 105 °C!**

Observe the indicated minimum distances!

Above the devices there may only be such materials which

- are not combustible
- are insensitive to the occurring high temperatures

Mounting and Installation

11.2 Connection Diagram

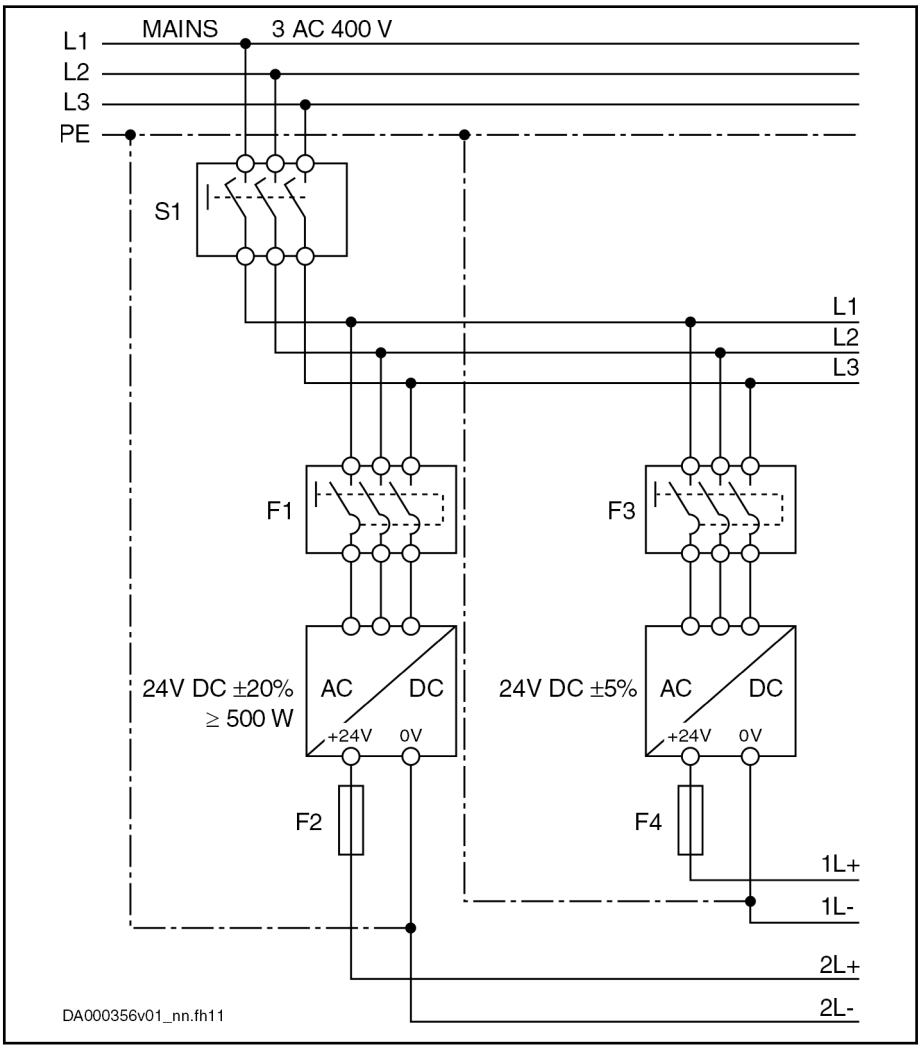
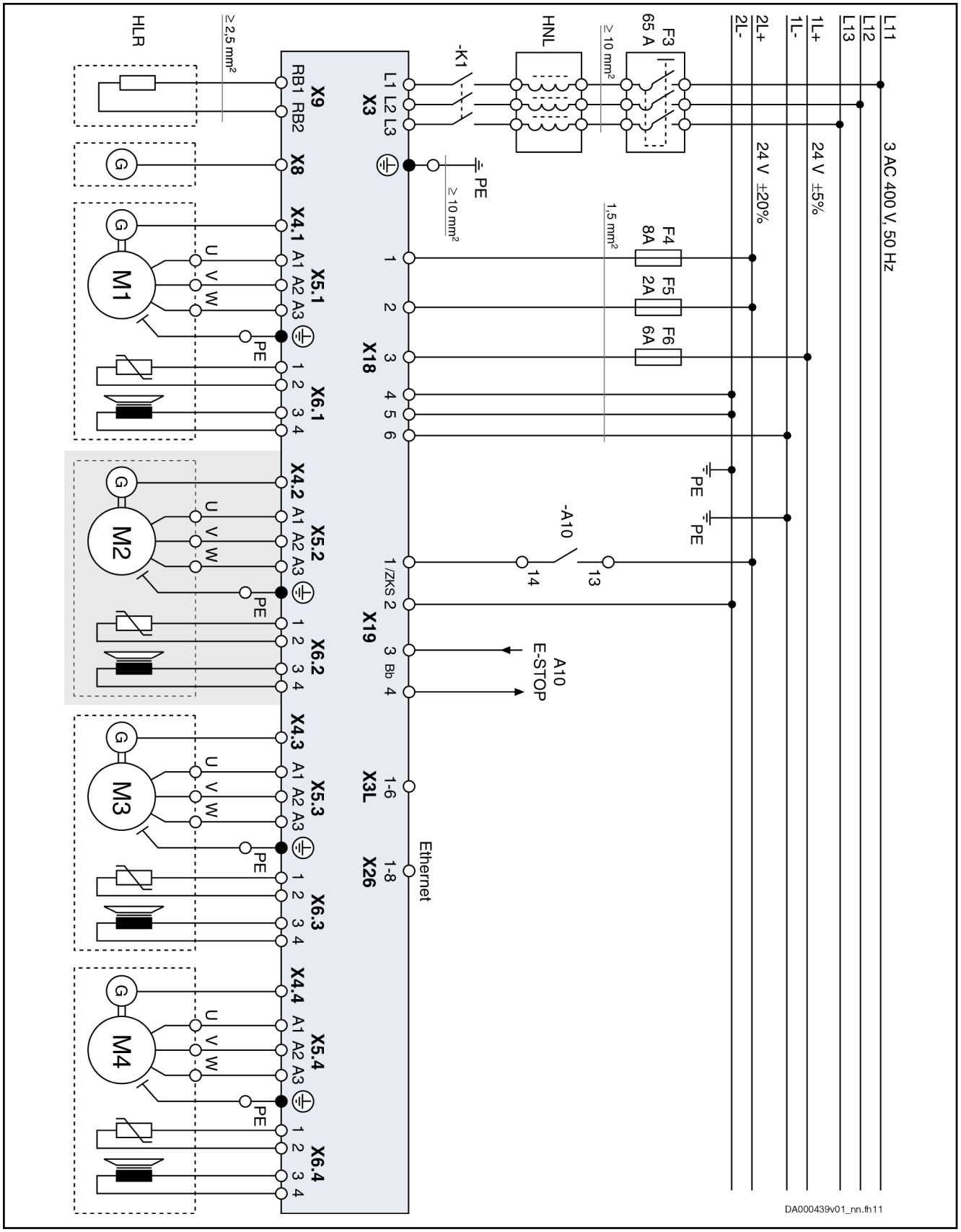


Fig.11-2: Mains Connection, Control Voltage Supply


L11
L12
L13
3 AC 400 V, 50 Hz
1L+
1L-
24 V ±5%
2L+
2L-
24 V ±20%
F3
65 A
HNL
≥ 10 mm²
-K1
L1 L2 L3
X3
PE
≥ 10 mm²
1,5 mm²
F4
8A
F5
2A
F6
6A
1
2
3
X18
4 5 6
PE
PE
-A10
14
13
1 /ZKS 2
X19
3 Bb 4
A10
E-STOP
1-6
X3L
1-8
X26
Ethernet
HLR
≥ 2,5 mm²
X9
RB1 RB2
X8
X4.1
A1 A2 A3
X5.1
1 2 3 4
X6.1
X4.2
X5.2
X6.2
X4.3
X5.3
X6.3
X4.4
X5.4
X6.4
G
M1
M2
M3
M4
U V W
PE
DA000439v01_nn.fh11

Mounting and Installation

The drive marked with gray background color does not exist at HCT02

Fig.11-3: Connections Mains, Motors, Encoders, Control Voltage, Braking Resistor

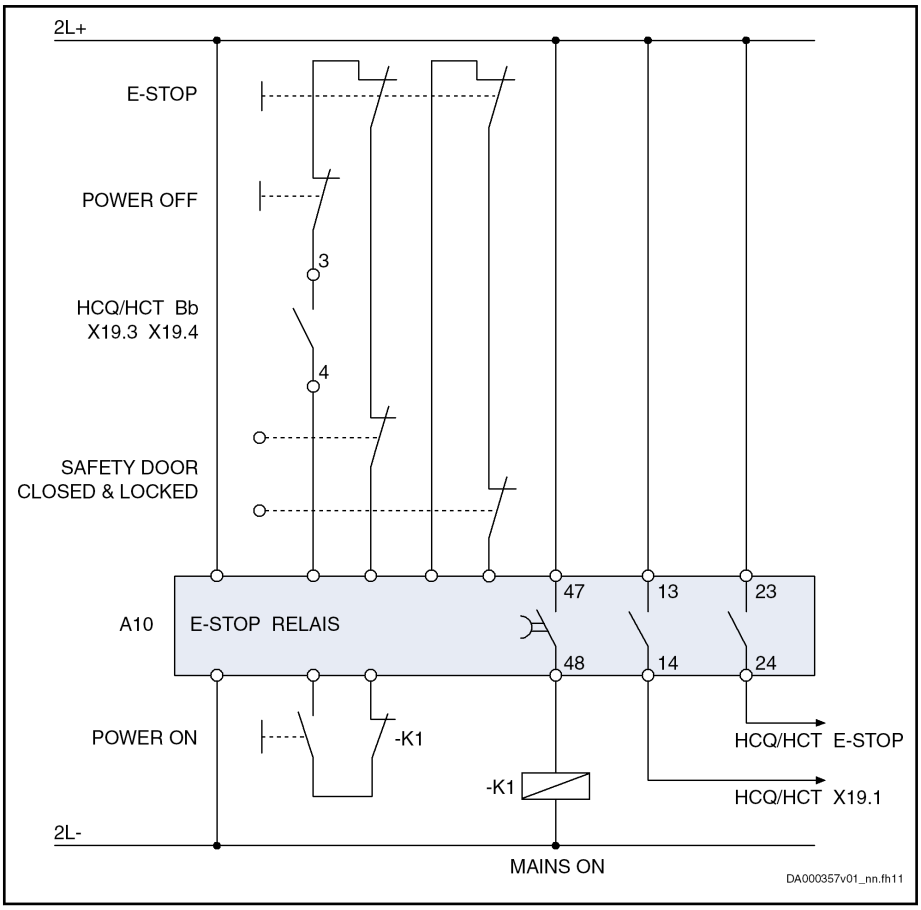
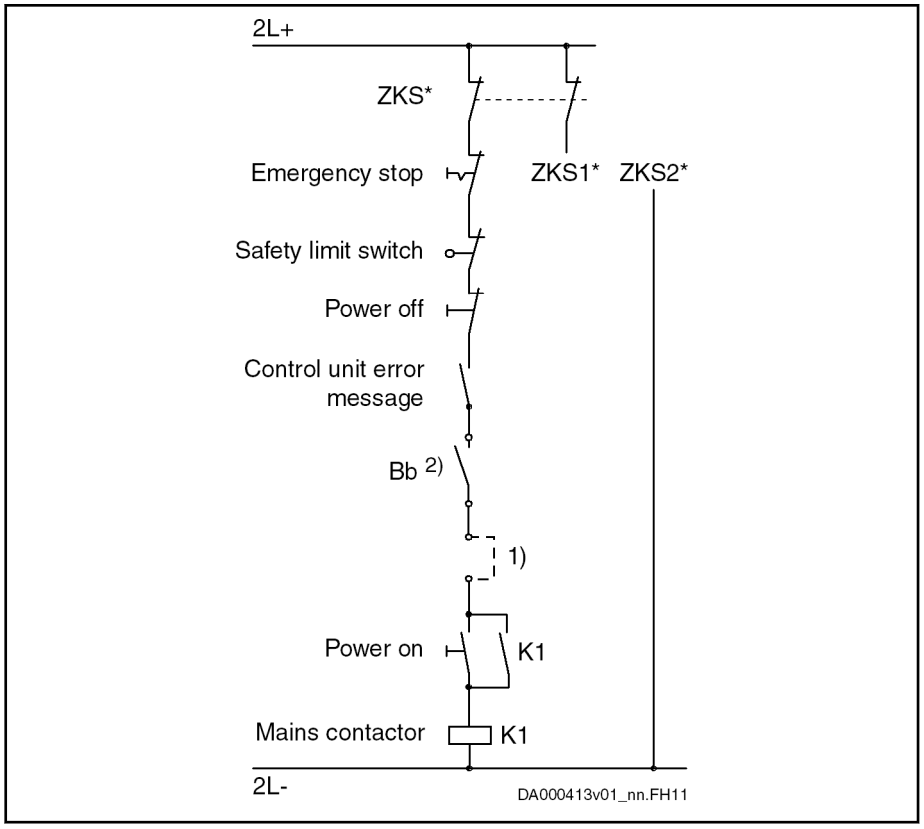


Fig.11-4: Connections Mains Contactor Control and E-Stop



* Optional DC bus short circuit
1) Integrate the Bb contacts of other devices
2) Take switching capacity of Bb contact into account
Fig. 11-5: Connections Mains Contactor Control without E-Stop

11.3 EMC Measures for Design and Installation

11.3.1 Rules for Design of Installations With Drive Controllers in Compliance With EMC

The following rules are the basics for designing and installing drives in compliance with EMC.

Mains filter Correctly use a mains filter recommended by Rexroth for radio interference suppression in the supply feeder of the drive system.

Control Cabinet Grounding Connect all metal parts of the cabinet with one another over the largest possible surface area to establish a good electrical connection. This, too, applies to the mounting of the mains filter. If required, use serrated washers which cut through the paint surface. Connect the cabinet door to the control cabinet using the shortest possible grounding straps.

Line Routing Avoid coupling routes between lines with high potential of noise and noise-free lines; therefore, signal, mains and motor lines and power cables have to be routed separately from another. Minimum distance: 10 cm. Provide separating sheets between power and signal lines. Ground separating sheets several times.

The lines with high potential of noise include:

- Lines at the mains connection
- Lines at the motor connection
- Lines at the DC bus connection

Generally, interference injections are reduced by routing cables close to grounded sheet steel plates. For this reason, cables and wires should not be routed freely in the cabinet, but close to the cabinet housing or mounting panels. Separate the incoming and outgoing cables of the radio interference suppression filter.

Interference Suppression Elements

Provide the following components in the control cabinet with interference suppression combinations:

- Contactors
- Relays
- Solenoid valves
- Electromechanical operating hours counters

Connect these combinations directly at each coil.

Twisted Wires

Twist unshielded wires belonging to the same circuit (feeder and return cable) or keep the surface between feeder and return cable as small as possible. Wires that are not used have to be grounded at both ends.

Lines of Measuring Systems

Lines of measuring systems must be shielded. Connect the shield to ground at both ends and over the largest possible surface area. The shield may not be interrupted, e.g. using intermediate terminals.

Digital Signal Lines

Ground the shields of digital signal lines at both ends (transmitter **and** receiver) over the largest possible surface area and with low impedance. In the case of bad ground connection between transmitter and receiver, additionally route a bonding conductor (min. 10 mm^2). Braided shields are better than foil shields.

Analog Signal Lines

Ground the shields of analog signal lines at one end (transmitter **or** receiver) over the largest possible surface area and with low impedance. This avoids low-frequency interference current (in the mains frequency range) on the shield.

Connecting the Mains Choke

Keep connection lines of the mains choke at the drive controller as short as possible and twist them.

Installing the Motor Power Cable

- Use shielded motor power cables or run motor power cables in a shielded duct
- Use the shortest possible motor power cables
- Ground shield of motor power cable at both ends over the largest possible surface area to establish a good electrical connection
- Run motor lines in shielded form inside the control cabinet
- Do not use any steel-shielded lines
- The shield of the motor power cable mustn't be interrupted by mounted components, such as output chokes, sine filters or motor filters

11.3.2 EMC-Optimal Installation in Facility and Control Cabinet

General Information

For EMC-optimal installation, a spatial separation of the interference-free area (mains connection) and the interference-susceptible area (drive components) is recommended, as shown in the figures below.

☞ Recommendation: For EMC-optimal installation in the control cabinet, use a separate control cabinet panel for the drive components.

Division Into Areas (Zones)

Exemplary arrangements in the control cabinet: See section Control Cabinet Design According to Interference Areas - Exemplary Arrangements, page 106.

We distinguish three areas:

1. Interference-free area of control cabinet **(area A)**:

   This includes:

   - Supply feeder, input terminals, fuse, main switch, mains side of mains filter for drives and corresponding connecting lines
   - Control voltage or auxiliary voltage connection with power supply unit, fuse and other parts unless connection is run via the mains filter of the AC drives
   - All components that are not electrically connected with the drive system

2. Interference-susceptible area **(area B)**:

   - Mains connections between drive system and mains filter for drives, mains contactor
   - Interface lines of drive controller

3. Strongly interference-susceptible area **(area C)**:

   - Motor power cables including single cores

Never run lines of one of these areas in parallel with lines of another area so that there isn't any unwanted interference injection from one area to the other and that the filter is jumpered with regard to high frequency. Use the shortest possible connecting lines.

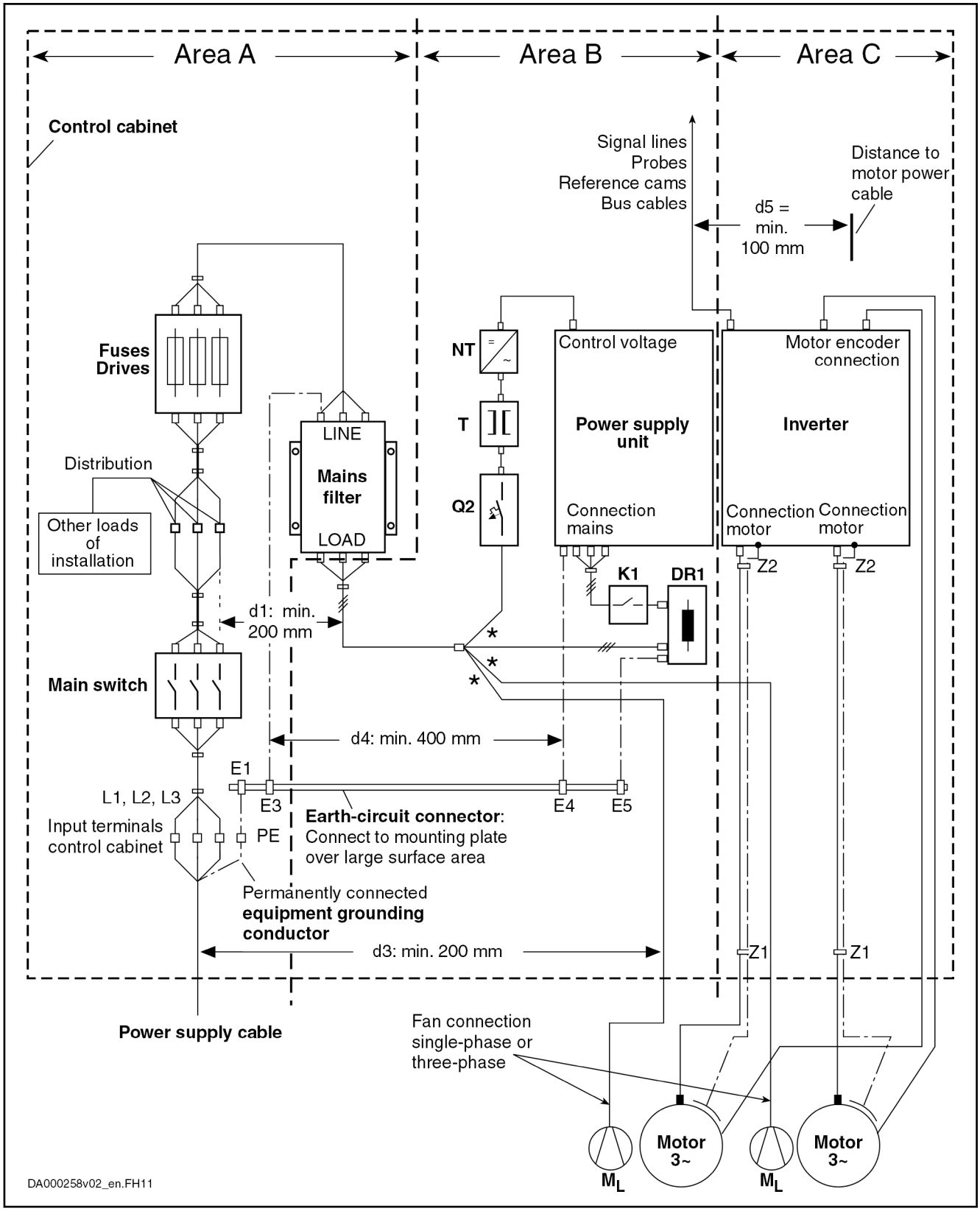
Recommendation for complex systems: Install drive components in one cabinet and the control units in a second, separate cabinet.

Badly grounded control cabinet doors act as antennas. Therefore, connect the control cabinet doors to the cabinet on top, in the middle and on the bottom via short equipment grounding conductors with a cross section of at least 6 mm^2 or, even better, via grounding straps with the same cross section. Make sure connection points have good contact.

Mounting and Installation

Control Cabinet Design According to Interference Areas - Exemplary Arrangements

Infeeding Supply Unit or Converter



DR1	Mains choke (optional)
E1…E5	Equipment grounding conductor of the components
K1	External mains contactor for supply units and converters without integrated mains contactor
M_L	Motor fan
NT	Power supply unit
Q2	Fusing
T	Transformer
Z1, Z2	Shield connection points for cables
*	Not allowed at HNF mains filter

Fig.11-6: Infeeding Supply Unit or Converter – EMC Areas in the Control Cabinet

Design and Installation in Area A - Interference-Free Area of Control Cabinet

Arranging the Components in the Control Cabinet

Comply with recommended distance of at least **200 mm** (distance d1 in the figure):

- Between components and electrical elements (switches, pushbuttons, fuses, terminal connectors) in the interference-free area A and the components in the two other areas B and C

Comply with recommended distance of at least **400 mm** (distance d4 in the figure):

- Between magnetic components (such as transformers, mains chokes and DC bus chokes that are directly connected to the power connections of the drive system) and the interference-free components and lines between mains and filter including the mains filter in area A

If these distances are not kept, the magnetic leakage fields are injected to the interference-free components and lines connected to the mains and the limit values at the mains connection are exceeded in spite of the installed filter.

Cable Routing of the Interference-Free Lines to the Mains Connection

Comply with recommended distance of at least **200 mm** (distance d1 and d3 in the figure):

- Between supply feeder or lines between filter and exit point from the control cabinet in area A and the lines in area B and C

If this is impossible, there are two alternatives:

1. Install lines in shielded form and connect the shield at several points (at least at the beginning and at the end of the line) to the mounting plate or the control cabinet housing over a large surface area.
2. Separate lines from the other interference-susceptible lines in areas B and C by means of a grounded distance plate vertically attached to the mounting plate.

Install the shortest possible lines within the control cabinet and install them directly on the grounded metal surface of the mounting plate or of the control cabinet housing.

Mains supply lines from areas B and C must not be connected to the mains without a filter.

☞ In case you do not observe the information on cable routing given in this section, the effect of the mains filter is totally or partly neutralized. This will cause the noise level of the interference emission to be higher within the range of 150 kHz to 40 MHz and the limit values at the connection points of the machine or installation will thereby be exceeded. Consider the specified distances to be recommended data, provided that the dimensions of the control cabinet allow installing the lines accordingly.

Routing and Connecting a Neutral Conductor (N)

If a neutral conductor is used together with a three-phase connection, it must not be installed unfiltered in zones B and C, in order to keep interference off the mains.

Motor Fan at Mains Filter

Single-phase or three-phase supply lines of motor fans, that are usually routed in parallel with motor power cables or interference-susceptible lines, must be filtered:

- In drive systems with **regenerative supply units**, via a separate single-phase (NFE type) or three-phase filter (HNF type) near the mains connection of the control cabinet
- In drive systems with **only infeeding supply units**, via the available three-phase filter of the drive system

When switching power off, make sure the fan is not switched off.

Loads at Mains Filter of Drive System

☞ **Only operate allowed loads at the mains filter of the drive system!**

At the three-phase filter for the power connection of regenerative supply units, it is only allowed to operate the following loads:

- HMV supply unit with mains choke and, if necessary, mains contactor

Do not operate any motor fans, power supply units etc. at the mains filter of the drive system.

Shielding Mains Supply Lines in Control Cabinet

If there is a high degree of interference injection to the mains supply line within the control cabinet, although you have observed the above instructions (to be found out by EMC measurement according to standard), proceed as follows:

- Only use shielded lines in area A
- Connect shields to the mounting plate at the beginning and the end of the line by means of clips

The same procedure may be required for long cables of more than 2 m between the point of power supply connection of the control cabinet and the filter within the control cabinet.

Mains Filters for AC Drives

Ideally mount the mains filter on the parting line between the areas A and B. Make sure the ground connection between filter housing and housing of the drive controllers has good electrically conductive properties.

If **single-phase** loads are connected on the load side of the filter, their current may be a maximum of 10% of the three-phase operating current. A highly imbalanced load of the filter would deteriorate its interference suppression capacity.

If the mains voltage is more than 480 V, connect the filter to the output side of the transformer and not to the supply side of the transformer.

Grounding

In the case of bad ground connections in the installation, the distance between the lines to the grounding points E1, E2 in area A and the other grounding points of the drive system should be at least d4 = 400 mm, in order to minimize interference injection from ground and ground cables to the power input lines.

See also Division Into Areas (Zones), page 105.

Point of Connection for Equipment Grounding Conductor at Machine, Installation, Control Cabinet

The equipment grounding conductor of the power cable of the machine, installation or control cabinet has to be **permanently connected** at point PE and have a **cross section of at least 10 mm²** or to be complemented by a second equipment grounding conductor via separate terminal connectors (according to EN 61800-5-1:2007, section 4.3.5.5.2). If the cross section of the outer

conductor is bigger, the cross section of the equipment grounding conductor must be accordingly bigger.

Design and Installation in Area B - Interference-Susceptible Area of Control Cabinet

Arranging Components and Lines

Modules, components and lines in area B should be placed at a distance of at least **d1 = 200 mm** from modules and lines in area A.

Alternative: Shield modules, components and lines in area B by distance plates mounted vertically on the mounting plate from modules and lines in area A or use shielded lines.

Only connect power supply units for auxiliary or control voltage connections in the drive system to the mains via a mains filter. See Division Into Areas (Zones), page 105.

Install the shortest possible lines between drive controller and filter.

Control Voltage or Auxiliary Voltage Connection

Only in exceptional cases should you connect power supply unit and fusing for the control voltage connection to phase and neutral conductor. In this case, mount and install these components in area A far away from the areas B and C of the drive system. For details see section Design and Installation in Area A - Interference-Free Area of Control Cabinet, page 107.

Run the connection between control voltage connection of the drive system and power supply unit used through area B over the shortest distance.

Line Routing

Run the lines along grounded metal surfaces, in order to minimize radiation of interference fields to area A (transmitting antenna effect).

Design and Installation in Area C - Strongly Interference-Susceptible Area of Control Cabinet

Area C mainly concerns the motor power cables, especially at the connection point at the drive controller.

Influence of the Motor Power Cable

The longer the motor power cable, the greater its leakage capacitance. To comply with a certain EMC limit value, the allowed leakage capacitance of the mains filter is limited. For the calculation of the leakage capacitance, see the documentation on the drive system of the drive controller used.

- Run the shortest possible motor power cables.
- Only use **shielded** motor power cables by Rexroth.

Routing the Motor Power Cables and Motor Encoder Cables

Route the motor power cables and motor encoder cables along grounded metal surfaces, both inside the control cabinet and outside of it, in order to minimize radiation of interference fields. If possible, route the motor power cables and motor encoder cables in metal-grounded cable ducts.

Route the motor power cables and motor encoder cables

- with a distance of at least **d5 = 100 mm** to interference-free lines, as well as to signal cables and signal lines

  (alternatively separated by a grounded distance plate)
- in separate cable ducts, if possible

Routing the Motor Power Cables and Mains Connection Lines

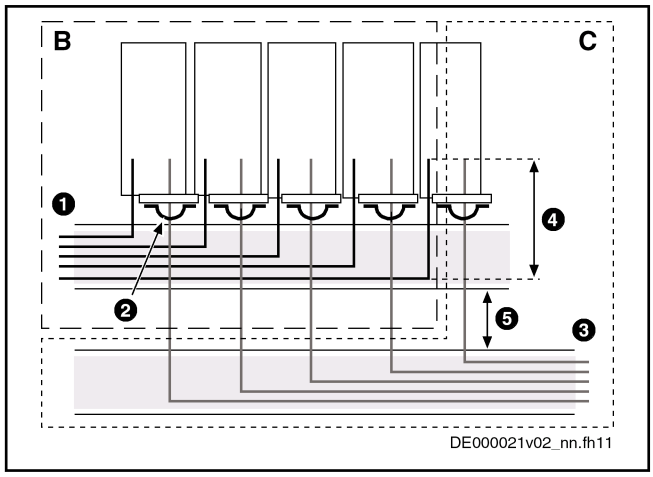
For converters (drive controllers with individual mains connection), route motor power cables and (unfiltered) mains connection lines **in parallel for a maximum distance of 300 mm**. After that distance, route motor power cables and power supply cables in opposite directions and preferably in separate **cable ducts**.

Ideally, the outlet of the motor power cables at the control cabinet should be provided in a distance of at least **d3 = 200 mm** from the (filtered) power supply cable.

Mounting and Installation

Converter - Routing the Motor Power Cables

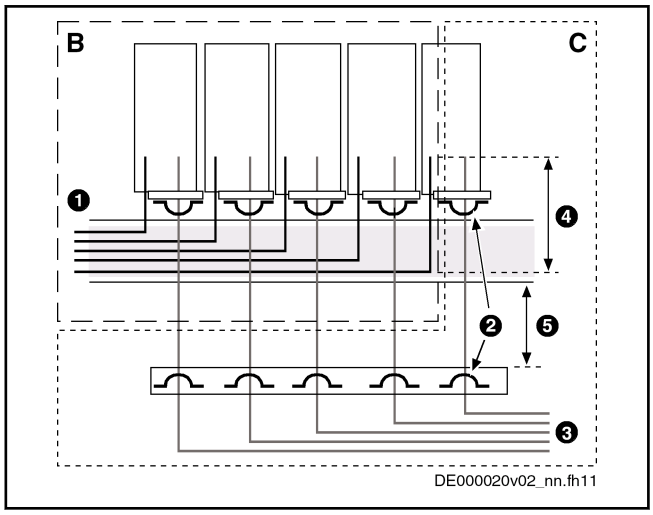
With cable duct



B	Area B
C	Area C
1	Cable duct for mains connection lines
2	Shield connection of motor power cable via clips at least at one point; alternatively, at the device or on mounting plate at control cabinet
3	Cable duct for motor power cables
4	Parallel routing of mains connection lines and motor power cables over a maximum of 300 mm
5	Distance of at least 100 mm or separated by a grounded distance plate

Fig.11-7: Routing of Motor Power Cables With Cable Duct

Without cable duct



B	Area B
C	Area C
1	Cable duct for mains connection lines
2	Shield connection of motor power cable via clips at least at one point; alternatively, at the device or on mounting plate at control cabinet
3	Control cabinet outlet of motor power cables
4	Parallel routing of mains connection lines and motor power cables over a maximum of 300 mm
5	Distance of at least 100 mm or separated by a grounded distance plate

Fig.11-8: Routing of Motor Power Cables Without Cable Duct

Fig.11-9: Routing of Cables for Converter

11.3.3 Ground Connections

Housing and Mounting Plate

By means of appropriate ground connections, it is possible to avoid the emission of interference, because interference is discharged to ground on the shortest possible way.

Ground connections of the metal housings of EMC-critical components (such as filters, devices of the drive system, connection points of the cable shields, devices with microprocessor and switching power supply units) have to be well contacted over a large surface area. This also applies to all screw connections between mounting plate and control cabinet wall and to the mounting of a ground bus to the mounting plate.

The best solution is to use a zinc-coated mounting plate. Compared to a lacquered plate, the connections in this case have a good long-time stability.

Connection Elements

For lacquered mounting plates, always use screw connections with tooth lock washers and zinc-coated, tinned screws as connection elements. At the connection points, remove the lacquer so that there is safe electrical contact over a large surface area. You achieve contact over a large surface area by means of bare connection surfaces or several connection screws. For screw connections, you can establish the contact to lacquered surfaces by using tooth lock washers.

Metal Surfaces

Always use connection elements (screws, nuts, plain washers) with good electroconductive surface.

Bare zinc-coated or tinned metal surfaces have **good electroconductive properties**.

Anodized, yellow chromatized, black gunmetal finish or lacquered metal surfaces have **bad electroconductive properties**.

Ground Wires and Shield Connections

For connecting ground wires and shield connections, it is not the cross section but the size of contact surface that is important, as the high-frequency interference currents mainly flow on the surface of the conductor.

Always connect cable shields, especially shields of the motor power cables, to ground potential over a large surface area.

11.3.4 Installing Signal Lines and Signal Cables

Line Routing

For measures to prevent interference, see the Project Planning Manuals of the respective device. In addition, we recommend the following measures:

- Route signal and control lines separately from the power cables with a minimum distance of **d5 = 100 mm** (see Division Into Areas (Zones), page 105) or with a grounded separating sheet. The optimum way is to route them in separate cable ducts. If possible, lead signal lines into the control cabinet at one point only.
- If signal lines are crossing power cables, route them in an angle of 90° in order to avoid interference injection.
- Ground spare cables, that are not used and have been connected, at least at both ends so that they do not have any antenna effect.
- Avoid unnecessary line lengths.
- Run cables as close as possible to grounded metal surfaces (reference potential). The ideal solution are closed, grounded cable ducts or metal pipes which, however, is only obligatory for high requirements (sensitive instrument leads).
- Avoid suspended lines or lines routed along synthetic carriers, because they are functioning like reception antennas (noise immunity) and like transmitting antennas (emission of interference). Exceptional cases are flexible cable tracks over short distances of a maximum of 5 m.

Shielding

Connect the cable shield immediately at the devices in the shortest and most direct possible way and over the largest possible surface area.

Connect the shield of **analog signal lines** at one end over a large surface area, normally in the control cabinet at the analog device. Make sure the connection to ground/housing is short and over a large surface area.

Connect the shield of **digital signal lines** at both ends over a large surface area and in short form. In the case of potential differences between beginning and end of the line, run an additional bonding conductor in parallel. This prevents compensating current from flowing via the shield. The guide value for the cross section is 10 mm^2.

You absolutely have to equip separable connections with connectors with grounded metal housing.

In the case of non-shielded lines belonging to the same circuit, twist feeder and return cable.

11.3.5 General Measures of Radio Interference Suppression for Relays, Contactors, Switches, Chokes and Inductive Loads

If, in conjunction with electronic devices and components, inductive loads, such as chokes, contactors, relays are switched by contacts or semiconductors, appropriate interference suppression has to be provided for them:

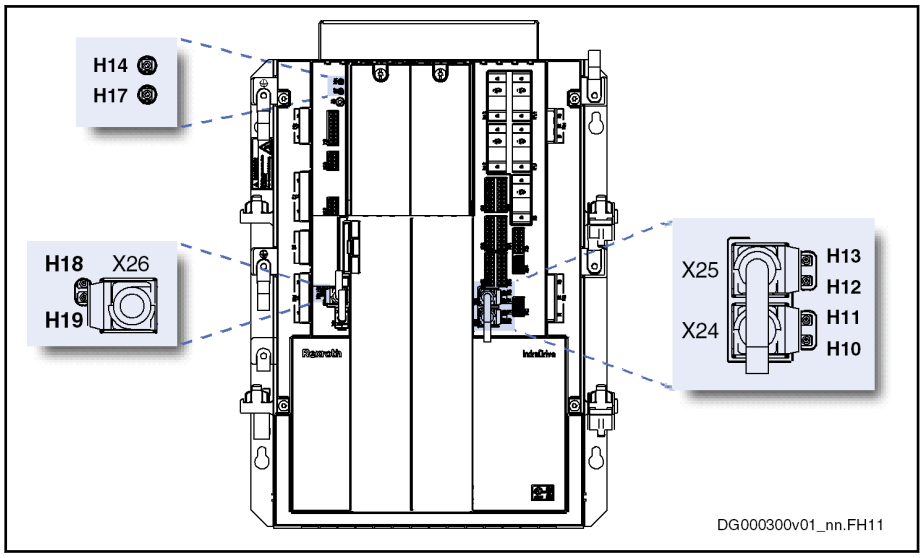
- By arranging free-wheeling diodes in the case of d.c. operation
- In the case of a.c. operation, by arranging usual RC interference suppression elements depending on the contactor type, immediately at the inductance

Only the interference suppression element arranged immediately at the inductance does serve this purpose. Otherwise, the emitted noise level is too high which can affect the function of the electronic system and of the drive.

12 Commissioning, Operation, Diagnostics

12.1 Operation and Diagnostics

12.1.1 Diagnostic LED Displays



H10…13 Ethernet status (X24, X25)
H14 Drive status
H17 Control unit status
H18, H19 Ethernet status (X26)
Fig. 12-1: Diagnostic Displays – LEDs

12.1.2 Diagnostic LED Displays with Drive Firmware MPM-16VRS

Via the operator panel, you can find out which drive firmware has been installed on your system:

Operating area "Maintain" ▸ F-key "F6 About"

H10 … 13; H18 … 19 Color / flashing pattern		Significance (Ethernet status)	Measures
☀	Green GN GN GN GN	Connection to network available	
☀	Yellow YE YE YE YE	Data transmission running	

Fig. 12-2: LED Displays H10, H11, H12, H13, H18, H19

H14 Color / flashing pattern		Significance (drive status)	Measures
○	Off -- -- -- --	Supply unit not switched on	Check 24V supply and switch it on, if not yet done
		Cable interrupted	Check cable and connector X18
		Hardware defective	Replace hardware

Commissioning, Operation, Diagnostics

H14 Color / flashing pattern		Significance (drive status)	Measures
	Flashing green GN GN -- --	Baud rate scan (P-1) Drive is error-free (phases 0, 1, 2, 3 and 4); in phase 4, drive is ready for drive enable ("Bb") Transition command active (C01xx/C02xx) Transition command error (C01xx/C02xx) Drive command active (Cxxxx) Drive command error (Cxxxx)	If necessary, read exact status via "S-0-0095, Diagnostic message"
	Green GN GN GN GN	Power on and DC bus voltage available ("Ab")	Drive is error-free in operation and runs according to inputs
		Drive in control ("AF", "AH")	
	Flashing green-yellow GN GN YE YE	Firmware update running	During the firmware update, do not interrupt the 24V supply and do not unplug connectors
	Flashing yellow YE -- YE --	Identifying the drive controller	
	Yellow YE YE YE YE	Drive warning (E2xxx … E3xxx) Communication warning (E4xxx) Travel range warning (E6xxx … E7xxx) Fatal warnings (E8xxx)	During the firmware update, do not interrupt the 24V supply and do not unplug connectors
	Flashing red RD RD -- --	Error (F2xxx, F3xxx, F4xxx, F6xxx, F7xxx, F8xxx)	Read exact status via "S-0-0095, Diagnostic message" and carry out service function
	RD -- RD --	Firmware update error	Repeat firmware update
	Red RD RD RD RD	Booting phase	Wait until booting phase is over (approx. 2 minutes)
		System error (F9xxx, E0800)	Switch off and on; replace hardware, if necessary

Fig. 12-3: LED Displays H14

H17 Color / flashing pattern		Significance (control unit status)	Measures
	Green GN GN GN GN	Rexroth IndraMotion MTX control is ready for operation	Observe information displayed at operator panel. See also Application Description "Rexroth IndraMotion MTX" and documentation "Rexroth IndraMotion MTX Diagnostics Messages"
	Yellow YE YE YE YE	Rexroth IndraMotion MTX control is booting	Wait for booting phase to end

H17 Color / flashing pattern		Significance (control unit status)	Measures
	Red RD RD RD RD	Error Rexroth IndraMotion MTX control In the case of errors **during** the booting process (approx. 30 s), an error code is displayed at the operator panel.	Observe information displayed at operator panel. If an error is present, generate log file "MtxaCritErr.log" on programming module by switching off/on (storage location of log file: Program → root/cf). See also Application Description "Rexroth IndraMotion MTX" and documentation "Rexroth IndraMotion MTX Diagnostics Messages"
	Flashing red RD RD -- --	Error Rexroth IndraMotion MTX control	
○	Off -- -- -- --	Supply unit not switched on	Check 24V supply at X18 and switch it on, if not yet done

Fig. 12-4: LED Displays H17

12.1.3 Diagnostic LED Displays with Drive Firmware MPM-17VRS

Via the operator panel, you can find out which drive firmware has been installed on your system:

Operating area "Maintain" ▸ F-key "F6 About"

H10 … 13; H18 … 19 Color / flashing pattern		Significance (Ethernet status)	Measures
	Green GN GN GN GN	Connection to network available	
	Yellow YE YE YE YE	Data transmission running	

Fig. 12-5: LED Displays H10, H11, H12, H13, H18, H19

H14 Color / flashing pattern [1)]		Significance (drive status)	Measures
○	Off -- -- -- --	Supply unit not switched on	Check and, if necessary, switch on the 24-V supply
		Cable interrupted	Check cable and connector X18
		Hardware defective	Replace hardware
	Flashing green GN GN -- --	Drive is error-free (phases 2, 3 and 4); in phase 4, drive is ready for drive enable ("Bb")	If necessary, read exact status via "S-0-0095, Diagnostic message"
	Green GN GN GN GN	Power on and DC bus voltage available ("Ab")	Drive is error-free in operation and runs according to inputs
		Drive in control ["AF", "AH" or drive command active (Cxxxs)]	

Commissioning, Operation, Diagnostics

H14 Color / flashing pattern [1]		Significance (drive status)	Measures
	Flashing green-yellow GN GN YE YE	Switching command active (C01xx/C02xx) Switching command error (C01xx/C02xx)	If necessary, read exact status via "S-0-0095, Diagnostic message"
		Firmware update running Loader active	Do not interrupt the 24-V supply and do not unplug connectors while the firmware is being updated
	YE -- -- GN	Drive command error (Cxxxx)	
	Flashing yellow YE -- -- --	Drive warning (E2xxx … E3xxx)	Read exact status via "S-0-0095, Diagnostic message" and execute service function
	YE YE -- --	Communication warning (E4xxx)	
	YE YE YE --	Travel range warning (E6xxx … E7xxx)	
	YE -- YE --	Drive controller identification	
	Yellow YE YE YE YE	Fatal warning (E8xxx)	Do not interrupt the 24-V supply and do not unplug connectors while the firmware is being updated
	Flashing red-yellow RD RD YE YE	Drive is error-free (phase 0), but not yet ready for drive enable ("Bb")	If necessary, read exact status via "S-0-0095, Diagnostic message"
	RD YE YE YE	Drive is error-free (phase 1), but not yet ready for drive enable ("Bb")	
	RD -- -- YE	Communication error (F4xxx)	
	Flashing red-green RD -- GN --	Baud rate scan (P-1)	If necessary, read exact status via "S-0-0095, Diagnostic message"
	Flashing red RD RD -- --	Error (F2xxx, F3xxx, F6xxx, F7xxx, F8xxx)	Read exact status via "S-0-0095, Diagnostic message" and execute service function
	RD -- RD --	Firmware update:	Repeat firmware update
	Red RD RD RD RD	Booting phase	Wait until booting phase is over (approx. 2 minutes)
		System error (F9xxx, E0800)	• Switch off and on; replace hardware, if necessary • Check whether the programming module is inserted; if necessary replace KSM/KMS crosswise to check whether the programming module is defective

1) A square in the illustrated flashing patterns corresponds to a time period of 250 ms.

Fig. 12-6: LED Displays H14

H17 Color / flashing pattern		Significance (control unit status)	Measures
	Green GN GN GN GN	Rexroth IndraMotion MTX control is ready for operation	Observe information displayed at operator panel. See also Application Description "Rexroth IndraMotion MTX" and documentation "Rexroth IndraMotion MTX Diagnostics Messages"
	Yellow YE YE YE YE	Rexroth IndraMotion MTX control is booting	Wait for booting phase to end
	Red RD RD RD RD	Error Rexroth IndraMotion MTX control In the case of errors **during** the booting process (approx. 30 s), an error code is displayed at the operator panel.	Observe information displayed at operator panel. If an error is present, generate log file "MtxaCritErr.log" on programming module by switching off/on (storage location of log file: Program → root/cf). See also Application Description "Rexroth IndraMotion MTX" and documentation "Rexroth IndraMotion MTX Diagnostics Messages"
	Flashing red RD RD -- --	Error Rexroth IndraMotion MTX control	
	Off -- -- -- --	Supply unit not switched on	Check 24V supply at X18 and switch it on, if not yet done

Fig. 12-7: LED Displays H17

13 Technical Data - Encoder Evaluation

13.1 ES - Standard Encoder Evaluation

13.1.1 Interface Standard Encoder Evaluation ES

Description

For encoders with a supply voltage of **5 and 12 volt**:

- Sin-cos encoder 1 V_{pp}; HIPERFACE®
- Sin-cos encoder 1 V_{pp}; EnDat 2.1
- Sin-cos encoder 1 V_{pp}; with reference track
- 5V-TTL square-wave encoder; with reference track
- EnDat 2.2
- Panasonic
- SSI

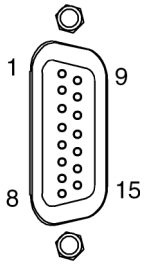
Connection point	Type	Number of poles	Type of design	Stranded wire [mm²]	Figure
See index entry "Encoder evaluation → X4.1, X4.2, X4.3, X4.4"	D-Sub	15	Female (device)	0,25–0,5	

Fig. 13-1: Connection

Pin Assignment

Connection	Signal	Function
1	GND_shld	Connection signal shields (internal shields)
2	A+	Track A analog positive
3	A-	Track A analog negative
4	GND_Encoder	Reference potential power supplies
5	B+	Track B analog positive
6	B-	Track B analog negative
7	EncData+	Data transmission positive
	A+TTL	Track A TTL positive
8	EncData-	Data transmission negative
	A-TTL	Track A TTL negative
9	R+	Reference track positive
10	R-	Reference track negative
11	+12V	Encoder supply 12V
12	+5V	Encoder supply 5V

Technical Data - Encoder Evaluation

Connection	Signal	Function
13	EncCLK+	Clock positive
	B+TTL	Track B TTL positive
14	EncCLK-	Clock negative
	B-TTL	Track B TTL negative
15	n. c.	Not assigned
Connector housing		Overall shield

Fig. 13-2: Pin Assignment

13.1.2 Properties of ES

Technical Data Input Circuit

Input Circuit for Sine Signals A+, A- or B+, B- or R+, R-

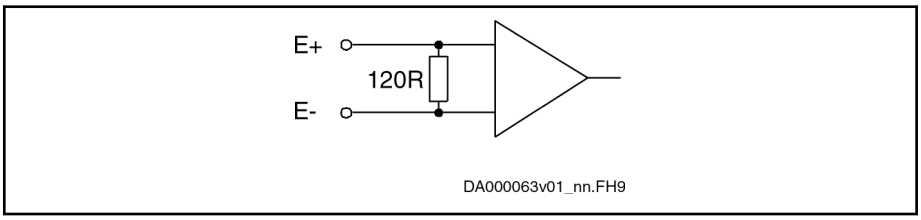


Fig. 13-3: Input Circuit for Sine Signals (Block Diagram)

Properties of Differential Input for Sine Signals

Data	Unit	Min.	Typ.	Max.
Amplitude of encoder signal peak-peak ($U_{PPencodersignal}$)	V	0,8	1,0	1,2
Cut-off frequency (-3 dB)	kHz		400	
Converter width A/D converter	Bit		12	
Input resistance	ohm		120	

Fig. 13-4: Differential Input Sine

Input Circuit for Square-Wave Signals

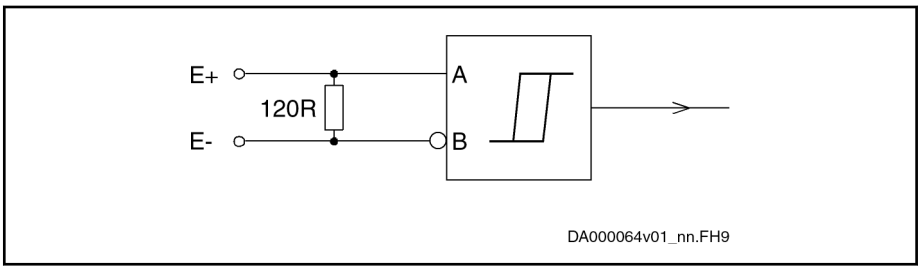


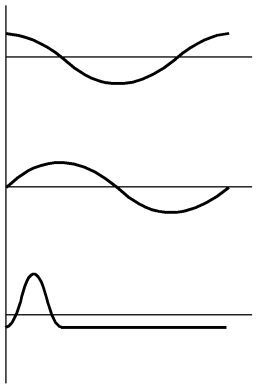
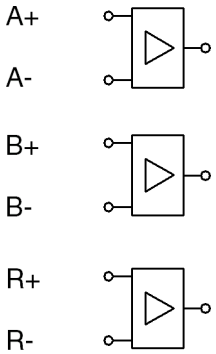
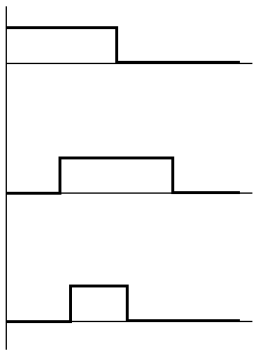
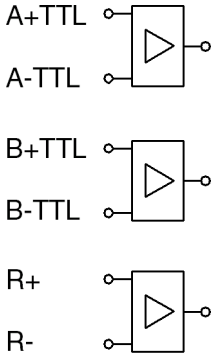
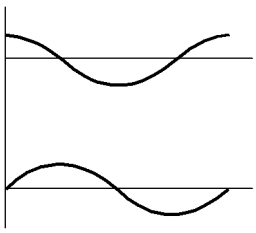
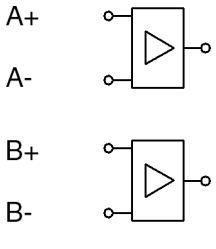
Fig. 13-5: Input Circuit for Square-Wave Signals (Block Diagram)

Properties of Differential Input for Square-Wave Signals

Data	Unit	Min.	Typ.	Max.
Input voltage "high"	V	2,4		5,0
Input voltage "low"	V	0		0,8
Input frequency	kHz			1000
Input resistance	ohm		120	

Fig. 13-6: Differential Input Square-Wave Signals

13.1.3 Signal Assignment to the Actual Position Value

Signal assignment [1]	Signal designation	Signal shape	Actual position value (with default setting)
 DK000089v01_nn.FH9	 A+ A- B+ B- R+ R- DF000381v01_nn.FH11	Sine (1 V_{pp}) Without absolute value	Increasing
 DK000090v01_nn.FH9	 A+TTL A-TTL B+TTL B-TTL R+ R- DF000380v01_nn.FH11	Square-wave (TTL) Without absolute value	Increasing
 DK000088v01_nn.FH9	 A+ A- B+ B- DF000382v01_nn.FH11	Sine (1 V_{pp}) With absolute value (e.g. EnDat)	Increasing

1) See following note

Fig. 13-7: Signal Assignment to the Actual Position Value

☞ The encoder signal assignment to the inputs is based on clockwise rotation (front view to motor shaft).

- Track A (A+, A-) advances track B (B+, B-) 90° electrically.
- The actual position value increases in this case (unless negation takes effect).
- If available, the reference track R (R+, R-) provides the reference mark pulse at positive signals of track A and track B (in the so-called "0-th" quadrant).

☞ Standard setting: See Functional Description of firmware

Technical Data - Encoder Evaluation

13.1.4 Connection for 12V Encoder Systems

Power Supply

Data	Unit	Min.	Typ.	Max.
Voltage for encoder supply	V	11,4	12	12,6
Output current	mA			350

Fig.13-8: 12V Encoder Supply

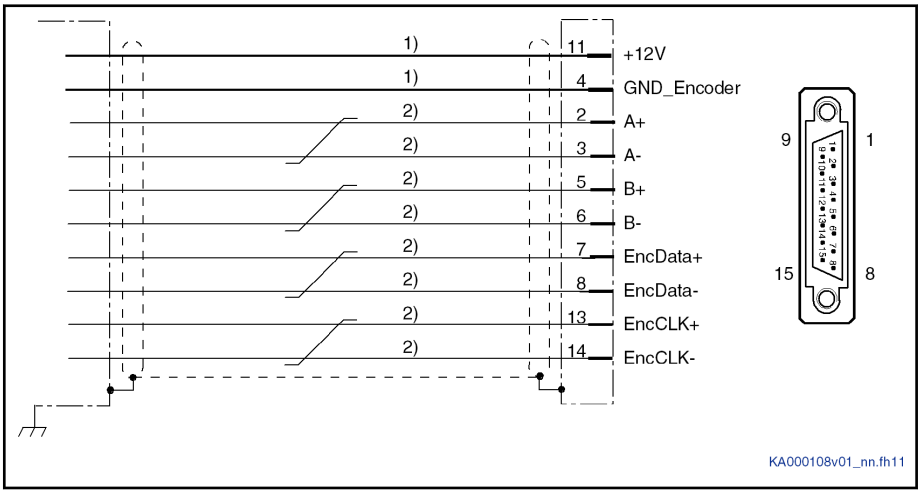
Allowed Encoder Cable Lengths for 12V Encoder Systems

The maximum allowed **encoder cable length** for 12V encoder systems is **40 m**.

Connection Diagrams for 12V Encoder Systems

☞ For encoder supply, use lines with the same line cross section.

ES with "MSK/QSK Encoder Interface" for Encoder Systems S1/M1, S2/M2, S5/M5



1) Cable cross section ≥ 0.5 mm²; observe allowed encoder cable length
2) Cable cross section ≥ 0.14 mm²

Fig.13-9: Connection Diagram "MSK/QSK Encoder Interface" for Encoder Systems S1/M1, S2/M2, S5/M5

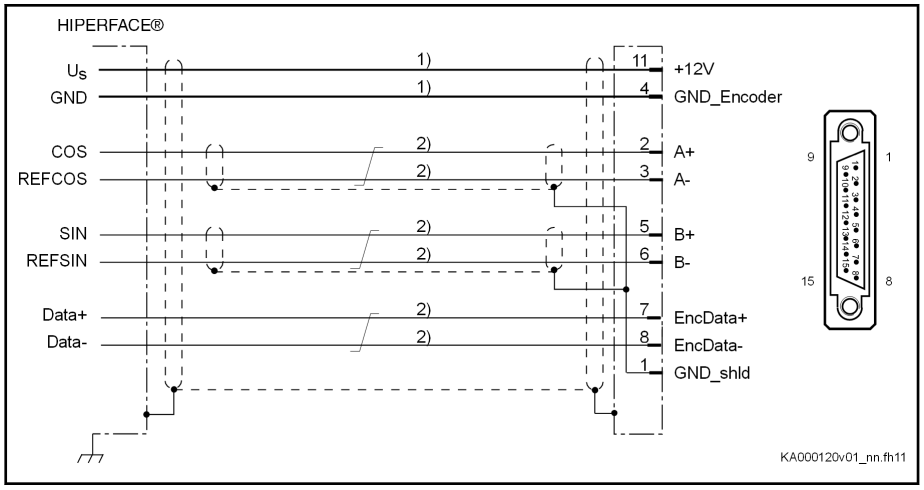
☞ For **direct** connection to the encoder system use our cable **RKG4200**. For connector type and encoder connector pin assignment, please see the cable documentation.

Connection Diagrams for 12V Third-Party Encoder Systems

☞ For encoder supply, use lines with the same line cross section.

☞ Observe that the third-party encoder used has to be suited for the voltage available at the encoder evaluation ES as voltage for encoder supply.

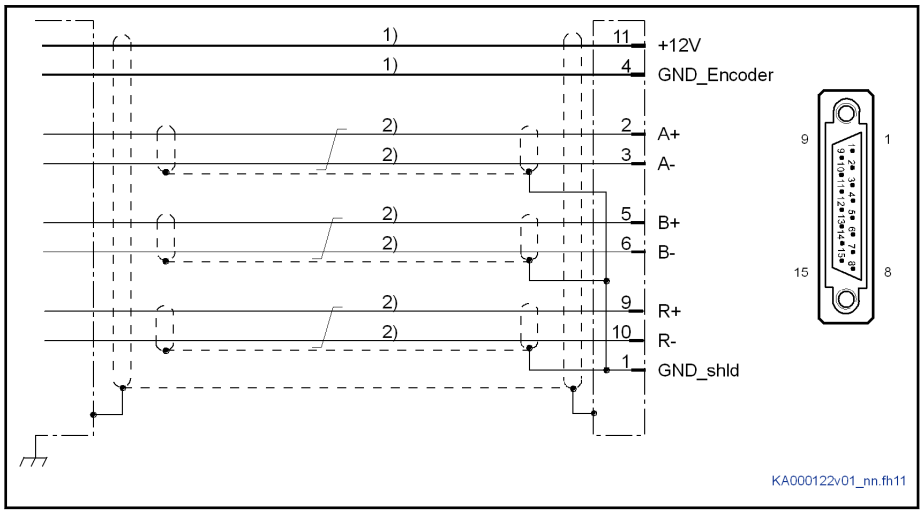
ES with Encoder System "HIPERFACE®", 12 V



1) Cable cross section ≥ 0.5 mm²; observe allowed encoder cable length
2) Cable cross section ≥ 0.14 mm²

Fig. 13-10: Connection Diagram Encoder System "HIPERFACE®"

ES with Encoder System "1V_{pp}", 12 V

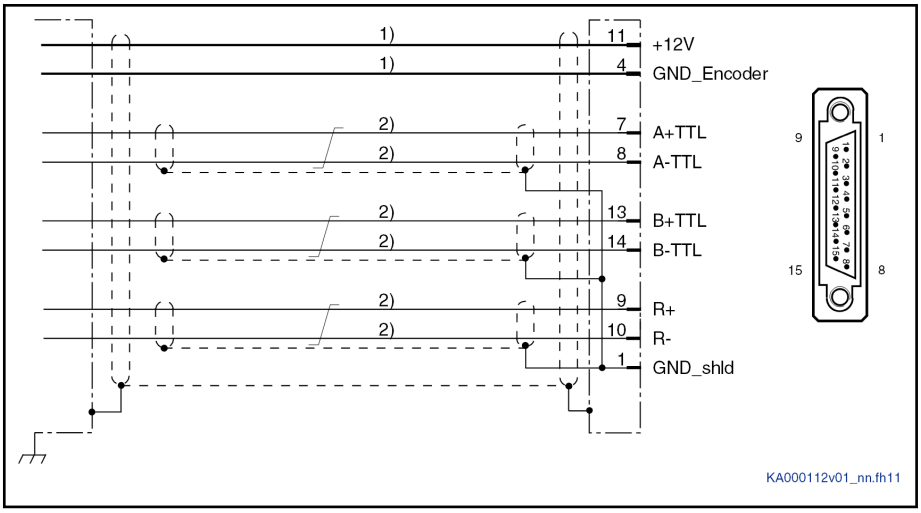


1) Cable cross section ≥ 0.5 mm²; observe allowed encoder cable length
2) Cable cross section ≥ 0.14 mm²

Fig. 13-11: Connection Diagram Encoder System "1Vpp"

Technical Data - Encoder Evaluation

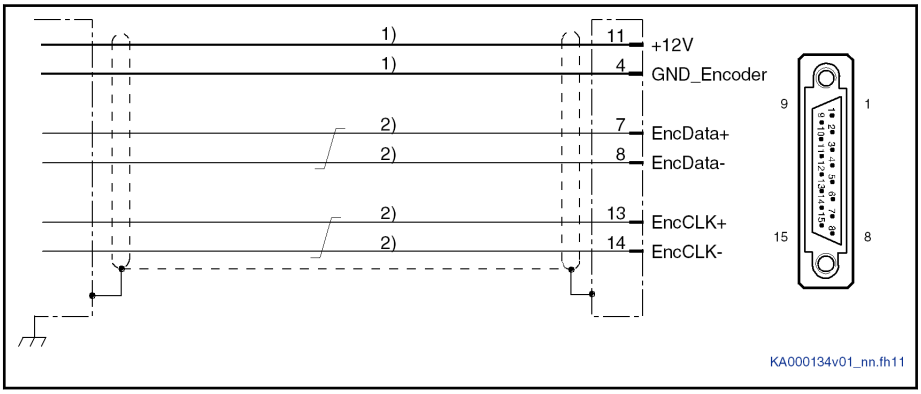
ES with Encoder System "TTL", 12 V



1) Cable cross section ≥ 0.5 mm²; observe allowed encoder cable length
2) Cable cross section ≥ 0.14 mm²

Fig. 13-12: Connection Diagram Encoder System "TTL"

ES with Encoder System "SSI", 12 V



1) Cable cross section ≥ 0.5 mm²; observe allowed encoder cable length
2) Cable cross section ≥ 0.14 mm²

Fig. 13-13: Connection Diagram Encoder System "SSI"

13.1.5 Connection for 5V Encoder Systems

Power Supply

Data	Unit	Min.	Typ.	Max.
DC output voltage +5V **without** voltage return (Sense)	V	5,1		5,27
Output current	mA			350

Fig. 13-14: 5V Encoder Supply

Allowed Encoder Cable Lengths for 5V Encoder Systems without Sense Evaluation

☞ The maximum allowed encoder cable length for 5V encoder systems without Sense evaluation is **40 m**.

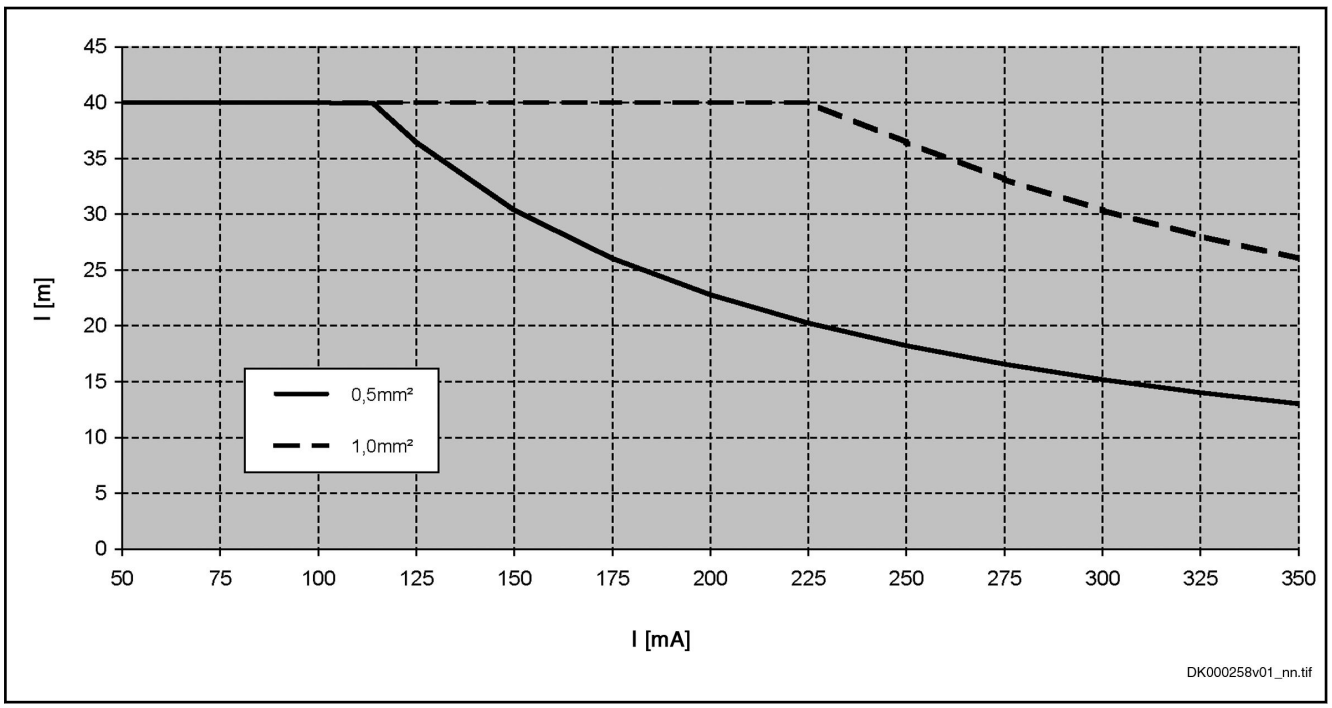
The current consumption of the connected encoder system generates a voltage drop due to the ohmic resistance of the encoder cable (line cross section and line length). This reduces the signal at the encoder input.

In the diagram below, the following aspects have been taken into account:

- The **cross section** of the wires for supply voltage is at least **0.5 mm²**

- The allowed **supply voltage** at the encoder is **5V ±5%**

Allowed encoder cable length:



I [mA]	Encoder current consumption
l [m]	Cable length
0.5; 1.0 mm^2	Cable cross sections

Fig.13-15: Maximum Allowed Encoder Cable Lengths without Sense Connection Depending on Cable Cross Section

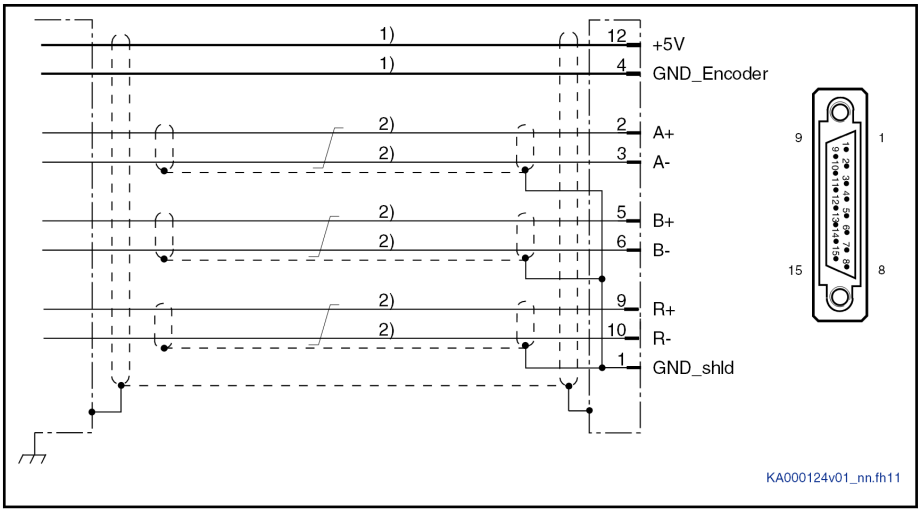
Connection Diagrams for 5V Encoder Systems with Third-Party Encoder

☞ For encoder supply, use lines with the same line cross section.

☞ Observe that the third-party encoder used has to be suited for the voltage available at the encoder evaluation ES as voltage for encoder supply.

Technical Data - Encoder Evaluation

ES with Encoder System "1V_{pp}" (According to Heidenhain Standard), 5 V

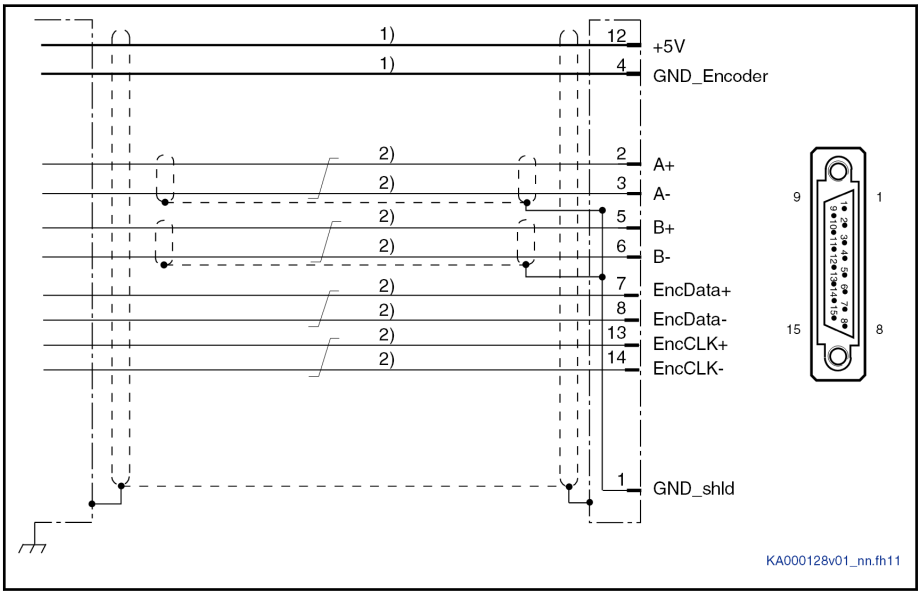


1) Cable cross section ≥ 0.5 mm²; observe allowed encoder cable length
2) Cable cross section ≥ 0.14 mm²

Fig. 13-16: Connection Diagram ES with Encoder System "1Vpp"

For **direct** connection to the encoder system use our cable **RKG0035**. For connector type and encoder connector pin assignment, please see the cable documentation.

ES with Encoder System "EnDat 2.1" (According to Heidenhain Standard), 5 V

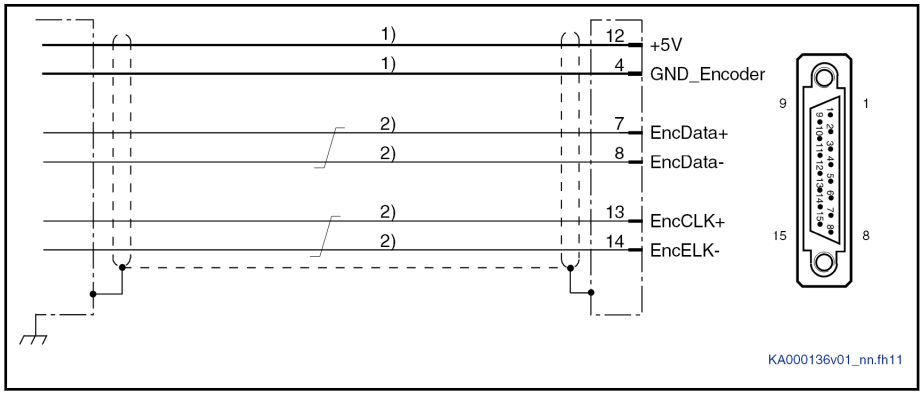


1) Cable cross section ≥ 0.5 mm²; observe allowed encoder cable length
2) Cable cross section ≥ 0.14 mm²

Fig. 13-17: Connection Diagram ES with Encoder System "EnDat 2.1"

For **direct** connection to the encoder system use our cable **RKG0036**. For connector type and encoder connector pin assignment, please see the cable documentation.

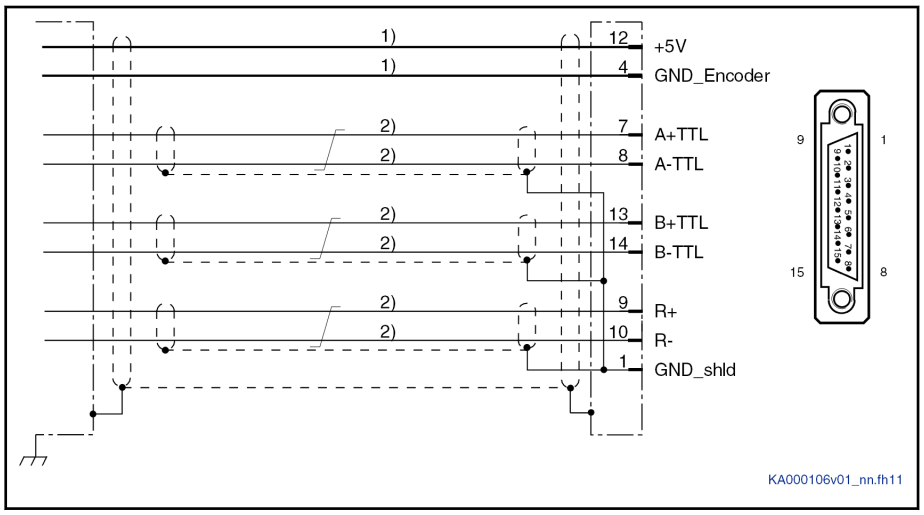
ES with Encoder System "SSI", 5 V



1) Cable cross section ≥ 0.5 mm²; observe allowed encoder cable length
2) Cable cross section ≥ 0.14 mm²

Fig. 13-18: Connection Diagram ES with Encoder System "SSI"

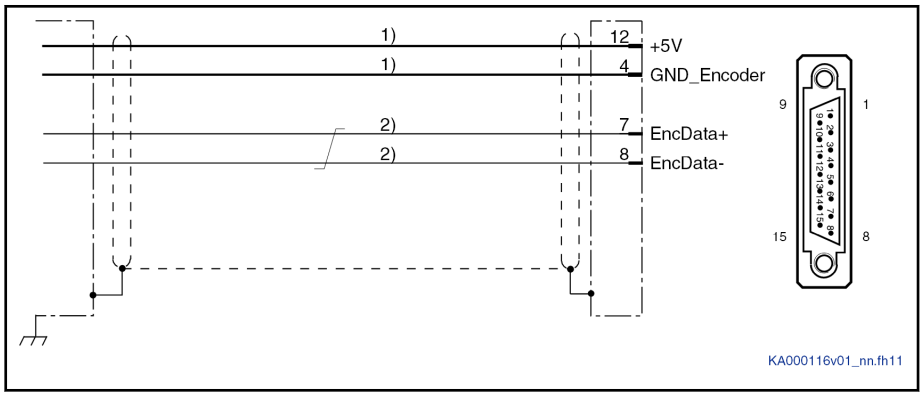
ES with Encoder System "TTL", 5 V



1) Cable cross section ≥ 0.5 mm²; observe allowed encoder cable length
2) Cable cross section ≥ 0.14 mm²

Fig. 13-19: Connection Diagram ES with Encoder System "TTL"

ES with Encoder System "Panasonic", 5 V



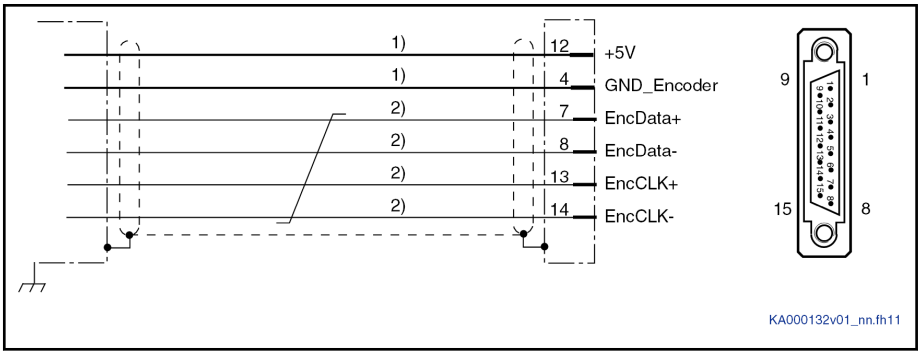
1) Cable cross section ≥ 0.5 mm²; observe allowed encoder cable length
2) Cable cross section ≥ 0.14 mm²

Fig. 13-20: Connection Diagram ES with Encoder System "Panasonic"

For **direct** connection to the encoder system use our cable **RKG0033**. For connector type and encoder connector pin assignment, please see the cable documentation.

Technical Data - Encoder Evaluation

ES with Encoder System "EnDat 2.2", 5 V



1) Cable cross section ≥ 0.5 mm²; observe allowed encoder cable length
2) Cable cross section ≥ 0.14 mm²

Fig.13-21: Connection Diagram with Encoder System "EnDat 2.2"

The Heidenhain company provides information on the cable for EnDat 2.2 and the specification to be complied with.

14 Technical Data - Functions

14.1 Relay Contacts

14.1.1 Relay Contact Type 2

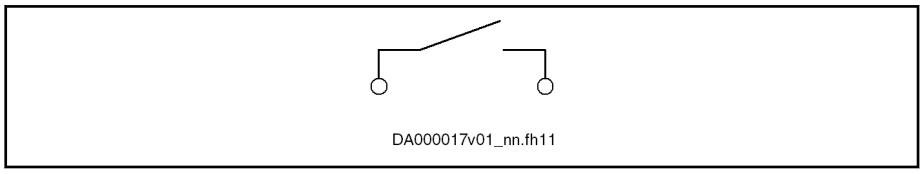


Fig. 14-1: Relay Contact

Data	Unit	Min.	Typ.	Max.
Current carrying capacity	A			DC 1
Voltage load capacity	V			DC 30
Minimum load of the contacts	mA	10		
Contact resistance at minimum current	mΩ			1000
Switching actions at max. time constant of load			1×10^6	
Number of mechanical switching cycles			1×10^8	
Time constant of load	ms	ohmic		
Pick up delay	ms			10
Drop out delay	ms			10

Fig. 14-2: Relay Contacts Type 2

14.2 Digital Inputs/Outputs

14.2.1 General Information

The digital inputs/outputs correspond to "IEC 61131, type 1".

Do not operate digital outputs at low-resistance sources!

In the Functional Description of the firmware, observe the Notes on Commissioning for digital inputs/outputs.

14.2.2 Digital Inputs

Digital Inputs Type A (Standard)

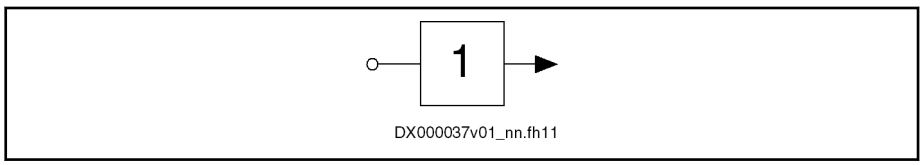


Fig. 14-3: Symbol

Technical Data - Functions

Data	Unit	Min.	Typ.	Max.
Allowed input voltage	V	-3		30
On	V	15		
Off	V			5
Input current	mA	2		5
Input resistance	kΩ	7,42		
Sampling frequency	kHz	Depending on firmware		
Control delay	µs	20		100 + 1 cycle time of position control

Fig.14-4: Digital Inputs Type A

Digital Inputs Type B (Probe)

Function See "Probe" in the Functional Description of the firmware.

Technical Data

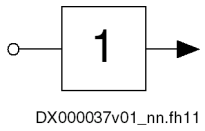
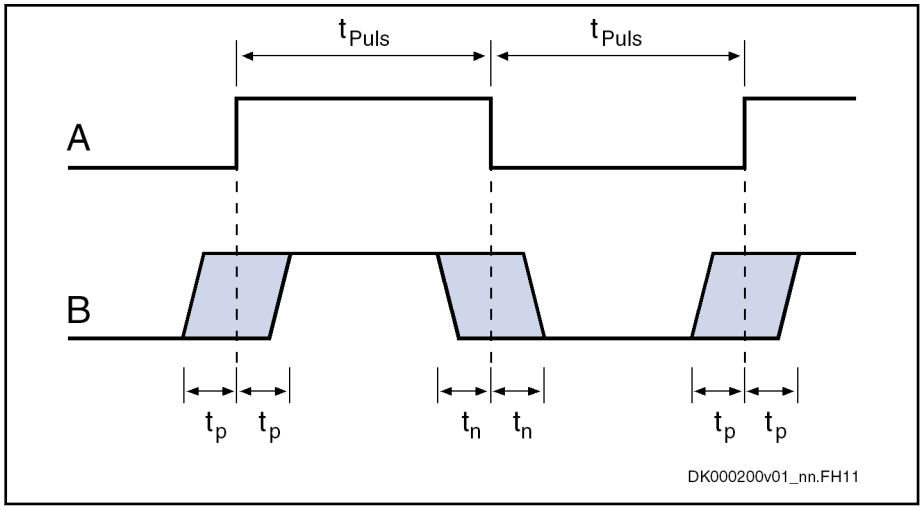


Fig.14-5: Symbol

Data	Unit	Min.	Typ.	Max.
Allowed input voltage	V	-3		30
On	V	15		
Off	V			5
Input current	mA	2		5
Input resistance	kΩ	7,42		
Pulse width t_{Puls}	µs	4		
Measuring accuracy t_x	µs			1

Fig.14-6: Digital Inputs Type B



A	Signal
B	Signal detection at probe input
t_{Puls}	Pulse width
t_p	Measuring accuracy of the positive signal edge
t_n	Measuring accuracy of the negative signal edge

Fig. 14-7: Signal Detection at Probe Input

Use To acquire fast digital input signals.

☞ **Probe inputs** are "fast" inputs. For control use bounce-free switching elements (e.g. electronic switches) to avoid incorrect evaluation.

14.2.3 Digital Outputs

The digital outputs are compatible with digital inputs of types 1, 2 and 3 (IEC 61131).

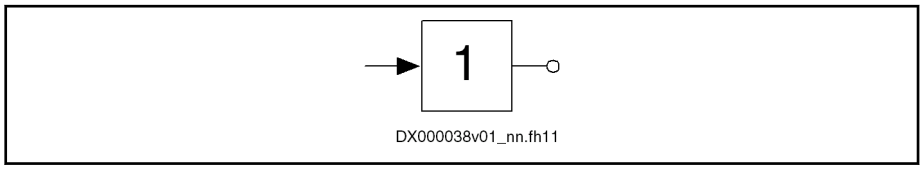


Fig. 14-8: Symbol

Data	Unit	Min.	Typ.	Max.
Output voltage ON	V	U_{ext} - 0.5	24	U_{ext}
Output voltage OFF	V			2,1
Output current OFF	mA			0,05
Allowed output current per output	mA			500
Allowed output current per group (8 outputs)	mA			2000
Update interval	ns	Depending on firmware		
Short circuit protection		Present		
Overload protection		Present		

Technical Data - Functions

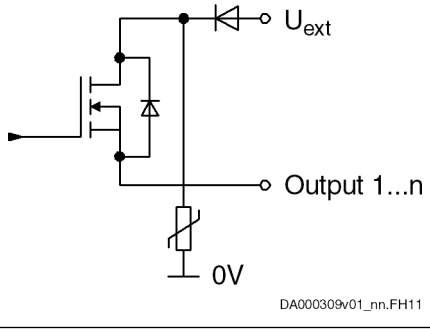
Data	Unit	Min.	Typ.	Max.
Allowed energy content of connected inductive loads, e.g. relay coils; only allowed as single pulse Per output	mJ			250
Allowed energy content of connected inductive loads, e.g. relay coils; only allowed as single pulse Per group (8 outputs)	mJ			1000
Block diagram output:				

Fig.14-9: Digital Outputs

- The digital outputs have been realized with high-side switches. This means that these outputs only can actively supply current.
- The energy absorption capacity of the outputs is used to limit voltage peaks caused when inductive loads are switched off.

  Limit voltage peaks by using free-wheeling diodes directly at the relay coil.

15 Accessories

15.1 HAS09

The accessories contain:

- Screws for mounting the drive controller
- Screws for connecting the equipment grounding conductor
- Adhesive labels with notes on safety in the English and French languages. Place the adhesive labels clearly visibly at the device or in the immediate vicinity of the device, if the adhesive labels existing at the device are hidden by neighboring devices.

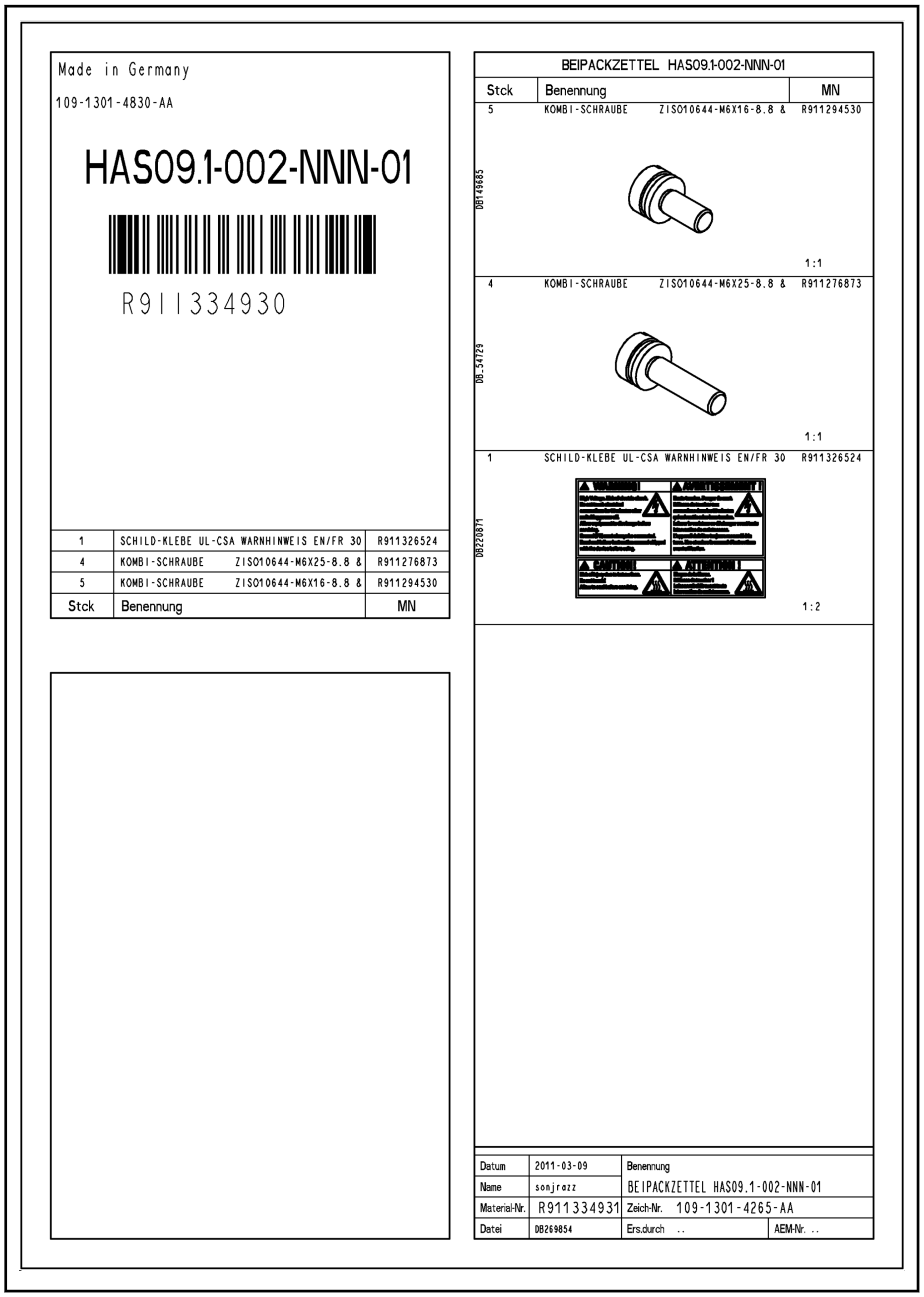


Fig. 15-1: Product Insert HAS09

Accessories

15.2 CompactFlash Memory Card

Name CFM01.1

Content Firmware and parameters for drive controller and control unit

Purchase Order To be ordered separately

16 Environmental Protection and Disposal

16.1 Environmental Protection

Production Processes

The products are made with energy- and resource-optimized production processes which allow re-using and recycling the resulting waste. We regularly try to replace pollutant-loaded raw materials and supplies by more environment-friendly alternatives.

No Release of Hazardous Substances

Our products do not contain any hazardous substances which may be released in the case of appropriate use. Normally, our products will not have any negativ influences on the environment.

Significant Components

Basically, our products contain the following components:

Electronic devices
- steel
- aluminum
- copper
- synthetic materials
- electronic components and modules

Motors
- steel
- aluminum
- copper
- brass
- magnetic materials
- electronic components and modules

16.2 Disposal

Return of Products

Our products can be returned to our premises free of charge for disposal. It is a precondition, however, that the products are free of oil, grease or other dirt.

Furthermore, the products returned for disposal must not contain any undue foreign material or foreign components.

Send the products ”free domicile” to the following address:

Bosch Rexroth AG
Electric Drives and Controls
Buergermeister-Dr.-Nebel-Strasse 2
97816 Lohr am Main, Germany

Packaging

The packaging materials consist of cardboard, wood and polystyrene. These materials can be recycled anywhere without any problem.

For ecological reasons, please refrain from returning the empty packages to us.

Batteries and Accumulators

Batteries and accumulators can be labeled with this symbol.

The symbol indicating "separate collection" for all batteries and accumulators is the crossed-out wheeled bin.

The end user within the EU is legally obligated to return used batteries. Outside the validity of the EU Directive 2006/66/EC keep the stipulated directives.

Used batteries can contain hazardous substances, which can harm the environment or the people´s health when they are improper stored or disposed of.

After use, the batteries or accumulators contained in Rexroth products have to be properly disposed of according to the country-specific collection.

Recycling

Most of the products can be recycled due to their high content of metal. In order to recycle the metal in the best possible way, the products must be disassembled into individual modules.

Environmental Protection and Disposal

Metals contained in electric and electronic modules can also be recycled by means of special separation processes.

Products made of plastics can contain flame retardants. These plastic parts are labeled according to EN ISO 1043. They have to be recycled separately or disposed of according to the valid legal requirements.

17 Service and Support

Our worldwide service network provides an optimized and efficient support. Our experts offer you advice and assistance should you have any queries. You can contact us **24/7**.

Service Germany

Our technology-oriented Competence Center in Lohr, Germany, is responsible for all your service-related queries for electric drive and controls.

Contact the **Service Helpdesk & Hotline** under:

Phone:	**+49 9352 40 5060**
Fax:	**+49 9352 18 4941**
E-mail:	service.svc@boschrexroth.de
Internet:	http://www.boschrexroth.com

Additional information on service, repair (e.g. delivery addresses) and training can be found on our internet sites.

Service worldwide

Outside Germany, please contact your local service office first. For hotline numbers, refer to the sales office addresses on the internet.

Preparing information

To be able to help you more quickly and efficiently, please have the following information ready:

- Detailed description of malfunction and circumstances resulting in the malfunction
- Type plate name of the affected products, in particular type codes and serial numbers
- Your contact data (phone and fax number as well as your email address)

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Notes

Rexroth
Bosch Group

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