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

Rexroth
Bosch Group

Rexroth IndraDrive Drive Controllers HCQ02

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Preliminary edition 01

Project Planning Manual



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Drive Controllers
HCQ02

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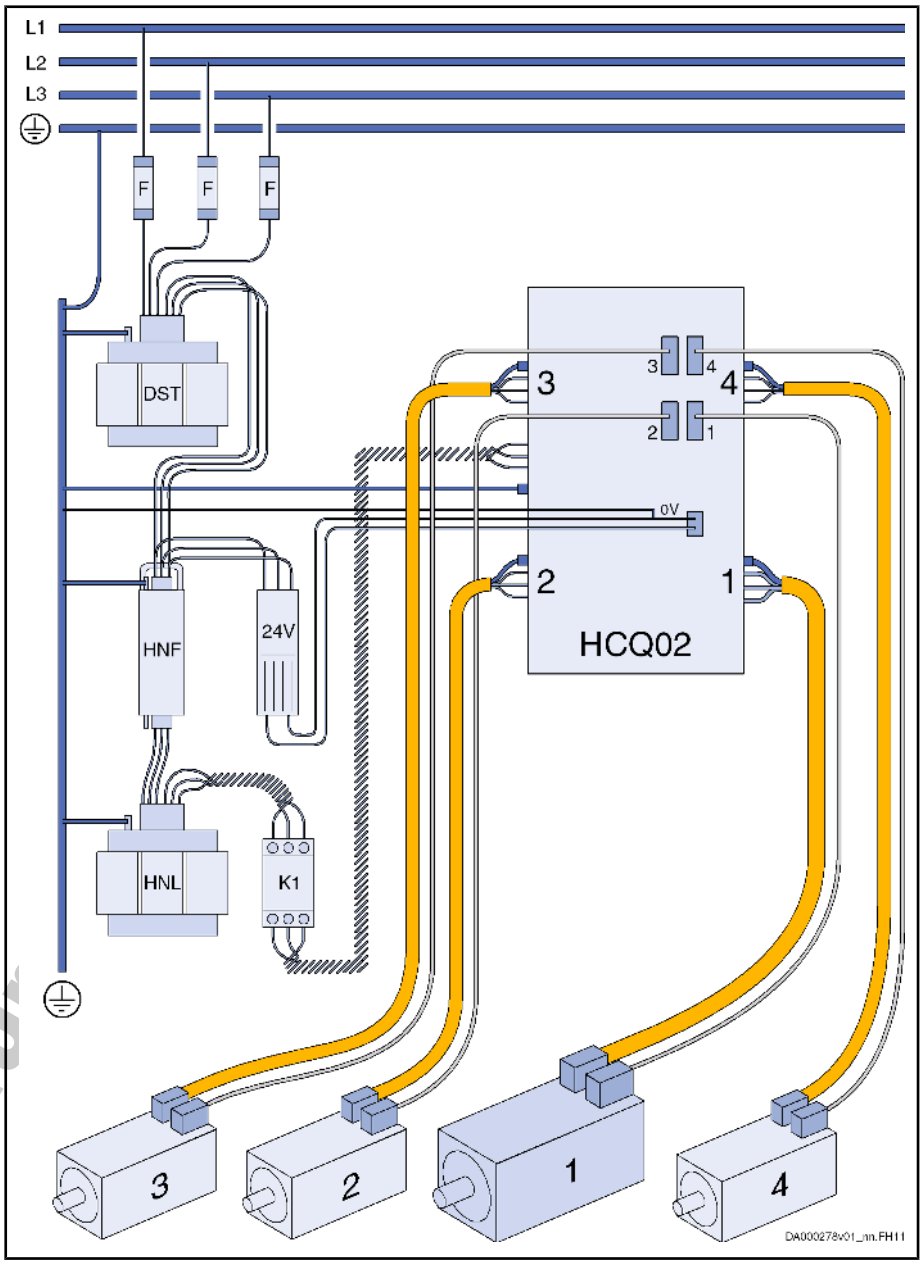
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1 Introducing the System

1.1 Drive System With Rexroth IndraDrive HCQ02

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
HNF	Mains filter
HNL	Mains choke
K1	Mains contactor

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

Nur für

1.2 Drive Controllers HCQ02

Main Features



Fig.1-2: 4-Axis Converter HCQ02

- Multi-axis converter (HCQ02) in flat type of construction with forced-ventilated cooling
- Degree of protection IP20
- Voltage range mains connection nominal 3 AC 200 … 500 V
- 4 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 control panels
- Changeable programming module in CompactFlash format with firmware and parameters

Properties

Property	HCQ02			
Type of drive controller	Converter			
Number of axes	4			
Mains connection	■			

Property	HCQ02			
DC bus connection	-			
Encoder evaluations	5			
Configurable	■			
Number of configurable slots	2			
Configuration slots safety technology	-			
Braking resistor	External			
DC bus short circuit input	■			
Interface to control panel (LVDS +USB)	■			
Ethernet Engineering Port	■			
SERCOS III Master Port	-			
Master communication				
Embedded PC	■			
Multi-protocol Ethernet	-			
PROFIBUS	-			
Inputs / outputs				
Digital inputs Thereof probes	32 4			
Digital outputs	16			
Analog inputs	0			
Analog outputs	0			
Relay contacts	1 N/O			
Switching frequencies				
4 kHz	■			
8 kHz	■			

■ Available
- Not available

Fig. 1-3: Properties

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1.3 Type Code

1.3.1 HCQ02

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

Introducing the System

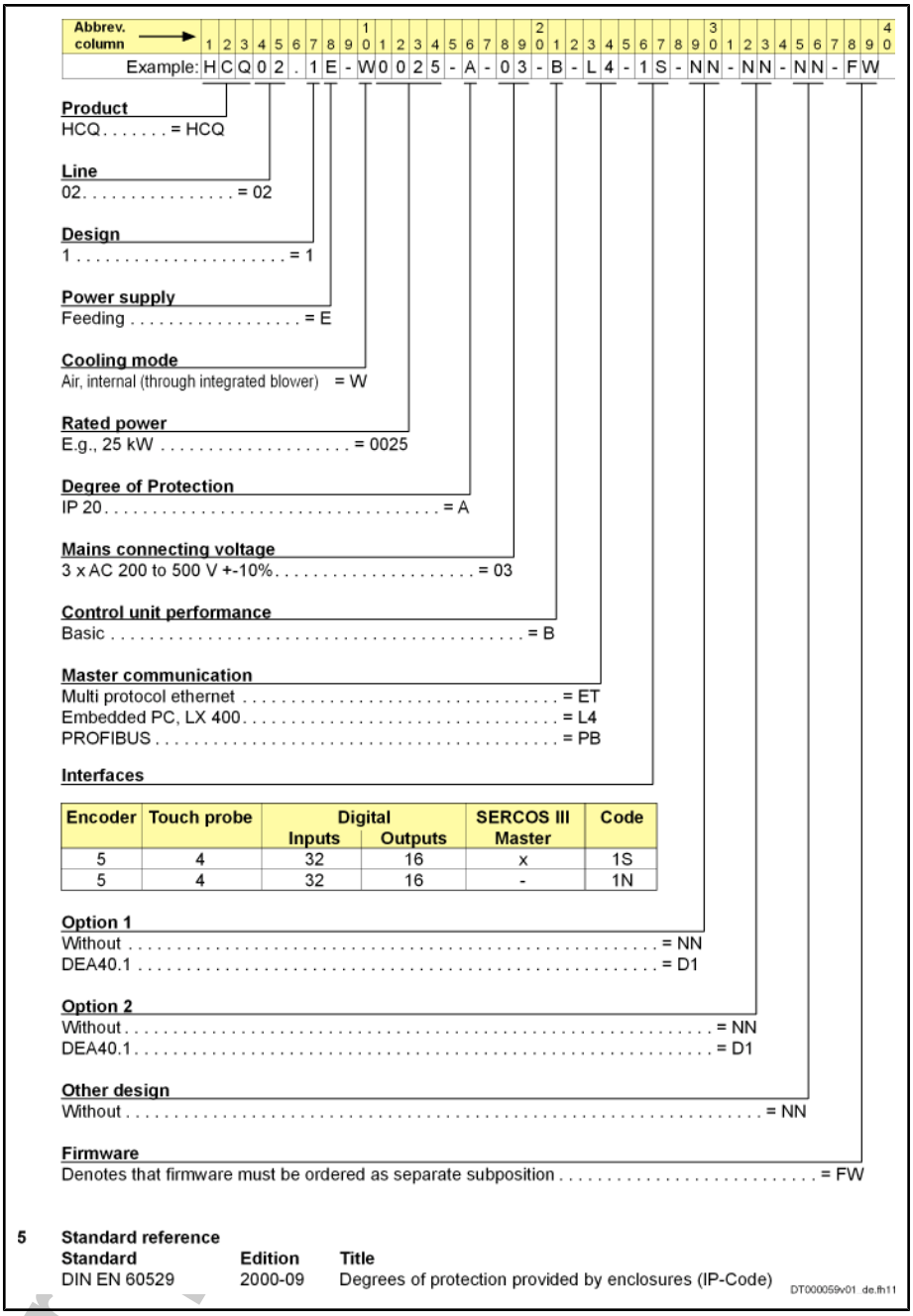


Fig. 1-4: Type Code HCQ02

1.3.2 Firmware

Operating a Rexroth IndraDrive system with multi-axis drive controllers requires the standard firmware **FWA-INDRV*-MPx-16VRS-D5** or higher.

1.4 About This Documentation

1.4.1 Purpose



WARNING

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

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

This documentation provides information on

- how to configure Rexroth IndraDrive systems
- considering the components
  - HCQ02

1.4.2 Reference Documentations

Drive Systems, System Components

Title Rexroth IndraDrive …	Kind of documentation	Document typecode[1)] DOK-INDRV*-…	Part number R911…
Drive Controllers HCS01	Project Planning Manual	HCS01******-PRxx-EN-P	322210
Drive Controllers HCQ02	Project Planning Manual	HCQ-T+HMQ-T-PRxx-EN-P	324185
Additional Components	Project Planning Manual	ADDCOMP****-PRxx-EN-P	306140

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. 1-5: Documentations – Drive Systems, System Components

Motors

Title Rexroth IndraDyn …	Kind of documentation	Document typecode[1)] DOK-MOTOR*-…	Part number R911…
A Series Asynchronous Motors	Project Planning Manual	MAD/MAF****-PRxx-EN-P	295781
H Frameless Synchronous Spindle Motors	Project Planning Manual	MBS-H******-PRxx-EN-P	297895
L Synchronous Linear Motors	Project Planning Manual	MLF********-PRxx-EN-P	293635
S MSK Synchronous Motors	Project Planning Manual	MSK********-PRxx-EN-P	296289
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. 1-6: Documentations – Motors

Cables

Title	Kind of documentation	Document typecode[1)] DOK-CONNEC-…	Part number R911…
Rexroth Connection Cables	Selection Data	CABLE*STAND-AUxx-EN-P	282688

1) In the document typecodes, "xx" is a wild card for the current edition of the documentation (example: AU03 is the third edition of the documentation "Selection Data")

Fig. 1-7: Documentations – Cables

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Firmware

Title Rexroth IndraDrive …	Kind of documentation	Document typecode[1)] DOK-INDRV*-…	Part number R911…
Firmware for Drive Controllers	Functional Description	MP*-16VRS**-FKxx-EN-P	326767
Firmware for Drive Controllers	Parameter Description	GEN1-**VRS*-PAxx-EN-P	327008
MPx-16VRS	Troubleshooting Guide	GEN1-**VRS*-WAxx-EN-P	326738

1) In the document typecodes, "xx" is a wild card for the current edition of the documentation (example: PA02 is the second edition of a Parameter Description)

Fig. 1-8: Documentations – Firmware

1.4.3 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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2 Important Directions for Use

2.1 Appropriate Use

2.1.1 Introduction

Rexroth products represent state-of-the-art developments and manufacturing. 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 the industrial environment 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, make sure that all the pre-requisites for an appropriate use of the products are satisfied:

- Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with 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.
- Do not mount damaged or faulty products or use them in 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, making it possible for the motor to execute 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:

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- 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 indicated technical data and specifications is defined as "inappropriate use".

Drive controllers must 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 must not be used in applications which have not been expressly authorized by Rexroth. Please carefully follow the specifications outlined in the general Safety Instructions!

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3 Safety Instructions for Electric Drives and Controls

3.1 Safety Instructions - General Information

3.1.1 Using the Safety Instructions and Passing them on to Others

Do not attempt to install or commission this device without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation prior to working with the device. If you do not have the user documentation for the device, contact your responsible Bosch Rexroth sales representative. Ask for these documents to be sent immediately to the person or persons responsible for the safe operation of the device.

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



WARNING

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

Observe the safety instructions!

3.1.2 How to Employ the Safety Instructions

Read these instructions before initial commissioning of the equipment in order to eliminate the risk of bodily harm and/or material damage. Follow these safety instructions at all times.

- Bosch Rexroth AG is not liable for damages resulting from failure to observe the warnings provided in this documentation.
- Read the operating, maintenance and safety instructions in your language before commissioning the machine. If you find that you cannot completely understand the documentation for your product, please ask your supplier to clarify.
- Proper and correct transport, storage, assembly and installation, as well as care in operation and maintenance, are prerequisites for optimal and safe operation of this device.
- Only assign trained and qualified persons to work with electrical installations:
  - Only persons who are trained and qualified for the use and operation of the device may work on this device or within its proximity. The persons are qualified if they have sufficient knowledge of the assembly, installation and operation of the product, as well as an understanding of all warnings and precautionary measures noted in these instructions.
  - Furthermore, they must be trained, instructed and qualified to switch electrical circuits and devices on and off in accordance with technical safety regulations, to ground them and to mark them according to the requirements of safe work practices. They must have adequate safety equipment and be trained in first aid.
- Only use spare parts and accessories approved by the manufacturer.

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- Follow all safety regulations and requirements for the specific application as practiced in the country of use.
- The devices have been designed for installation in industrial machinery.
- The ambient conditions given in the product documentation must be observed.
- Only use safety-relevant applications that are clearly and explicitly approved in the Project Planning Manual. If this is not the case, they are excluded. Safety-relevant are all such applications which can cause danger to persons and material damage.
- The information given in the documentation of the product with regard to the use of the delivered components contains only examples of applications and suggestions.

  The machine and installation manufacturer must

  – make sure that the delivered components are suited for his individual application and check the information given in this documentation with regard to the use of the components,
  – make sure that his 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 permitted once it is sure that the machine or installation in which they are installed complies with the national regulations, safety specifications and standards of the application.
- Operation is only permitted 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 documentation (Project Planning Manuals of components and system).

  The machine or installation manufacturer is responsible for compliance with the limiting values as prescribed in the national regulations.
- Technical data, connection and installation conditions are specified in the product documentation and must be followed at all times.

National regulations which the user must take into account

- European countries: according to 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)

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3.1.3 Explanation of Warning Symbols and Degrees of Hazard Seriousness

The safety instructions describe the following degrees of hazard seriousness. The degree of hazard seriousness informs about the consequences resulting from non-compliance with the safety instructions:

Warning symbol	Signal word	Degree of hazard seriousness acc. to ANSI Z 535.4-2002
	Danger	Death or severe bodily harm will occur.
	Warning	Death or severe bodily harm may occur.
	Caution	Minor or moderate bodily harm or material damage may occur.

Fig.3-1: Hazard classification (according to ANSI Z 535)

3.1.4 Hazards by Improper Use



DANGER

High electric voltage and high working current! Risk of death or severe bodily injury by electric shock!

Observe the safety instructions!



DANGER

Dangerous movements! Danger to life, severe bodily harm or material damage by unintentional motor movements!

Observe the safety instructions!



WARNING

High electric voltage because of incorrect connection! Risk of death or bodily injury by electric shock!

Observe the safety instructions!



WARNING

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

Observe the safety instructions!



CAUTION

Hot surfaces on device housing! Danger of injury! Danger of burns!

Observe the safety instructions!



CAUTION

Risk of injury by improper handling! Risk of bodily injury by bruising, shearing, cutting, hitting or improper handling of pressurized lines!

Observe the safety instructions!

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CAUTION

Risk of injury by improper handling of batteries!

Observe the safety instructions!

3.2 Instructions with Regard to Specific Dangers

3.2.1 Protection Against Contact with Electrical Parts and Housings

☞ This section concerns devices and drive components with voltages of **more than 50 Volt**.

Contact with parts conducting voltages above 50 Volts can cause personal danger and electric shock. When operating electrical equipment, it is unavoidable that some parts of the devices conduct dangerous voltage.



DANGER

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

- Only those trained and qualified to work with or on electrical equipment are permitted to operate, maintain and repair this equipment.
- Follow general construction and safety regulations when working on power installations.
- Before switching on the device, the equipment grounding conductor must have been non-detachably connected to all electrical equipment in accordance with the connection diagram.
- Do not operate electrical equipment at any time, even for brief measurements or tests, if the equipment grounding conductor is not permanently connected to the mounting points of the components provided for this purpose.
- Before working with electrical parts with voltage potentials higher than 50 V, the device must be disconnected from the mains voltage or power supply unit. Provide a safeguard to prevent reconnection.
- With electrical drive and filter components, observe the following:

  Wait **30 minutes** after switching off power to allow capacitors to discharge before beginning to work. Measure the electric voltage on the capacitors before beginning to work to make sure that the equipment is safe to touch.
- Never touch the electrical connection points of a component while power is turned on. Do not remove or plug in connectors when the component has been powered.
- Install the covers and guards provided with the equipment properly before switching the device on. Before switching the equipment on, cover and safeguard live parts safely to prevent contact with those parts.
- A residual-current-operated circuit-breaker or r.c.d. cannot be used for electric drives! Indirect contact must be prevented by other means, for example, by an overcurrent protective device according to the relevant standards.
- Secure built-in devices from direct touching of electrical parts by providing an external housing, for example a control cabinet.

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For electrical drive and filter components with voltages of **more than 50 volts**, observe the following additional safety instructions.



DANGER

High housing voltage and high leakage current! Risk of death or bodily injury by electric shock!

- Before switching on, the housings of all electrical equipment and motors must be connected or grounded with the equipment grounding conductor to the grounding points. This is also applicable before short tests.
- The equipment grounding conductor of the electrical equipment and the devices must be non-detachably and permanently connected to the power supply unit at all times. The leakage current is greater than 3.5 mA.
- Over the total length, use copper wire of a cross section of a minimum of 10 mm^2 for this equipment grounding connection!
- Before commissioning, also in trial runs, always attach the equipment grounding conductor or connect to the ground wire. Otherwise, high voltages may occur at the housing causing electric shock.

3.2.2 Protection Against Electric Shock by Protective Extra-Low Voltage

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

All connections and terminals with voltages between 5 and 50 volts at Rexroth products are PELV systems. [1] It is therefore allowed to connect devices equipped with basic insulation (such as programming devices, PCs, notebooks, display units) to these connections and terminals.



WARNING

High electric voltage by incorrect connection! Risk of death or bodily injury by electric shock!

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. [2]

3.2.3 Protection Against Dangerous Movements

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

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

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

1) *"Protective Extra-Low Voltage"*

2) *"Protective Extra-Low Voltage"*

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

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DANGER

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

- Ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation.

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

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

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

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3.2.4 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated by current-carrying conductors and permanent magnets in motors represent a serious personal danger to those with heart pacemakers, metal implants and hearing aids.



WARNING

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

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

3.2.5 Protection Against Contact with Hot Parts



CAUTION

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

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

3.2.6 Protection During Handling and Mounting

In unfavorable conditions, handling and mounting certain parts and components in an improper way can cause injuries.

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CAUTION

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

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

3.2.7 Battery Safety

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



CAUTION

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 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 electrical parts installed in the devices.
- Only use the battery types specified by the manufacturer.

☞ 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 separate from other waste. Observe the local regulations in the country of assembly.

3.2.8 Protection Against Pressurized Systems

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

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Safety Instructions for Electric Drives and Controls



CAUTION

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 (for example safety goggles, safety shoes, safety gloves).
- Immediately clean up any spilled liquids from the floor.

☞ Environmental protection and disposal! The agents used to operate the product might not be economically friendly. Dispose of ecologically harmful agents separately from other waste. Observe the local regulations in the country of assembly.

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4 General Specifications of the Components

4.1 Certifications

Declaration of Conformity

For the components, there are declarations of conformity available which confirm that the components have been designed according to the valid EN standards and EC directives. If required, our sales representative can provide you with the declarations of conformity.

Description	Standard
CE conformity regarding Low-Voltage Directive	EN61800-5-1 (IEC 61800-5-1:2003)
CE conformity regarding EMC product standard	EN61800-3 (IEC 61800-3:2004)

Fig.4-1: Applied Standards

CE Label

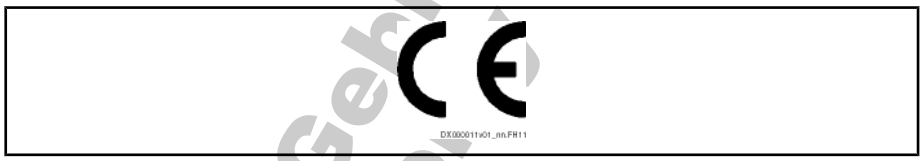


Fig.4-2: CE Label

C-UL-US Listing

In preparation

CCC (China Compulsory Certification)

For the Rexroth drive components 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	-25 … 70
Relative humidity		%	5 … 95
Absolute humidity		g/m^3	1 … 60
Climatic category (IEC721)			2K3
Moisture condensation			Not allowed
Icing			Not allowed

Fig.4-3: Ambient and Operating Conditions - Transport

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4.2.2 Storage of the Components

CAUTION

Damage to the component caused by long storage periods!

Some components contain electrolytic capacitors which may deteriorate during storage.

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

- HCQ and HCT: Operation with mains voltage U_{LN}
- HMQ and HMT: Operation with DC bus voltage U_{DC}

Ambient and Operating Conditions - Storage

Description	Symbol	Unit	Value
Temperature range	T_{a_store}	°C	-25 … 55
Relative humidity		%	5 … 95
Absolute humidity		g/m^3	1 … 29
Climatic category (IEC721)			1K3
Moisture condensation			Not allowed
Icing			Not allowed

Fig.4-4: Ambient and Operating Conditions - Storage

4.3 Installation Conditions

4.3.1 Ambient and Operating Conditions

The **supply units and drive controllers**, as well as their additional components, are designed for control cabinet mounting.

☞ 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 find out 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

Description	Symbol	Unit	Value
Degree of protection (IEC529)			IP20
Use in the scope of CSA / UL			For use in NFPA-79 Applications only.
Temperature during storage			See chapter "Storage of the Components"
Temperature during transport			See chapter "Transport of the Components"
Allowed mounting position (Definition of mounting positions: See chapter Definition of the Mounting Positions of Components on page 22)			G1

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Description	Symbol	Unit	Value
Allowed ambient temperature range	T_{a_work}	°C	0 … 40
Allowed ambient temperature range during operation with reduced nominal data[1)]	$T_{a_work_red}$	°C	0 … 55 See figure "Capacity Utilization at Higher Ambient Temperature" in chapter "Capacity Utilization"
Derating at $T_{a_work} < T_a < T_{a_work_red}$[2)]	f_{Ta}	%/K	See Technical Data of the individual components
Nominal data up to installation altitude	h_{nenn}	m	1000
Maximum installation altitude without additional overvoltage limiter	h_{max_ohne}	m	2000
Maximum installation altitude[3)]	h_{max}	m	4000 See figure "Capacity Utilization at Higher Installation Altitude" in chapter "Capacity Utilization"
Reduced power data above installation altitude at $T_a < T_{a_work_red}$[4)]	h_{red}	m	1000
Relative humidity		%	5 … 95
Absolute humidity		g/m^3	1 … 29
Climatic category (IEC721)			3K4
Allowed pollution degree (EN50178)			2
Allowed dust, steam			EN50178 tab. A.2
Vibration sine: Amplitude (peak-peak) at 10 … 57 Hz[5)]		mm	0,15 ±15 %
Vibration sine: Acceleration at 57 … 150 Hz[5)]		g	1 ±15 %
Vibration noise (random) frequency[5)]		Hz	20 … 150
Vibration noise (random) spectral acceleration density, amplitude[5)]		g^2/Hz	0,005 ±3 dB
Vibration noise (random) rms value of total acceleration[5)]		g	1
Shock test out of operation (EN60068-2-27), 11 ms		g	10
Shock test half sine: Out of operation (6 ms) [7)]		g	-
Vibration sine: Acceleration at 10 … 2000 Hz [6)], axial		g	-
Vibration sine: Acceleration at 10 … 2000 Hz [6)], radial		g	-

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1) Observe derating
2) Data to be derated: PDC_cont; PBD; Iout_cont
3) Install overvoltage limiter for transient overvoltage in the installation to limit the voltage to 1 kV between the outer conductors and to 2.5 kV between conductor-ground.
4) See following characteristic; observe derating
5) According to EN 60068-2-36
6) According to EN 60068-2-6
7) According to EN 60068-2-27

Fig.4-5: Ambient and Operating Conditions

4.3.2 Mounting Positions of Components

CAUTION

Risk of damage to the components!

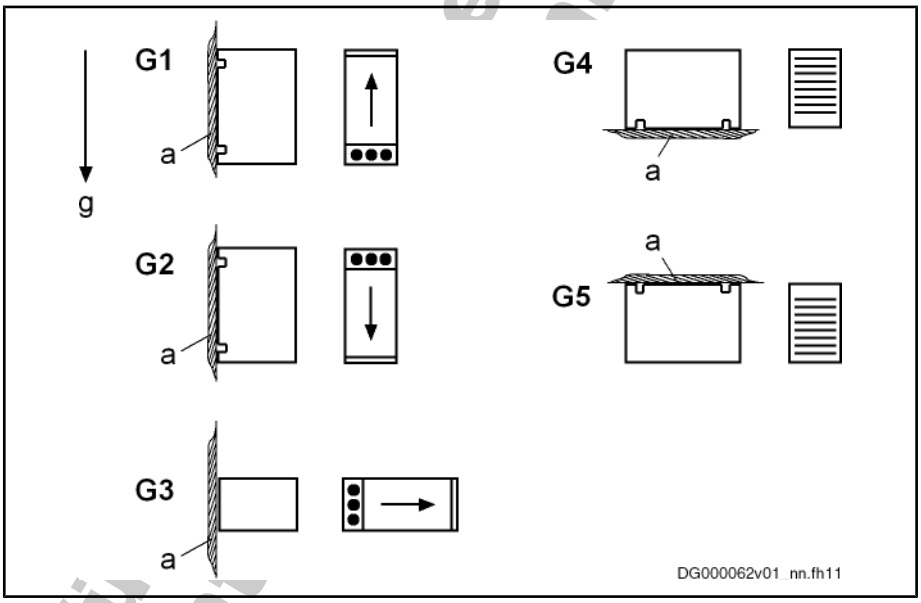
Only operate the components in their allowed mounting positions.

For the allowed mounting positions, see technical data of the respective component (→ Data for Cooling and Power Dissipation).

For Rexroth IndraDrive supply units and drive controllers installed in control cabinets, only the mounting position G1 is allowed as a matter of principle. (G1: See definition of the different mounting positions below).

☞ The **figure below** shows the **theoretically** possible mounting positions. The figure explains the abbreviations **G1…G5**. In the technical data, these abbreviations are used to specify the allowed mounting positions of the components (→ Data for Cooling and Power Dissipation).

Definition of the Mounting Positions of Components



a	Mounting surface
g	Direction of gravitational force
G1	Normal mounting position. The natural convection supports the forced cooling air current. This avoids the generation of pockets of heat in the component.
G2	180° to normal mounting position
G3	Turned by 90° from vertical to horizontal mounting position
G4	Bottom mounting; mounting surface on bottom of control cabinet
G5	Top mounting; mounting surface at top of control cabinet

Fig.4-6: Definition of the Mounting Positions of Components

4.3.3 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 our controls and drives, it cannot be completely ruled out that any reactions with the materials used by Bosch Rexroth might occur.

Nur für den ebenbürtigen Gebrauch

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/our materials.

4.4 Capacity Utilization

Where installation conditions differ, the following performance data are reduced in accordance with the diagrams:

Drive controller:

- Allowed DC bus continuous power P_{DC_cont}
- Braking resistor continuous power P_{BD}
- Continuous current I_{out_cont}

Motor:

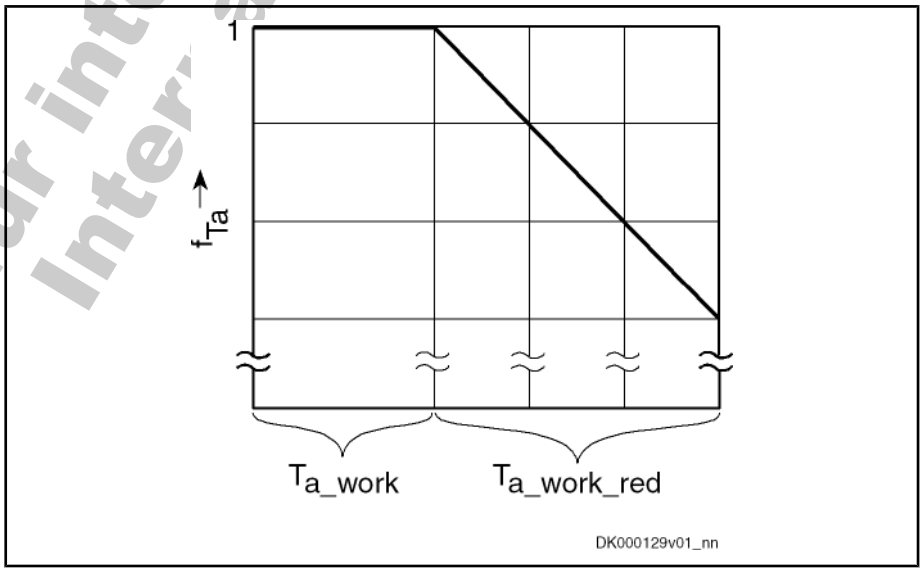
- Power
- Continuous torque at standstill
- S1 continuous torques
- Short-time service torque MKB

If differing ambient temperatures and higher installation altitudes occur simultaneously, both capacity utilization factors must be multiplied. The installation altitude must only be taken into account once, deviating ambient temperatures must be taken into account separately for motor and drive controller.

☞ Use outside of the indicated installation conditions is not allowed, even if the performance data are additionally reduced.

Capacity Utilization vs. Ambient Temperature

As the ambient temperature increases, the capacity utilization of the devices is reduced according to the figure below.

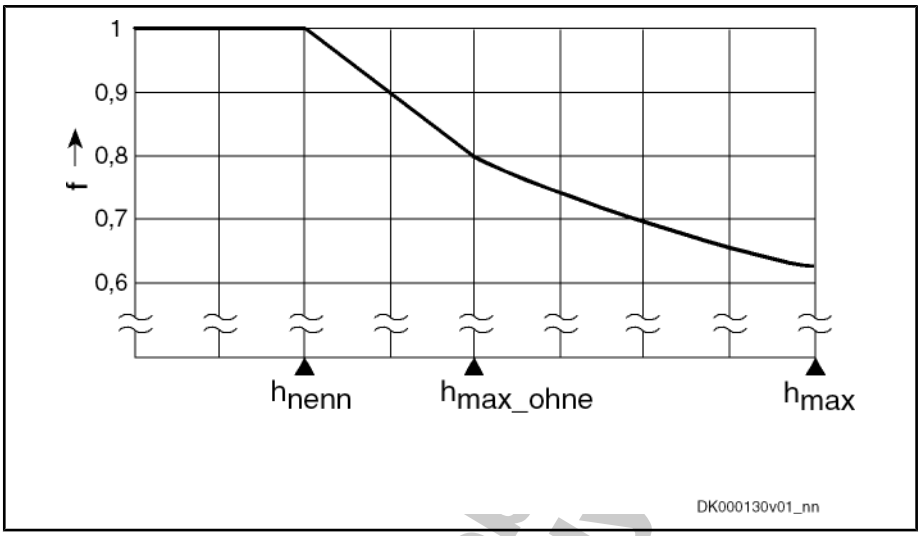


f_{Ta} Capacity utilization factor
$T_{a\ work}$ Ambient temperature range for operation with nominal data
$T_{a\ work\ red}$ Ambient temperature range for operation with reduced nominal data
Fig.4-7: Capacity Utilization at Higher Ambient Temperature

Nur für internen Gebrauch
Internal use only

Capacity Utilization vs. Installation Altitude

As the installation altitude increases, the capacity utilization of the devices is reduced according to the figure below.



f	Capacity utilization factor
h_{nenn}	Maximum installation altitude for operation with nominal data
h_{max_ohne}	Maximum installation altitude for operation with reduced nominal data without using an overvoltage limiter
h_{max}	Maximum installation altitude for operation with reduced nominal data when using an overvoltage limiter

Fig.4-8: Capacity Utilization at Higher Installation Altitude

4.5 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% (EN61800-5-1)
Insulation resistance test	100% (EN50178)

Fig.4-9: Applied Standards

☞ **Voltage test of the installation**

Disconnect all connections to the components or disconnect the plug-in connections to protect the electronic components, before making

- a **voltage test** or
- an **insulation resistance test** for the **installation** in which the components are used.

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4.6 Control Voltage Specification (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 … 28,8** (24 ±20%)
Control voltage for drive systems **with** operation of **motor holding brakes** in Rexroth motors	U_{N3}	V	Depending on the motor cable length, the control voltage must be within the following voltage ranges: Motor cable length **< 40 m**: **22,8 … 25,2** (24 ±5%) Take the data of the corresponding motor holding brake into account.
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.4-10: 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.

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1) *Protective Extra Low Voltage*

☞ **Insulation monitoring impossible**

The input 0 V is connected in conductive form with the housing potential. Insulation monitoring at +24 V and 0 V against housing is impossible.

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5 Technical Data of the Components

5.1 HCQ02 - Four-Axis Converter

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.

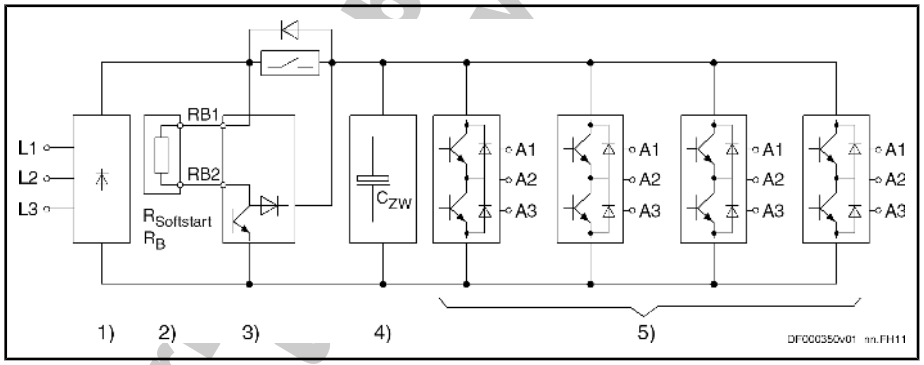
Use

The different types are used as follows:

Type	Use
HCQ02.1E-W025-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-W025-A-03-… Block Diagram

5.1.2 Technical Data

Ambient and Operating Conditions

General Information

Conditions for transport and storage: See chapter "General Specifications of the Components" → "Transport and Storage".

Installation conditions: See chapter "General Specifications of the Components" → "Installation Conditions".

This chapter contains:

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

Nur für interne Nutzung

Technical Data of the Components

UL Data

Ambient and Operating Conditions - UL Ratings

Description	Symbol	Unit	HCQ02.1E-W0025-_-03 planned
Short circuit current rating (UL)[1)]	SCCR	A rms	tbd
Rated input voltage, power (UL) [2)]	U_{LN_nenn}	V	tbd
Rated input current (UL)	I_{LN}	A	44,0
Output voltage (UL)	U_{out}	V	tbd
Output current (UL)	I_{out}	A	tbd
			Last modification: 2008-05-28

1) Use listed AC input line fuses (600 V AC) or listed circuit breakers (600 V AC) at the mains supply
2) 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 planned
Listing according to UL standard (UL)			tbd
UL files (UL)			tbd
Listing according to CSA standard (UL)			tbd
			Last modification: 2008-04-23

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 chapter "Mounting on page 71".

Data for Mass, Dimensions, Sound Pressure Level, Insulation

Description	Symbol	Unit	HCQ02.1E-W0025-_-03 planned
Mass (weight)	m	kg	11,70
Device height (UL)[1)]	H	mm	163...204
Device depth (UL)[2)]	T	mm	455
Device width (UL)[3)]	B	mm	320
Insulation resistance at DC 500 V	R_{is}	Mohm	8,00
			Last modification: 2008-11-04

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Description	Symbol	Unit	HCQ02.1E-W0025-_-03 planned
Capacitance against housing	C_Y	nF	2x 470
Average sound pressure level (accuracy class 2) at P_{DC_cont} 4)	L_P	dB (A)	tbd
			Last modification: 2008-11-04

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 planned
Allowed ambient temperature range during operation with nominal data	T_{a_work}	°C	0...40
Allowed ambient temperature range during 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	2,0
Allowed mounting position			G1
Cooling type			Forced ventilation
Volumetric capacity of forced cooling	V	m^3/h	tbd
Power dissipation at continuous current and continuous DC bus power respectively (UL)1)	P_{Diss_cont}	W	tbd
Minimum distance on the top of the device2)	d_{top}	mm	80
Minimum distance on the bottom of the device3)	d_{bot}	mm	80
Temperature rise with minimum distances d_{bot}; d_{top}; P_{BD}	ΔT	K	tbd
			Last modification: 2008-09-09

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

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

Basic Data Power Section HCQ02

General Information

This section contains

- Data for control voltage supply

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- 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 dimensioning of the power supply unit for 24V supply, take the following aspects into account:

- Power consumption of control voltage P_{N3}
- Power consumption of optional modules (OM1, OM2)
- Power consumption for motor holding brakes

See also chapter "Notes on Project Planning" → "24V Supply".

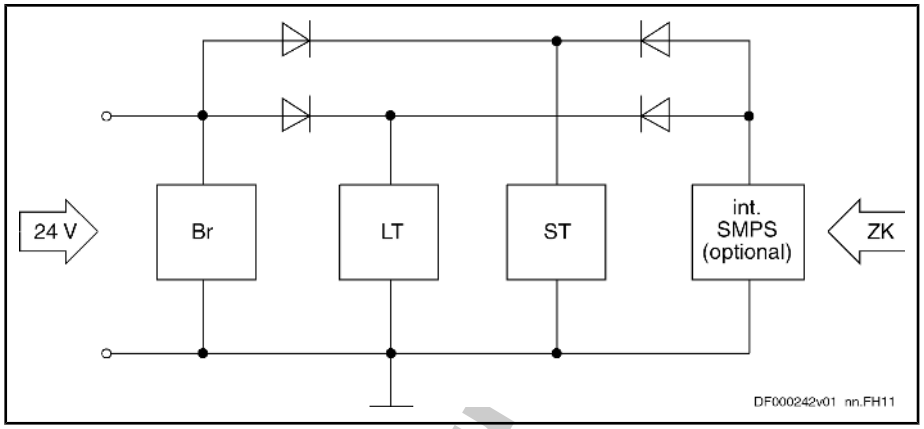
Data for Control Voltage Supply

Description	Symbol	Unit	HCQ02.1E-W0025-_-03 planned
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	< 10
Input capacitance	C_{N3}	mF	2,64
Rated power consumption control voltage input at U_{N3} (UL) [2)]	P_{N3}	W	tbd
			Last modification: 2008-04-23

1) Observe supply voltage for motor holding brake
2) HMS, HMD, HCS plus motor holding brake and control section; HCS01 including control section

Fig.5-7: HCQ - Data for Control Voltage Supply

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BR	Circuit for brake control
LT	Power section, e.g. HCS02
ST	Control section, e.g. CSB01
int. SMPS	For types HCS0x.1E-Wxxxx-NxxV: Internal switched-mode power supply
ZK	DC bus

Fig.5-8: Block Diagram of Internal 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.

Mains Voltage

Single-Phase Mains Connection

Single-phase mains connection

The single-phase mains connection is not allowed!

Data for Mains Voltage Supply

Description	Symbol	Unit	HCQ02.1E-W0025-_-03 planned
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)[1)]	SCCR	A rms	tbd
Nominal mains voltage	U_{LN_nenn}	V	3 AC 400
			Last modification: 2008-05-28

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Technical Data of the Components

Description	Symbol	Unit	HCQ02.1E-W0025-_-03 planned
Mains voltage three-phase at TN-S, TN-C, TT mains	U_{LN}	V	200...500
Mains voltage three-phase at IT mains[2)]	U_{LN}	V	200...500
Mains voltage three-phase at Corner-grounded-Delta mains[3)]	U_{LN}	V	200...500
Tolerance U_{LN} (UL)		%	±10
Minimum inductance of the mains supply (inductance of mains phase)[4)]	L_{min}	µH	40
Assigned type of mains choke			HNL01.1E-0400-N0051-A-480
Assigned type of mains filter			
Minimum short circuit power of the mains for failure-free operation	S_{k_min}	MVA	tbd
Inrush current	$I_{L_trans_max_on}$	A	56,4 @ 3AC400V; 10 ohm
Maximum allowed ON-OFF cycles per minute[5)]			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}[6)]	TPF		-
Power factor TPF (λ_L) at 10% P_{DC_cont} without mains choke; U_{LN_nenn}[7)]	TPF_{10}		-
Power factor of fundam. component DPF at P_{DC_cont} with mains choke	$\cos\varphi^{h1}$		tbd
Power factor of fundam. component DPF at P_{DC_cont} without mains choke	$\cos\varphi^{h1}$		-
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	-
Rated input current (UL)	I_{LN}	A	44,0
Nominal current AC1 for mains contactor at nom. data with mains choke; U_{LN_nenn}			I L_cont
			Last modification: 2008-05-28

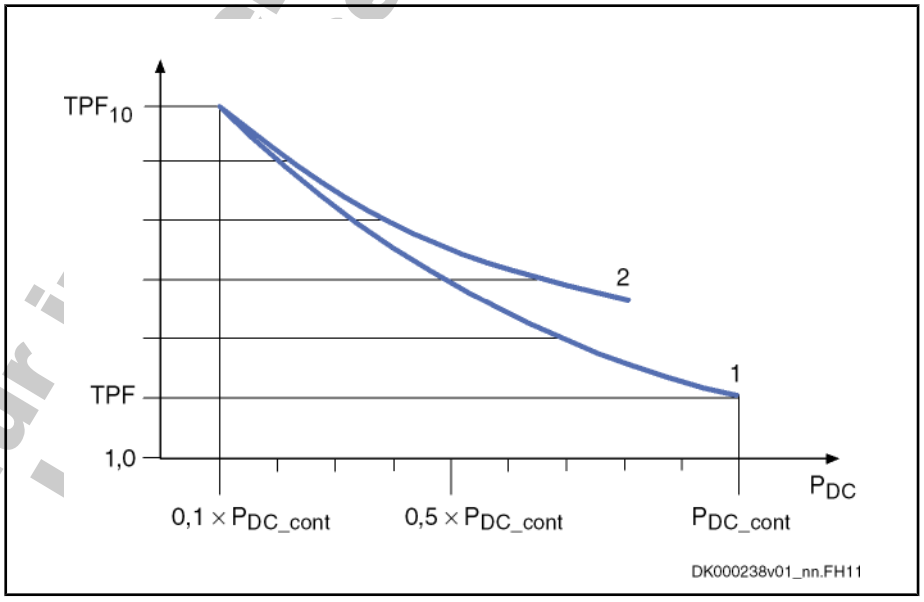
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Description	Symbol	Unit	HCQ02.1E-W0025-_-03 planned
Mains fuse according to IEC 60364-5-52; at nom. data with mains choke; U_{LN_nenn}		A	63; gL
Required wire size according to IEC 60364-5-52; at I_{LN} 8)	A_{LN}	mm^2	16
Required wire size according to UL 508 A (internal wiring); at I_{LN} (UL) 9)	A_{LN}	AWG	AWG 6
			Last modification: 2008-05-28

1) Use listed AC input line fuses (600 V AC) or listed circuit breakers (600 V AC) at the mains supply
2) 3) Mains voltage > ULN: Use a transformer with grounded neutral point, don´t use autotransformers!
4) Otherwise use mains choke HNL
5) Without external capacities on DC bus
6) 7) Find interim values by interpolation
8) Copper wire; PVC-insulation (conductor temperature 70 °C); installation method B2; table B52-4; Ta ≤ 40 °C
9) Copper wire; PVC-insulation (conductor temperature 90 °C); table 13.5.1; Ta ≤ 40 °C

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

Qualitative Characteristic TPF vs. DC Bus Power PDC_cont



TPF_{10}; TPF Values From Table "Data for Mains Voltage Supply"
P_{DC_cont} Values From Table "Data of Power Section - DC Bus"
1 With mains choke
2 Without mains choke

Fig.5-10: Qualitative Characteristic TPF vs. DC Bus Power PDC_cont

Nur für den Gebrauch

Technical Data of the Components

DC Bus

Data of Power Section - DC Bus

Description	Symbol	Unit	HCQ02.1E-W0025-_-03 planned
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-) at U_{DC} = 750 V	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	-
P_{DC_cont} and P_{DC_max} vs. mains input voltage; $U_{LN} \leq U_{LN_nenn}$		%/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	tbd
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	tbd
Monitoring value maximum DC bus voltage, switch-off threshold	$U_{DC_limit_max}$	V	tbd
Monitoring value minimum DC bus voltage, undervoltage threshold	$U_{DC_limit_min}$	V	tbd
Charging resistor continuous power	P_{DC_Start}	kW	External resistor required
Maximum allowed external DC bus capacitance[1)]	C_{DCext}	mF	5,00
Charging time at maximum allowed C_{DCext} external DC bus capacitance at U_{LN_nenn}	$t_{lade_DC_Cext}$	s	tbd
			Last modification: 2008-11-18

1) Use assigned type of mains choke

Fig.5-11: HCQ - Data of Power Section - DC Bus

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Braking Resistor

Use external braking resistor!

For charging current limitation when connecting the mains voltage, HCQ02 need an external resistor ($R_{Softstart}$).

After the mains voltage has been connected, the external resistor is operated as a braking resistor ($R_{DC_Bleeder}$).

Requirements on External Braking Resistor

Description	Symbol	Unit	HCQ02.1E-W0025-_-03 planned
Resistance value of external braking resistor[1)]	$R_{DC_Bleeder}$	ohm	9 ... 11
Minimum continuous power of external braking resistor[2)]	P_{BD}	kW	2,00
Maximum regenerative power to be absorbed	W_{R_max}	kWs	100,00
			Last modification: 2008-09-09

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

Fig.5-12: HCQ - Requirements on External Braking Resistor

Inverter

Data of Inverter Outputs

Description	Symbol	Unit	HCQ02.1E-W0025-_-03 planned			
			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			
			Last modification: 2008-10-30			

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Technical Data of the Components

Description	Symbol	Unit	HCQ02.1E-W0025-_-03 planned			
			X5.1	X5.2	X5.3	X5.4
Maximum output current at f_s = 4 kHz	I_{out_max4}	A	55,0	50,0	31,0	
Maximum output current at f_s = 8 kHz	I_{out_max8}	A	34,4	34,3	23,2	23,1
Allowed continuous output current at f_s = 4 kHz	I_{out_cont4}	A	34,9	20,0	14,0	
Allowed continuous output current at f_s = 8 kHz	I_{out_cont8}	A	18,4	16,7	14,0	
Allowed continuous output current at f_s = 4 kHz; output frequency $f_{out} < f_{out_still}$	$I_{out_cont0Hz_4}$	A	19,8	17,7	12,5	12,4
Allowed continuous output current at f_s = 8 kHz; output frequency $f_{out} < f_{out_still}$	$I_{out_cont0Hz_8}$	A	6,0	8,6	7,3	
Assigned output filters at nom. data; f_s = 4 kHz			tbd			
Last modification: 2008-10-30						

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.5-13: HCQ - Data of Inverter Outputs

Guide value "Rise of voltage at output"

Observe that the 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.

Observe the information contained in the chapter "Third-Party Motors at IndraDrive Controllers" in the Project Planning Manual of the drive system.

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.

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6 Electrical Connection Points

6.1 Connection Diagram HCQ02

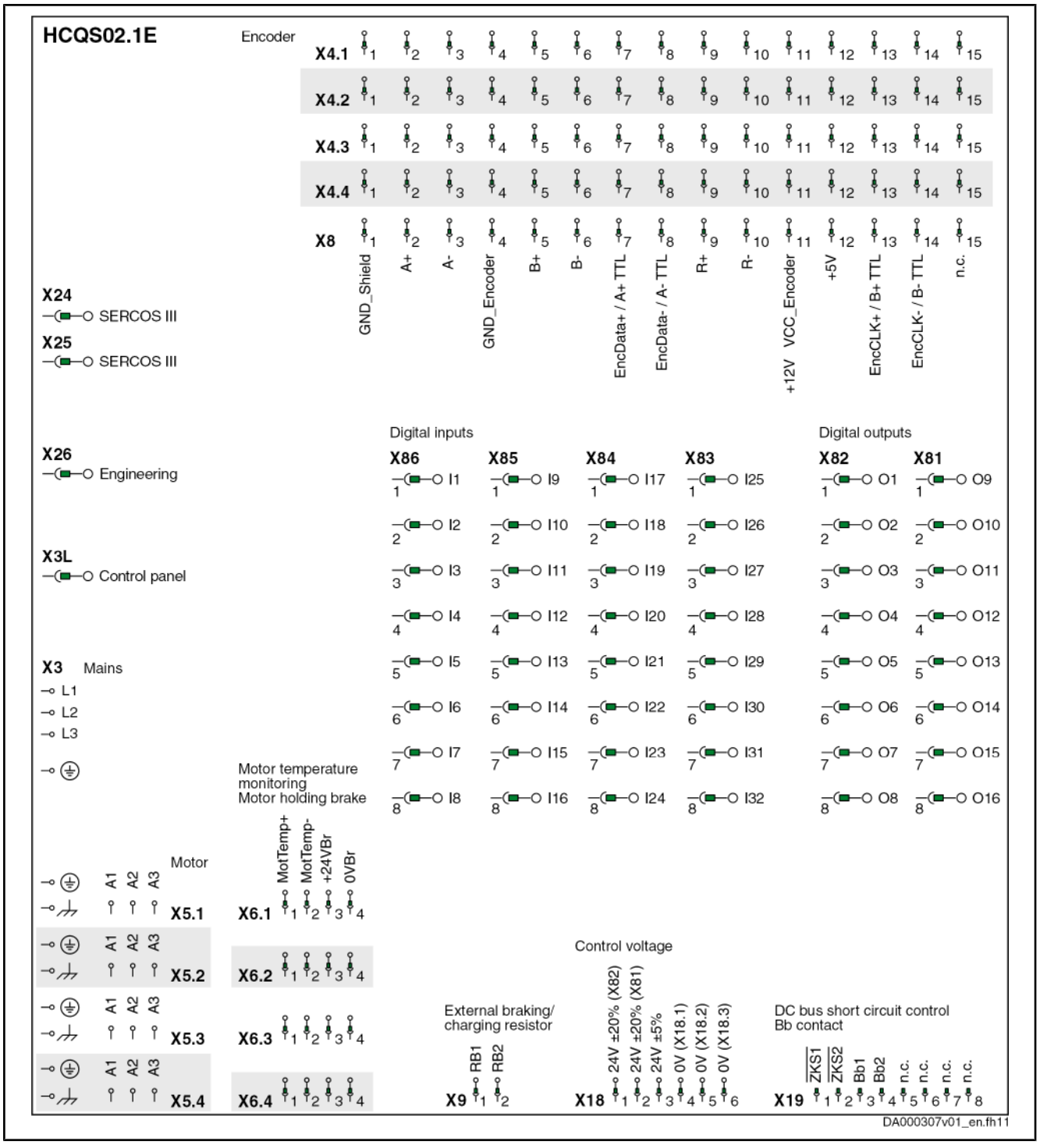


Fig.6-1: Overall Connection Diagram

Electrical Connection Points

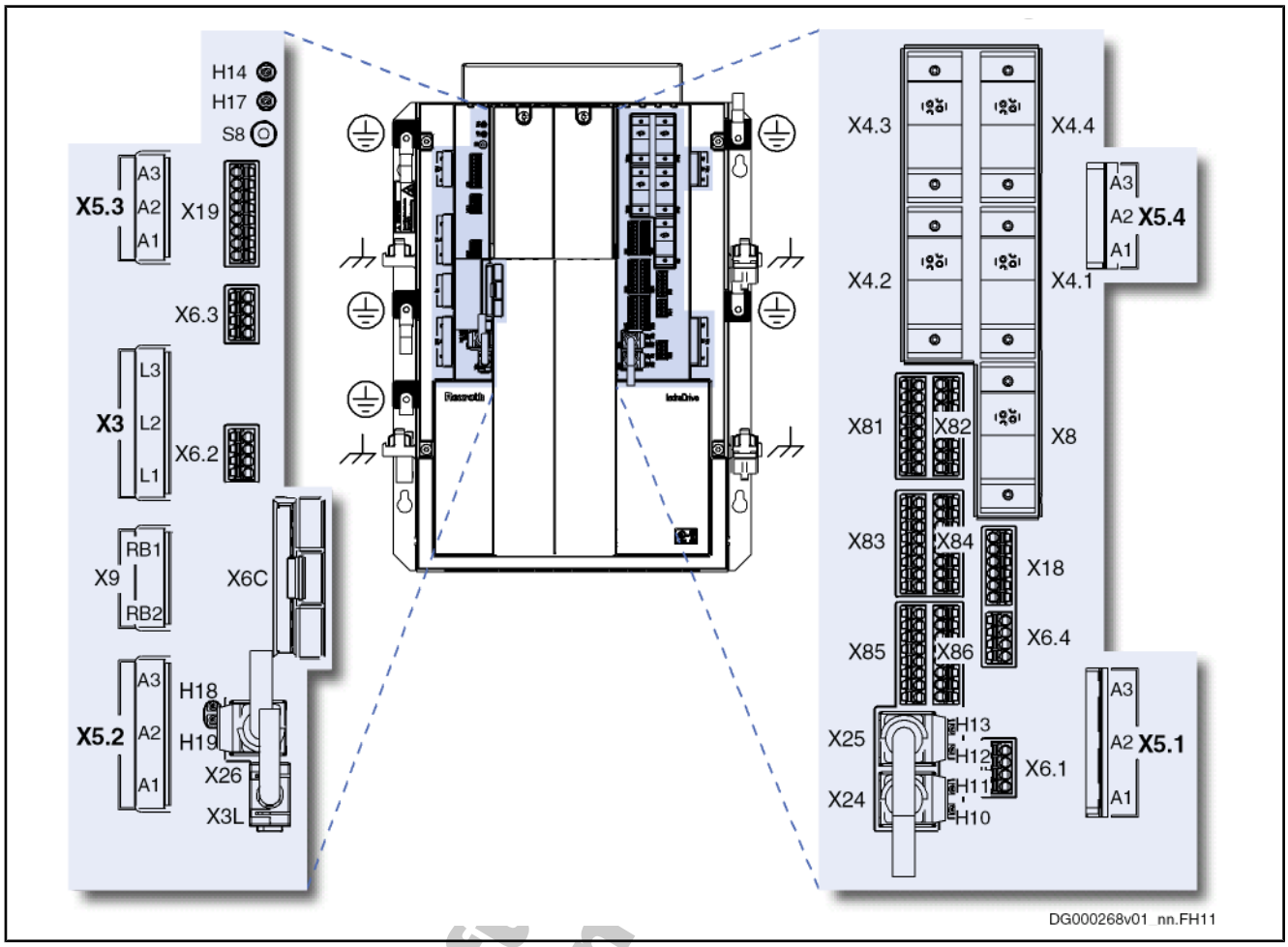
6.2 Arrangement of the Connection Points HCQ02

WARNING

Lethal electric shock caused 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 control panels
X4.1…4.4	Encoder evaluation
X5.1…5.4	Motor connection (inverter output)
X6.1…6.4	Motor temperature monitoring and motor holding brake
X6C	Extension of memory with CompactFlash memory card
X8	Optional encoder evaluation
X9 (RB1, RB2)	External braking and charging resistor
X18	24V power supply (for control voltage and brake voltage)
X19	Bb contact, DC bus short circuit control, module bus
X24, X25	Communication
X26	Engineering interface
X81, X82	Digital outputs
X83…86	Digital inputs

Fig.6-2: Connection Points HCQ02.1E-W025-A-03 Front

6.3 Connection of Equipment Grounding Conductor



WARNING

Lethal electric shock caused 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:

For **HCQ02** drive controllers, **at least 10 mm²**, but not smaller than the cross sections of the outer conductors of the mains supply feeder.

For outer conductors with a cross section greater than 16 mm², you can reduce the cross section of the equipment grounding connection according to the table "Equipment Grounding Conductor Cross Section, Excerpt From EN 61800-5-1:2003, Table 2".

Cross-sectional area A of outer conductors	Minimum cross-sectional area A_{PE} of equipment grounding connection
A ≤ 16 mm²	A
16 mm² < A ≤ 35 mm²	16
35 mm² < A	A / 2

Fig.6-3: Equipment grounding conductor cross section, excerpt from EN 61800-5-1:2003, table 2

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.

   See Project Planning Manual "Rexroth IndraDrive – Drive System" chapter "Dimensioning the Mains Connection"

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6.5 X3, Mains Connection

CAUTION

Damage to the device!

Provide strain relief for the terminal connectors of the device in the control cabinet or use the optionally available connection accessory HAS02.

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	7	6
Stripped length	mm	12	13
Occurring current load and minimum required connection cross section	A	See technical data of device used (I_{L_cont}, I_{L_max} and A_{LN})	
Occurring voltage load	V	See technical data of device used (U_{LN})	

Fig.6-4: Function, Pin Assignment, Properties

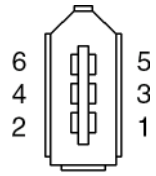
Notes on Installation

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

6.6 X3L, Interface for Control Panels

Function, Pin Assignment

Control 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 control panel
	4	USB+	
	5	LVDS-	LVDS interface to control panel
	6	LVDS+	

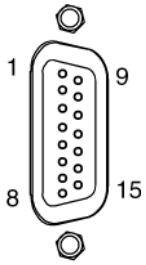
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Properties	
Type	Female (device); FireWire IEEE1394a, 6-pin

Fig.6-5: 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 chapter "Technical Data - Functions"		

Fig.6-6: 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	17	6
Stripped length	mm	11	12

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Electrical Connection Points

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.6-7: 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
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.

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



DANGER

Dangerous movements! Danger to personnel 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 the safety of personnel!

Personnel safety must be achieved using higher-ranking, fail-safe procedures:

- Dangerous areas should be blocked off with protective fences or grids
- Additionally secure vertical axes against falling or dropping after switching off the motor power by, for example:
  - mechanically securing the vertical axes
  - providing external braking/catching/clamping mechanisms
  - ensuring sufficient equilibration of the vertical axes

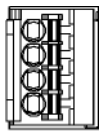
Function

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	mm^2	0,2	1,5
Stranded wire	AWG	24	16
Current load capacity of outputs for controlling motor holding brakes			
HCQ02	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

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Electrical Connection Points

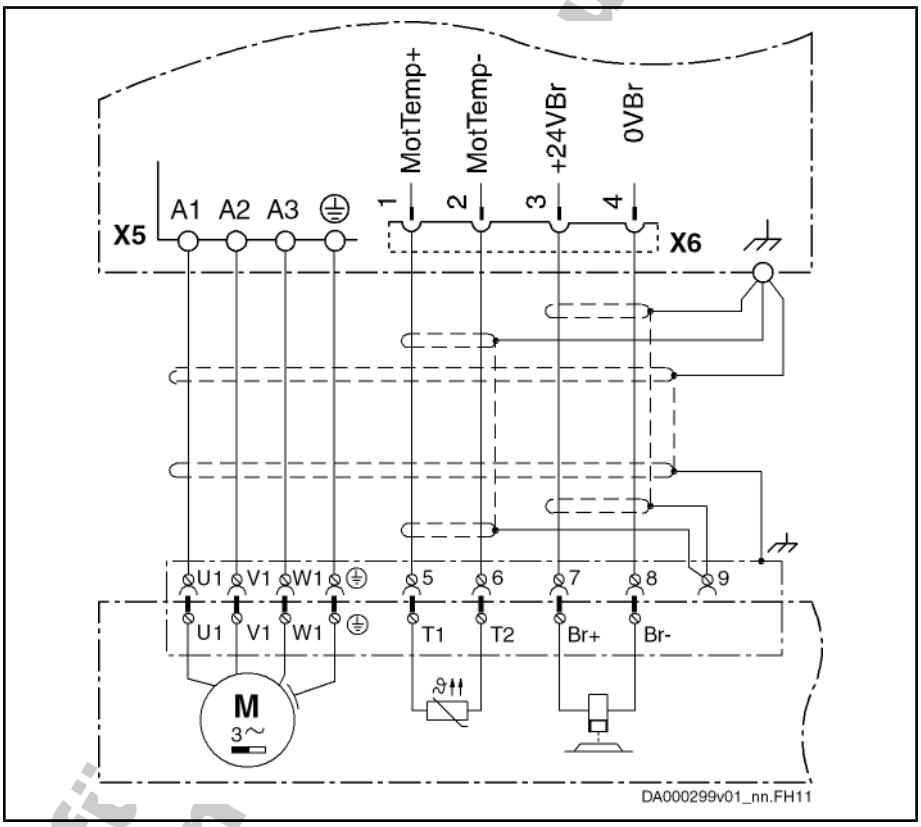
Short circuit protection		Available
Overload protection		Available
Integrated contact element for controlling the motor holding brake		Electronic contact

Fig.6-9: 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 **connecting 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.x.

Connection Diagram



The connection of the equipment grounding conductor can either be at terminal connector X5 or directly at the drive controller (this figure shows a terminal connector X5 with connection of the equipment grounding conductor).

Fig.6-10: Connection of Motor Temperature Monitoring and Motor Holding Brake

Nur für den

Brake Supply

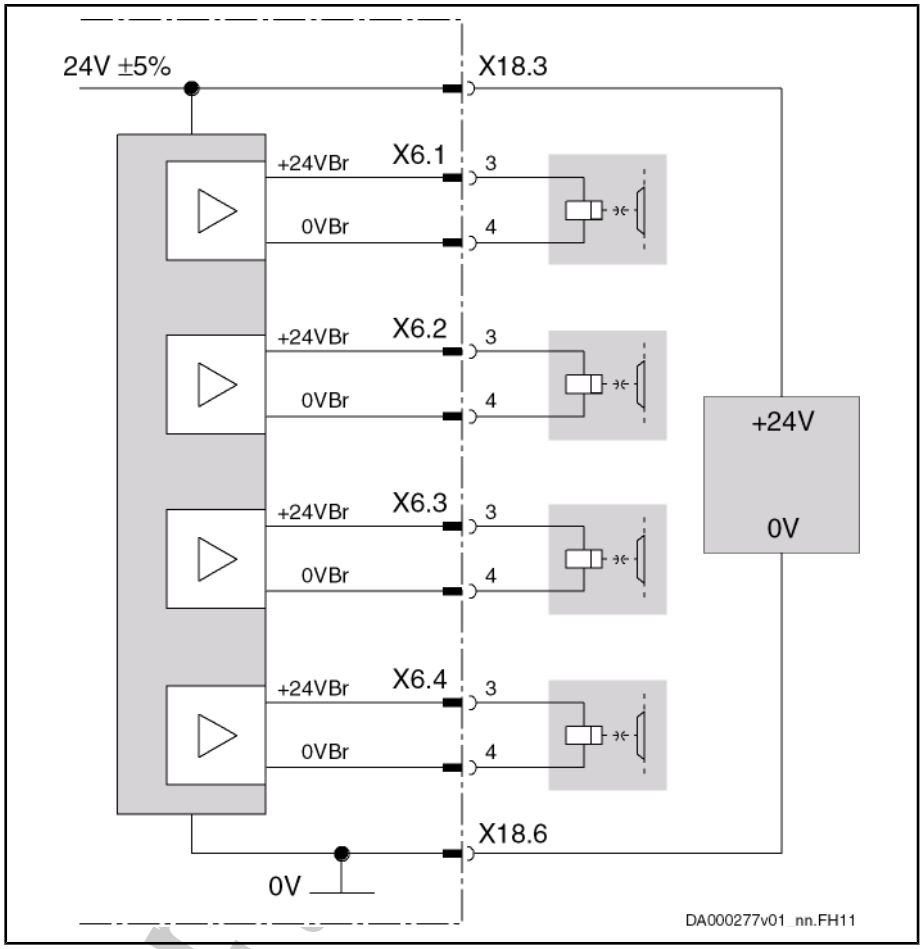


Fig.6-11: Design of Brake Supply

6.11 X6C, Extension of Memory

Function, Pin Assignment

The connection point X6C is used as a plug-in slot for extension of memory with CompactFlash memory cards.

6.12 X8, Optional Encoder Evaluation

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

Data: See description of connection point X4.1 … X4.4

6.13 X9, External Braking and Charging Resistor

☞ The external braking resistor must be parameterized via the firmware to protect the drive controller and the braking resistor against overload.

See also Parameter Description of the firmware used:

"P-0-0860, Converter configuration"

and

"P-0-0858, Data of external braking resistor"

Nur für interne Internal

Electrical Connection Points

Function X9 is used to connect an external braking resistor. By means of an internal switch, the braking resistor is connected to the DC bus.

View	Connection	Signal name	Function
	RB1	n.s.	Connection braking resistor
	RB2	n.s.	Connection braking resistor
Spring terminal	**Unit**	**Min.**	**Max.**
Connection cable	mm^2	2,5	6
Stranded wire	AWG	14	10
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.6-12: Function, Pin Assignment

Notes on Installation Maximum allowed line length to external braking resistor: **5 m**

Twist unshielded lines.



CAUTION

Risk of damage by insufficient installation!

By means of appropriate fusing elements, protect the output against overcurrent in the case of short circuit and ground fault.

6.14 X18, 24V Supply (Control Voltage)

Function, Pin Assignment The external 24V supply is applied via connection point X18 for:

- Power section of drive controller
- Control section of drive controller
- Brake control via X6
- Digital outputs at X81 and X82
- Device-internal blower

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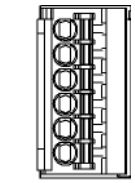
View	Connection	Requirement	Function
 DG000269.FH11	1	24 V ±20%	Supply (power section and control section) • Digital outputs X82.1 … 8 • Blower
	2	24 V ±20%	Supply of digital outputs X81.1 … 8
	3	24 V ±5%	Supply of motor holding brakes
	4	0 V	Reference potential for power supply (X18.1)
	5	0 V	Reference 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	See P_{N3} (see technical data of the device)	
Voltage load capacity	V	See U_{N3} (see technical data of the device)	
Polarity reversal protection		Within the allowed voltage range by internal protective diode	

Fig.6-13: Function, Pin Assignment, Properties

Notes on Installation

- **Fusing** (recommended fusing at 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)
- The 0V connections at connector X18 (X18.4, 18.5, 18.6) are jumpered in the drive controller.
- **Grounding of control voltage (0 V)**

  The control voltage (0 V) should be grounded as near as possible to the drive controller so that the lowest possible impedance to the ground of the drive controller is ensured.

☞ The input 0V is connected in conductive form with the housing potential. It is therefore **impossible** to use an **insulation monitor** at +24V and 0V against housing.

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6.15 X19, Bb Contact, DC Bus Short Circuit Control

CAUTION

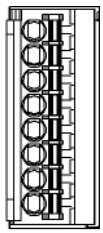
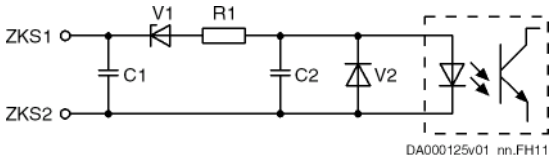
Risk of fire caused by the "sacrificing behavior" of the ZKS stage!

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:

- Do not use drive controllers with integrated ZKS stage or
- 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.
Connection cross section solid wire	mm^2	0,5	1,5

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Connection cross section stranded wire	mm^2	0,5	1,5
Connection cross section	AWG	24	16
Type of contact		Relay contact type 3 For technical data, see chapter "Technical Data - Functions"	

Fig.6-14: Function, Pin Assignment, Properties

☞ Include the Bb1 contact in the control circuit for mains connection. See chapter "Mounting and Installation" →"Installation" →"Connection Diagram".

When Bb1 contact opens, the mains contactor must interrupt the power supply.

6.16 X24 and X25, SERCOS III Master

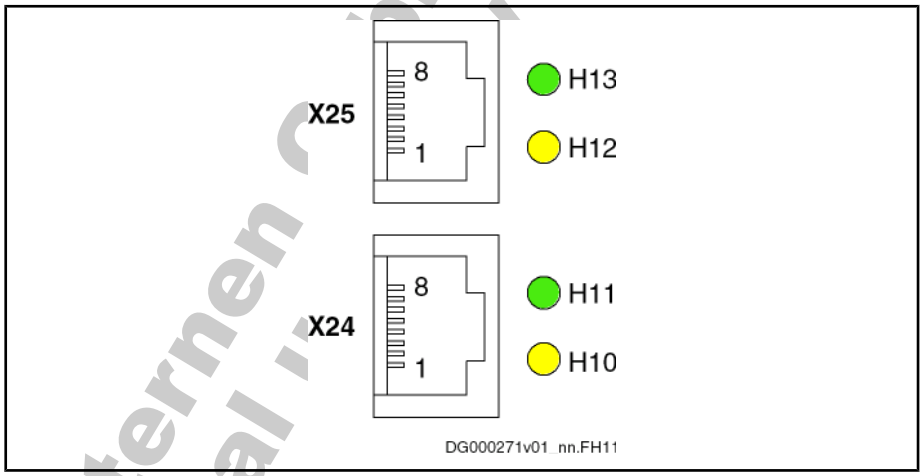
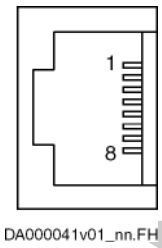


Fig.6-15: SERCOS III Master Connection Points

Description

View	Connection	Signal name	Function
	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		

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Electrical Connection Points

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 (100 m at maximum) to connect the drive system to the higher-level control unit. Minimum bending radius: – 48.75 mm with flexible installation – 32.50 mm with permanent installation 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. Order code for a 0.55 m long cable: RKB0013/00,55

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

H10, H11, H12, H13 Diagnostic LEDs:

See chapter "Commissioning, Operation, Diagnostics" → "Diagnostic Displays"

6.17 X26, Engineering Interface

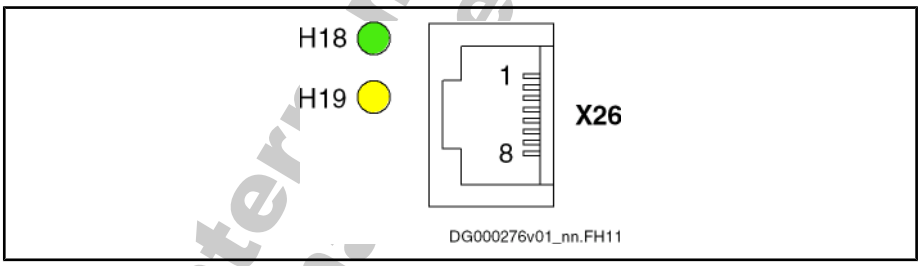
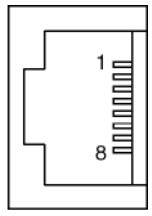


Fig.6-17: X26

Description

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		

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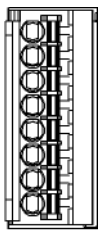
Compatibility	100Base-TX according to IEEE 802.3u
Recommended cable type	• According to **CAT5e**; type of shield ITP (Industrial Twisted Pair) • Ready-made cables which can be ordered: – **RKB0011** Long cables (100 m at maximum) to connect the drive system to the higher-level control unit. Minimum bending radius: – 48.75 mm with flexible installation – 32.50 mm with permanent installation 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. Order code for a 0.55 m long cable: RKB0013/00,55

Fig.6-18: Function, Pin Assignment, Properties

H18, H19 Diagnostic LEDs:

See chapter "Commissioning, Operation, Diagnostics" → "Diagnostic Displays"

6.18 X81 and X82, Digital Outputs

View	Connection X81 X82	Signal X81	Signal X82	Function
 DG000261.FH11	1	O9	O1	The digital outputs correspond to "IEC 61131, type 1". Power supply +24 V ±20%: • X81 ⇒ X18.2 • X82 ⇒ X18.1 Reference potential 0 V: • X81 ⇒ X18.5 • X82 ⇒ X18.4 Technical data: See chapter "Technical Data - Functions"
	2	O10	O2	
	3	O11	O3	
	4	O12	O4	
	5	O13	O5	
	6	O14	O6	
	7	O15	O7	
	8	O16	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.6-19: Signal Assignment

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6.19 X83 ... X86, Digital Inputs

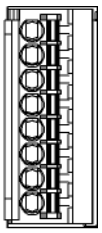
Type	Number of poles	Solid wire [mm²]	Stranded wire [mm²]	AWG	Figure
Spring terminal Female (connector)	8	0,2–1,5	0,2–1,5	24–16	 DG000261.FH11

Fig.6-20: Data of Connection Point

X83, X84

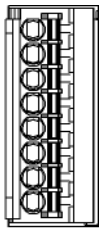
View	Connection X83 X84	Signal X83	Signal X84	Technical data
 DG000261.FH11	1	I25	I17	The digital inputs correspond to "IEC 61131, type 1". Reference potential 0 V ⇒ X18.4 Technical data: See chapter "Technical Data - Functions" → Digital Inputs Type 1
	2	I26	I18	
	3	I27	I19	
	4	I28	I20	
	5	I29	I21	
	6	I30	I22	
	7	I31	I23	
	8	I32	I24	

Fig.6-21: Signal Assignment X83, X84

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X85

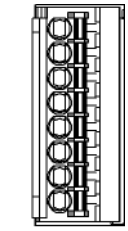
View	Connection X85	Signal X85	Factory setting	Technical data
 DG000261.FH11	1	I9	Travel range limit switch negative axis 1	The digital inputs correspond to "IEC 61131, type 1". Reference potential 0 V ⇒ X18.4 Technical data: See chapter "Technical Data - Functions" → Digital Inputs Type 1
	2	I10	Travel range limit switch positive axis 2	
	3	I11	Travel range limit switch negative axis 2	
	4	I12	Travel range limit switch positive axis 3	
	5	I13	Travel range limit switch negative axis 3	
	6	I14	Travel range limit switch positive axis 4	
	7	I15	Travel range limit switch negative axis 4	
	8	I16		

Fig.6-22: Signal Assignment X85

X86

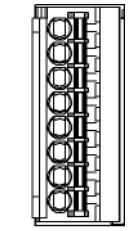
View	Connection X86	Signal X86	Factory setting	Technical data
 DG000261.FH11	1	I1	E-Stop (all axes)	The digital inputs correspond to "IEC 61131, type 1". Can be additionally used as **probes**. Reference potential 0 V ⇒ X18.4 Technical data: See chapter "Technical Data - Functions" → Digital Inputs Type 2 (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 chapter "Technical Data - Functions" → Digital Inputs Type 1
	6	I6	Home switch axis 3	
	7	I7	Home switch axis 4	
	8	I8	Travel range limit switch positive axis 1	

Fig.6-23: Signal Assignment X86

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6.20 XS2, Shield Connection Motor Cable

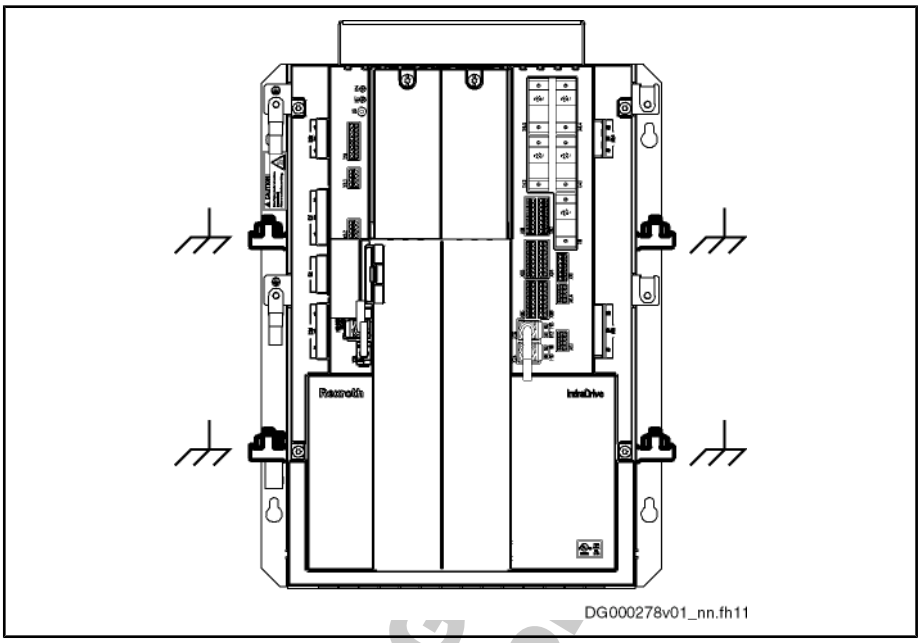


Fig.6-24: Shield Connection Motor Cable

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

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7 Optional Modules

7.1 OM1 and OM2

Optional extensions are possible at the slots OM1 and OM2.

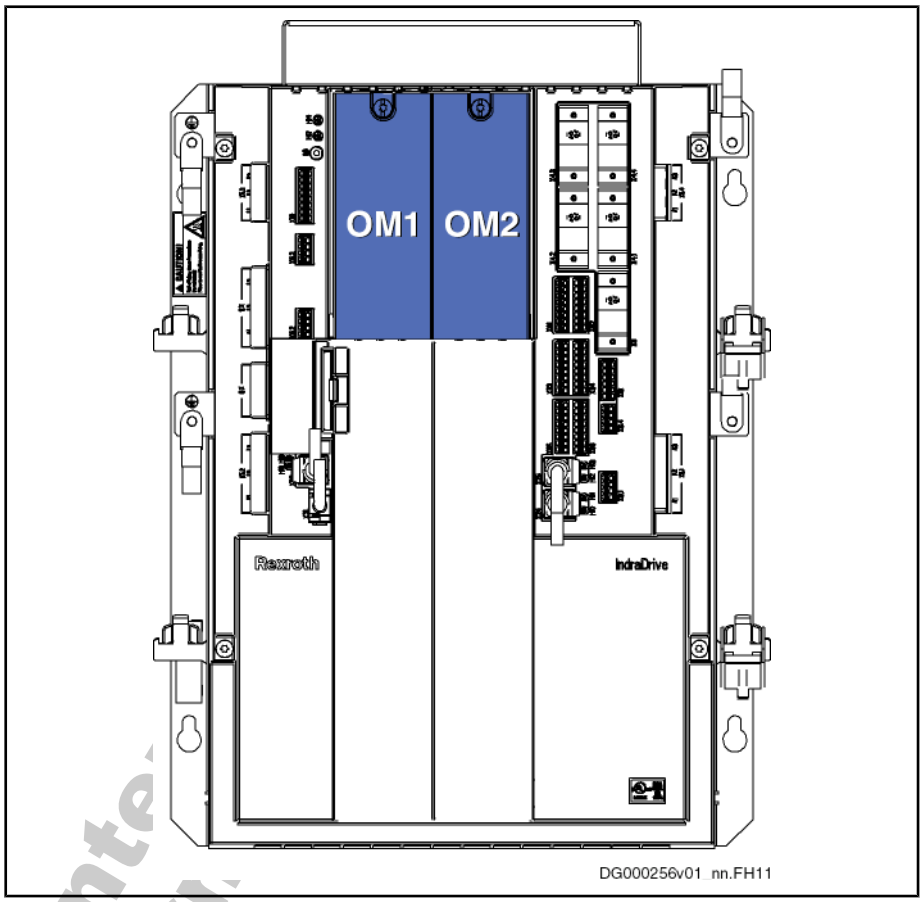


Fig.7-1: Position of OM1, OM2

Optional extension	OM1	OM2
Digital I/O extension	■	■

Fig.7-2: Configuration Table

Nur für interne

7.2 Digital I/O Extension

7.2.1 Interfaces

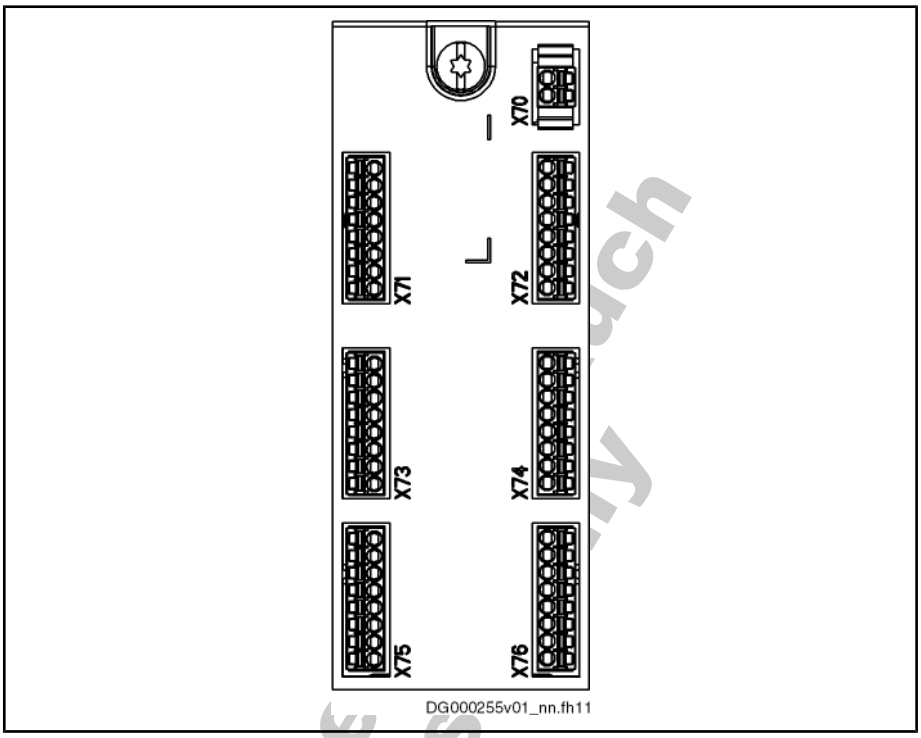


Fig.7-3: Interfaces

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

Fig.7-4: Interfaces

7.2.2 X70, External 24 V Power Supply

Description

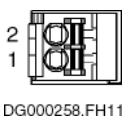
Connection point	Type	Number of poles	Solid wire [mm²]	Stranded wire [mm²]	AWG	Figure
X70	Spring terminal Female (connector)	2	0,2–1,5	0,2–1,5	24–16	

Fig.7-5: Connections

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Pin Assignment

Function	Signal	Connection	Technical data
Power supply	+24V	1	24 V ±20% Max. 4 A
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.

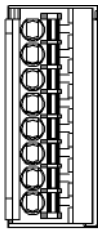
Connection point	Type	Number of poles	Solid wire [mm²]	Stranded wire [mm²]	AWG	Figure
X71 X72	Spring terminal Female (connector)	8	0,2–1,5	0,2–1,5	24–16	 DG000257.FH11

Fig.7-7: Connections

Pin Assignment

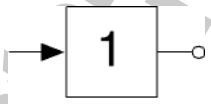
Function	Connection	Technical data
Digital outputs  DX000038v01_nn.fh11	1	The digital outputs correspond to "IEC 61131, type 1". See chapter "Technical Data - Functions" Reference potential 0 V at X70.2
	2	
	3	
	4	
	5	
	6	
	7	
	8	

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
X71.6	O30	O46
X71.7	O31	O47

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Optional Modules

Connection	Optional module	
	OM1	OM2
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.

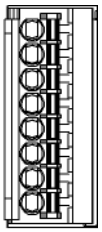
Connection point	Type	Number of poles	Solid wire [mm²]	Stranded wire [mm²]	AWG	Figure
X73 X74 X75 X76	Spring terminal Female (connector)	8	0,2–1,5	0,2–1,5	24–16	 DG000257.FH11

Fig.7-10: Connections

Pin Assignment

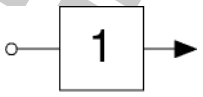
Function	Connection	Technical data
Digital inputs  DX000037v01_nn.fh11	1	The digital inputs correspond to "IEC 61131, type 1". See chapter "Technical Data - Functions" Reference potential 0 V at X70.2
	2	
	3	
	4	
	5	
	6	
	7	
	8	

Fig.7-11: Pin Assignment

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Signal Assignment

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Optional Modules

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

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

Fig.7-12: Signal Assignment

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8 Notes on Project Planning

8.1 24V Supply

Power Consumption of the Drive Controller

24V supply	Component	Max. current [A]	Max. power consumption [W]
24 V ±20% (at X18.1)	Basic device 4)	5,6 3)	108 1)
	Digital outputs (X82.1–8)	2 (0.5 per output)	58 2)
24 V ±20% (at X18.2)	Digital outputs (X81.1–8)	2 (0.5 per output)	58 2)
24 V ±5% (at X18.3)	Motor holding brakes (max. 4 brakes)	4,5 (1.3 per brake)	113 2)
24 V ±20% (at X70.1, optional module "Digital I/O extension")	Digital outputs (X71.1–8)	2 (0.5 per output)	58 2)
	Digital outputs (X72.1–8)	2 (0.5 per output)	58 2)

1) Applies to entire range of input voltage 19.2 … 28.8 V (= 24 V ±20%), because voltage is controlled
2) Applies to input voltage 25.2 V (= 24 V +5%); accordingly lower power consumption results from lower input voltage
3) Limitation of inrush current at 13.8 A with 5.2 ms of maximum pulse width
4) Basic device: Power section, control section, blower, encoder

Fig.8-1: Power Consumption of the Drive Controller

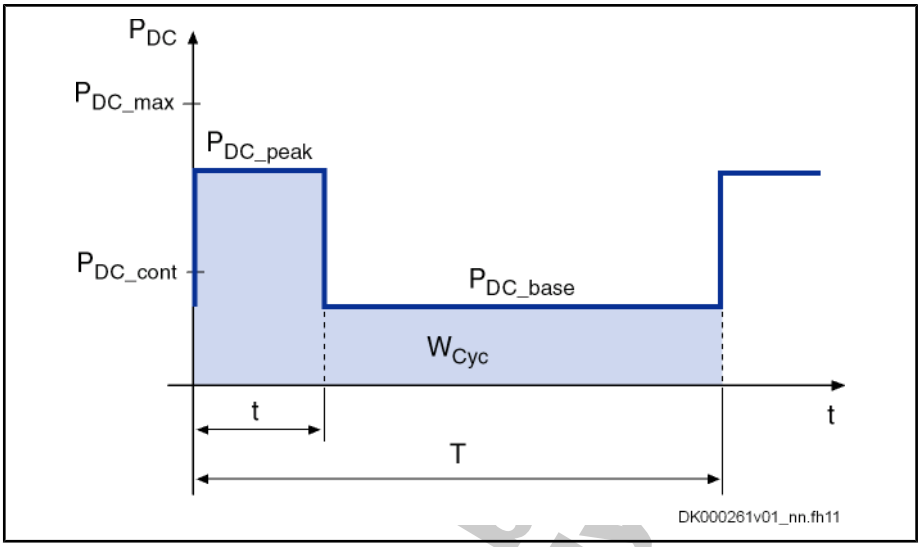
8.2 DC Bus Load

8.2.1 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.

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8.2.2 Calculation of Performance Profile



P_{DC_max}, P_{DC_cont}	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}

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

   Individual processes

   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}.

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

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9 Scope of Supply

Scope of supply **HCQ02**:

- 1 × touch guard
- 1 × connector each for
  - X6.1…6.4
  - X18
  - X19
  - X81…86
- 1 × brochure with safety instructions (in 5 languages)

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10 Identifying and Checking the Delivered Components

10.1 Type Plate

10.1.1 Arrangement

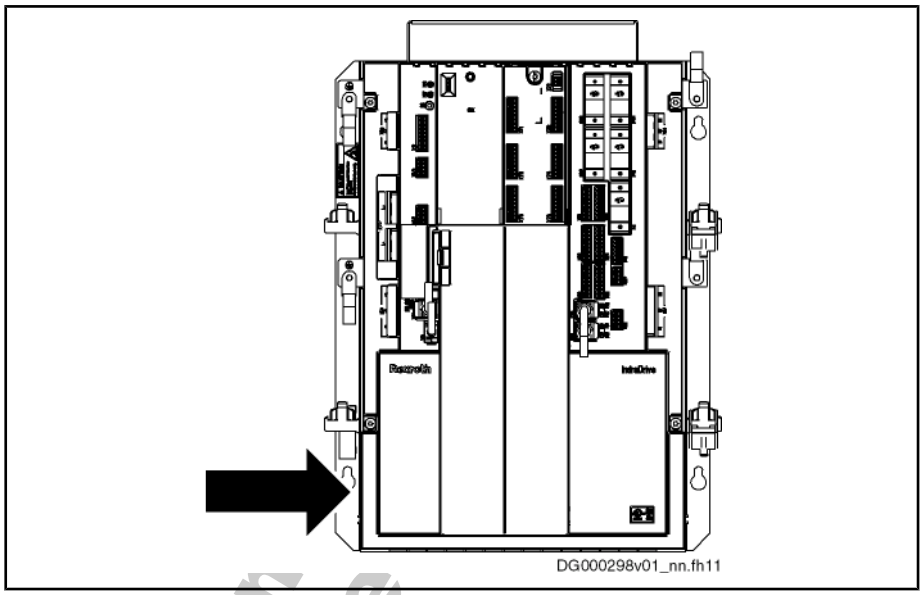
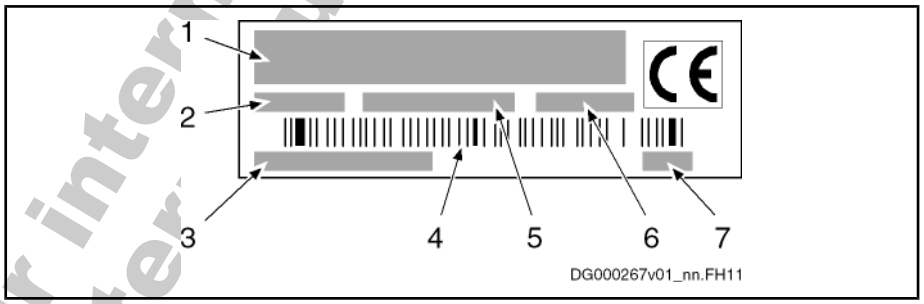


Fig.10-1: Type Plate Arrangement

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)

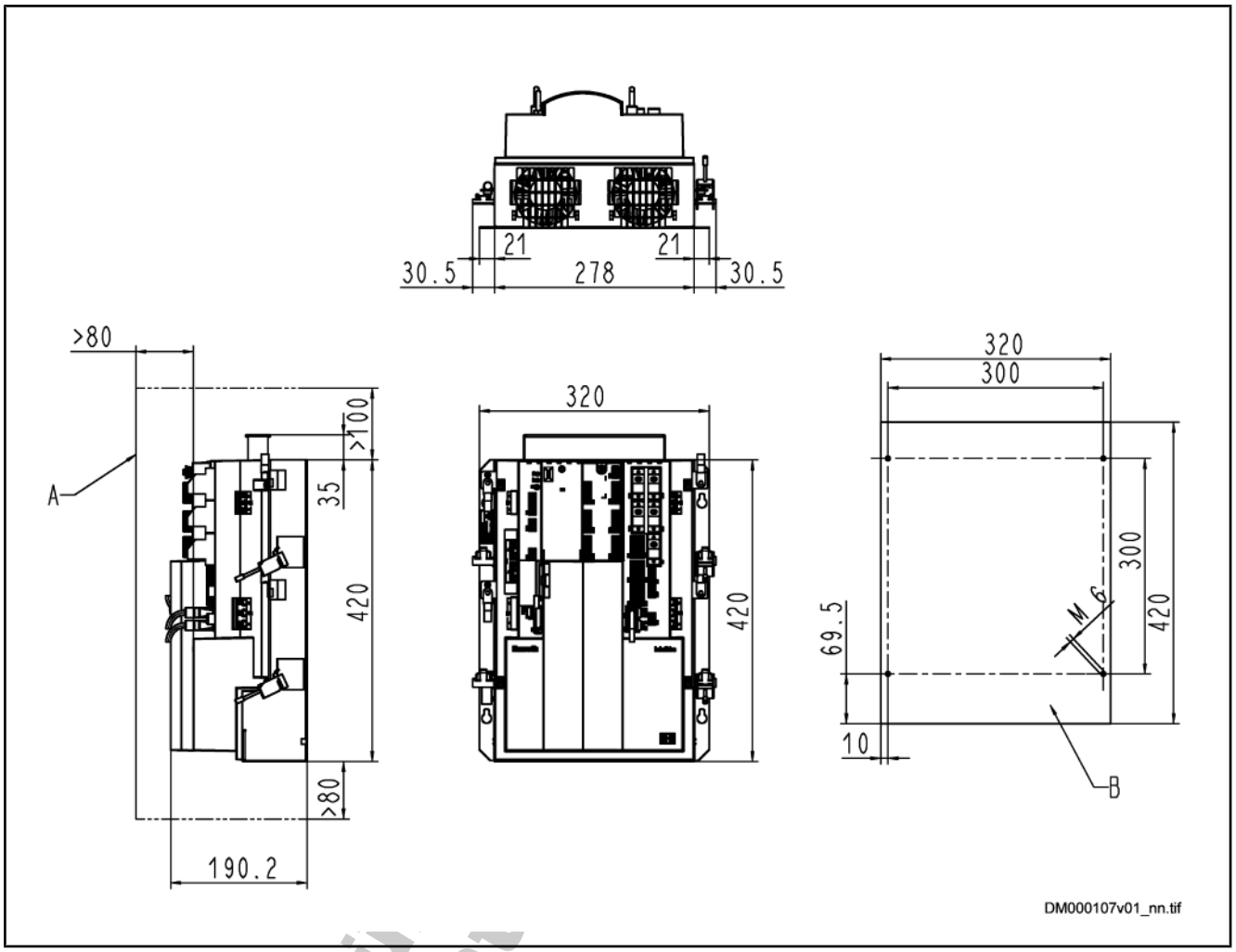
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11 Mounting and Installation

11.1 Mounting

11.1.1 Dimensional Drawings



A Minimum mounting clearance (when using accessory HAS02.1); plus additional space for cable
B Boring dimensions

Fig.11-1: Dimensional Drawing HCQ02.1E-W025-A-03

Nur für Int

Mounting and Installation

11.1.2 Distances

Data for Cooling and Power Dissipation

Description	Symbol	Unit	HCQ02.1E-W0025-_-03 planned
Allowed ambient temperature range during operation with nominal data	T_{a_work}	°C	0...40
Allowed ambient temperature range during 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	2,0
Allowed mounting position			G1
Cooling type			Forced ventilation
Volumetric capacity of forced cooling	V	m^3/h	tbd
Power dissipation at continuous current and continuous DC bus power respectively (UL)[1)]	P_{Diss_cont}	W	tbd
Minimum distance on the top of the device[2)]	d_{top}	mm	80
Minimum distance on the bottom of the device[3)]	d_{bot}	mm	80
Temperature rise with minimum distances d_{bot}; d_{top}; P_{BD}	ΔT	K	tbd
			Last modification: 2008-09-09

1) Plus dissipation of braking resistor and control section
2) 3) See fig. "Air Intake and Air Outlet at Drive Controller"
Fig.11-2: HCQ - Data for Cooling and Power Dissipation



CAUTION

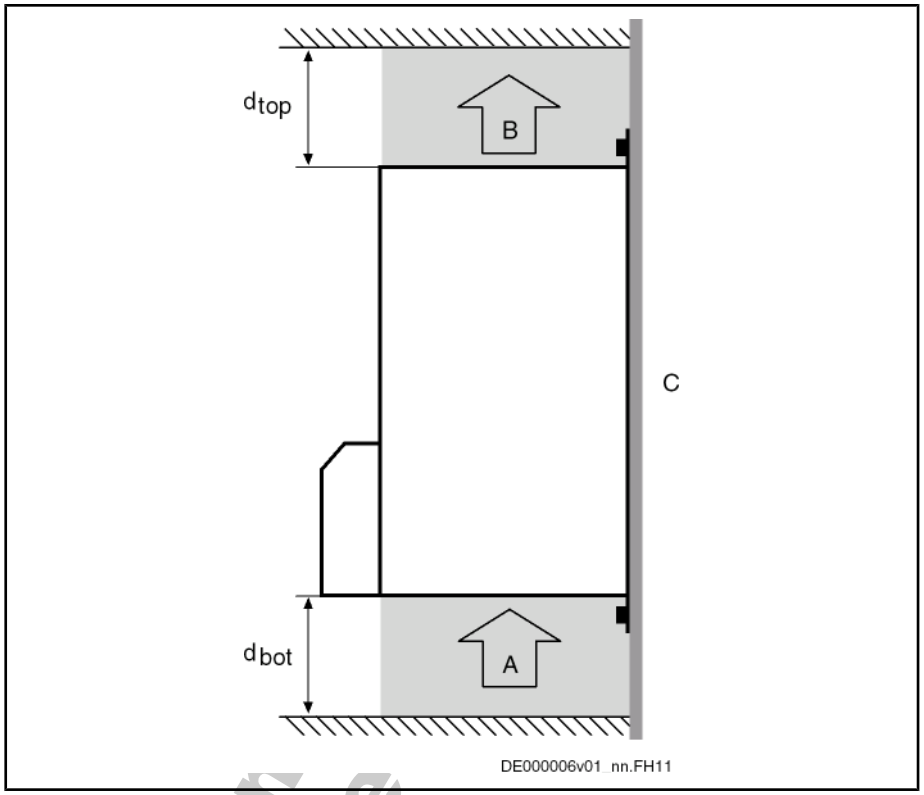
Property damage due to temperatures higher than 105 °C!

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

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A	Air intake
B	Air outlet
C	Mounting surface in control cabinet
d_{top}	Distance top
d_{bot}	Distance bottom

Fig.11-3: Air intake and air outlet at drive controller

Nur für interne Internal use

Mounting and Installation

11.2 Connection Diagram

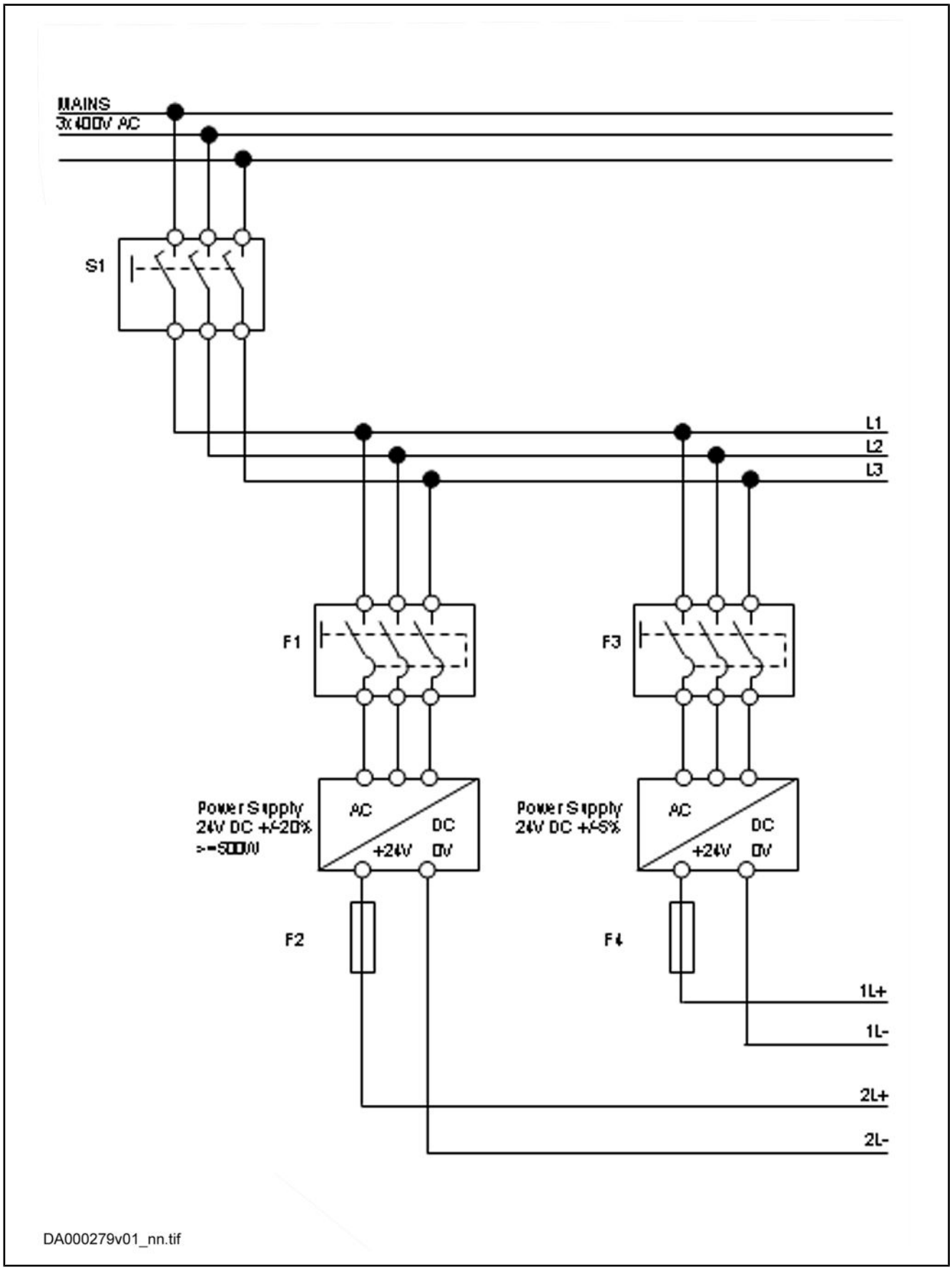


Fig.11-4: Mains Connection

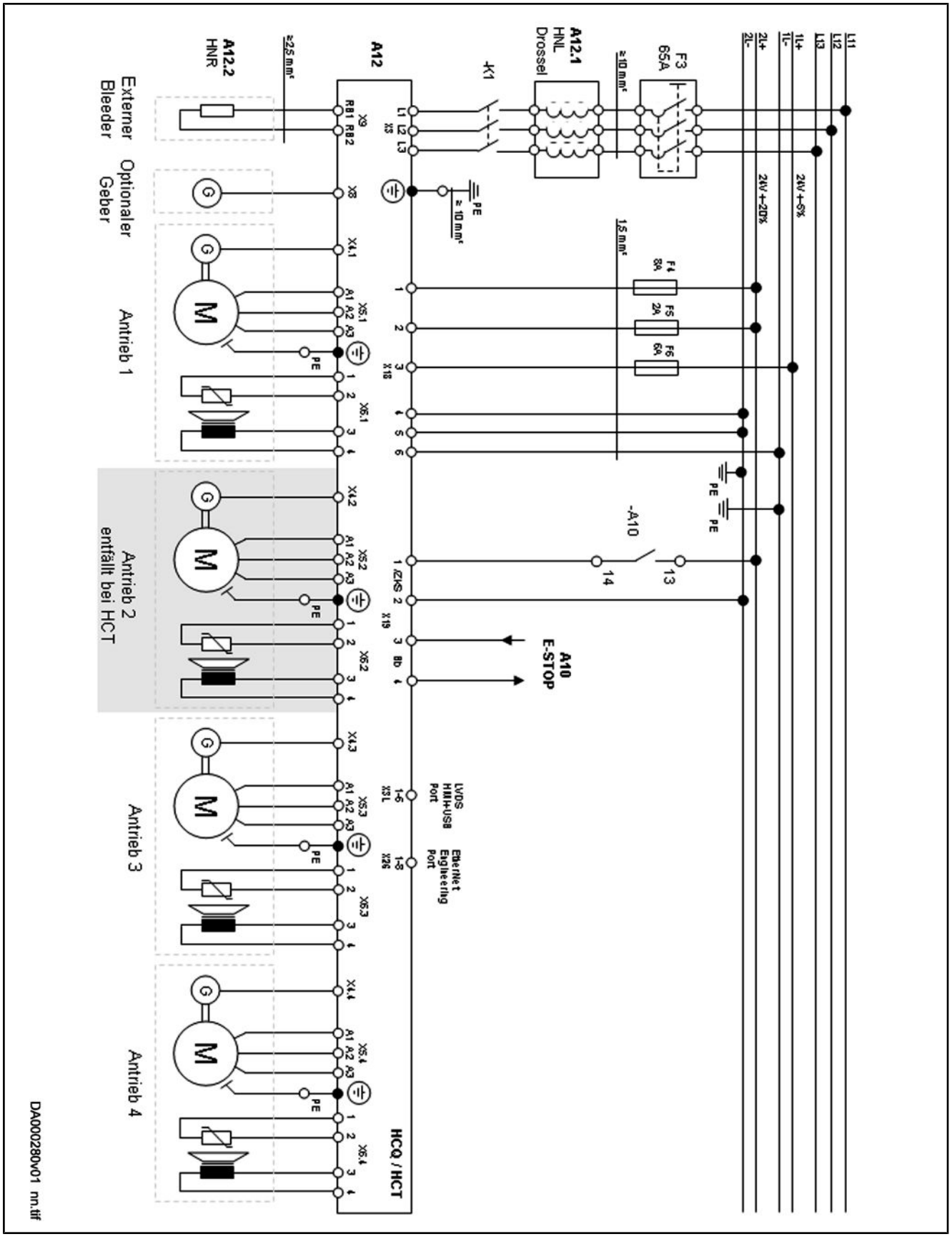


Fig.11-5: Connection Motors, Encoder, Control Voltage, Braking Resistor

Mounting and Installation

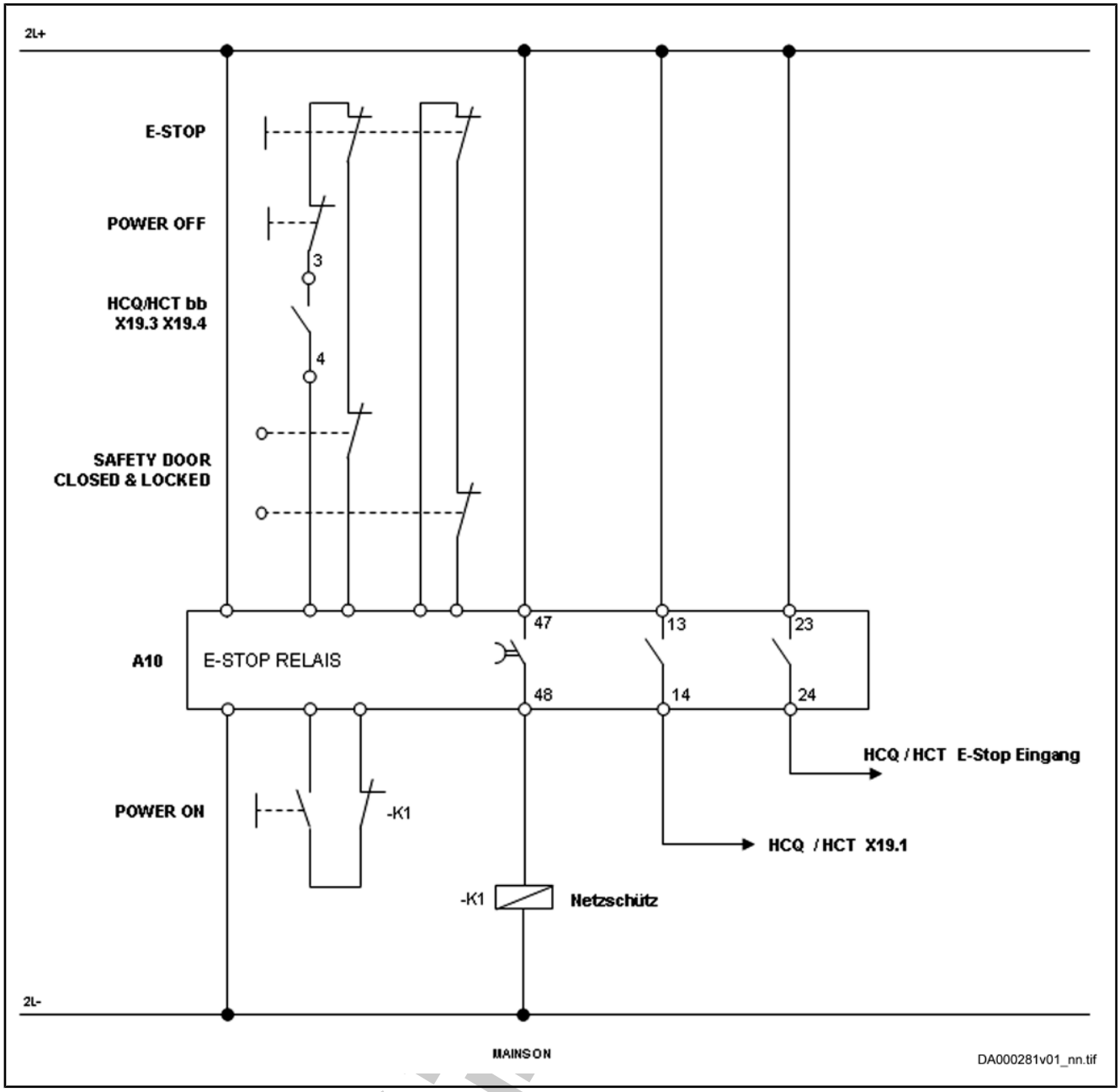
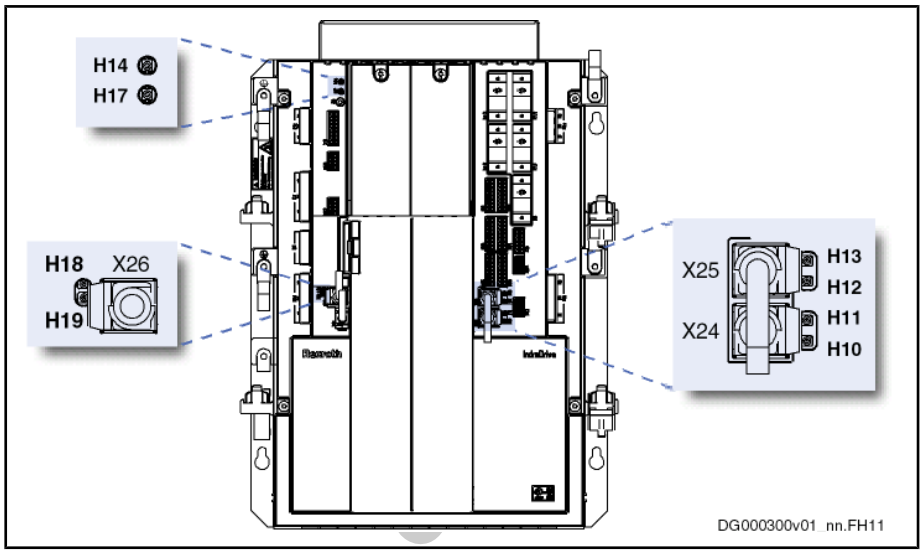


Fig.11-6: Connection Mains Contactor Control and E-Stop

12 Commissioning, Operation, Diagnostics

12.1 Operation and Diagnostics

12.1.1 Diagnostic 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

LED	Color / status		Significance	Measures
H10 Ethernet status		Yellow	Data transmission running	-
H11 Ethernet status		Green	Connection to network available	-
H12 Ethernet status		Yellow	Data transmission running	-
H13 Ethernet status		Green	Connection to network available	-

Nur für interne Internal use

Commissioning, Operation, Diagnostics

LED	Color / status		Significance	Measures
H14 **Drive** status		Green	Drive without error (Ab) Drive enable (AF)	-
		Flashing green	Phase 1–3 Drive ready for operation (Bb)	-
		Flashing yellow	Warning	See diagnostic message of control unit
		Red	Booting phase Error at drive	• Check firmware version • Replace device
		Flashing red	Error	See diagnostic message of control unit
		Off	Control voltage missing	Check 24V supply at X18
H17 **Control unit** status		Green	Rexroth IndraMotion MTX control is ready for operation	Observe information displayed at control panel. See also Application Description "Rexroth IndraMotion MTX" and documentation "Rexroth IndraMotion MTX Diagnostics Messages"
		Yellow	Rexroth IndraMotion MTX control is booting	Wait for booting phase to end
		Red	Error Rexroth IndraMotion MTX control In the case of errors **during** the booting process (approx. 30 s), an error code is displayed at the control panel.	Observe information displayed at control 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	Error Rexroth IndraMotion MTX control	
		Off	Supply unit not switched on	Check 24V supply at X18 and switch it on, if not yet done
H18 Ethernet status		Green	Connection to network available	-
H19 Ethernet status		Yellow	Data transmission running	-

Fig. 12-2: LED Displays

Nur für internen Gebrauch
Internal use only

13 Technical Data - Functions

13.1 Encoder Evaluations

13.1.1 ES - Standard Encoder Evaluation

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

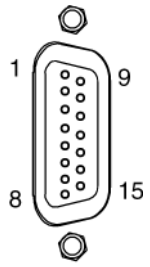
Connection point	Type	Number of poles	Type of design	Stranded wire [mm²]	Figure
See chapter "Electrical Connection Points"	D-Sub	15	Female (device)	0,25–0,5	

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

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Internal use only

Technical Data - Functions

Connection	Signal	Function
12	+5V	Encoder supply 5V
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

Properties of ES

Technical Data Input Circuit

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

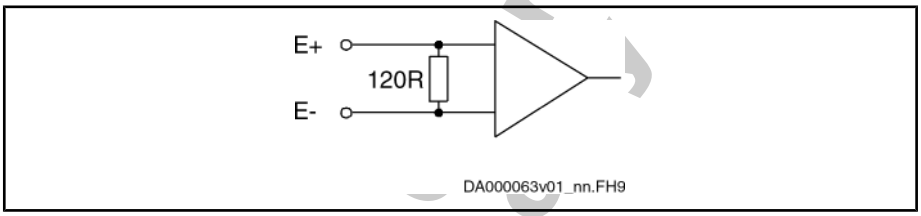


Fig. 13-3: Input Circuit for Sine Signals (Block Diagram)

Properties of Differential Input for Sine Signals

Date	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

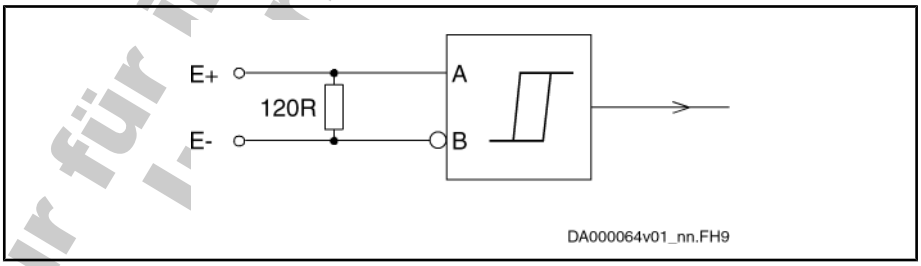


Fig. 13-5: Input Circuit for Square-Wave Signals (Block Diagram)

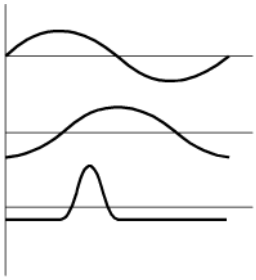
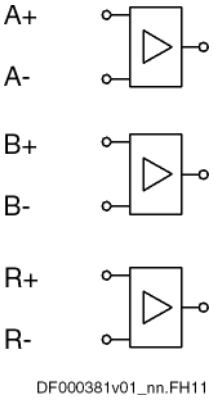
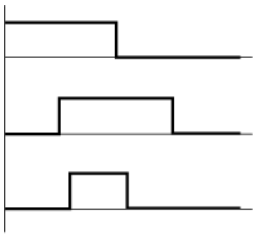
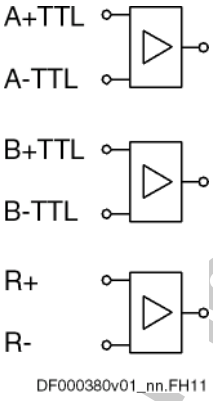
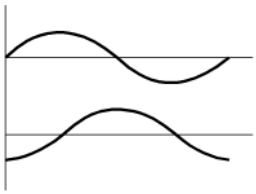
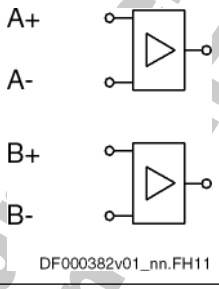
Properties of Differential Input for Square-Wave Signals

Date	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

Nur für interne Verwendung / Internal use only

Signal Assignment to the Actual Position Value

Signal assignment [1]	Signal designation	Signal shape	Actual position value (with default setting)
 DK000089v01_nn.FH9	 DF000381v01_nn.FH11	Sine (1 V_{pp}) Without absolute value	Increasing
 DK000090v01 nn.FH9	 DF000380v01_nn.FH11	Square-wave (TTL) Without absolute value	Increasing
 DK000088v01 nn.FH9	 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

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☞ 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 - Functions

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**.

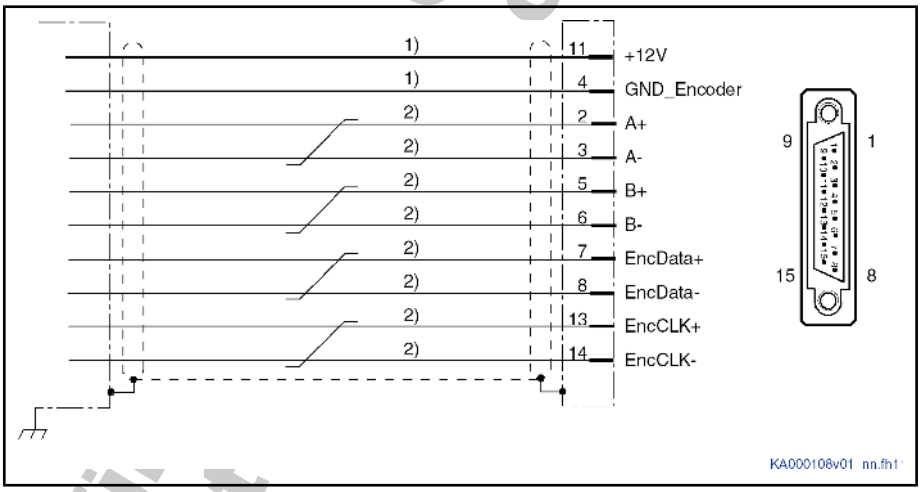
Requirements for the maximum encoder cable length:

- The minimum allowed **supply voltage** at the encoder is **10 V**
- The **cross section** of the wires for supply voltage is at least **0.5 mm²**

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**.

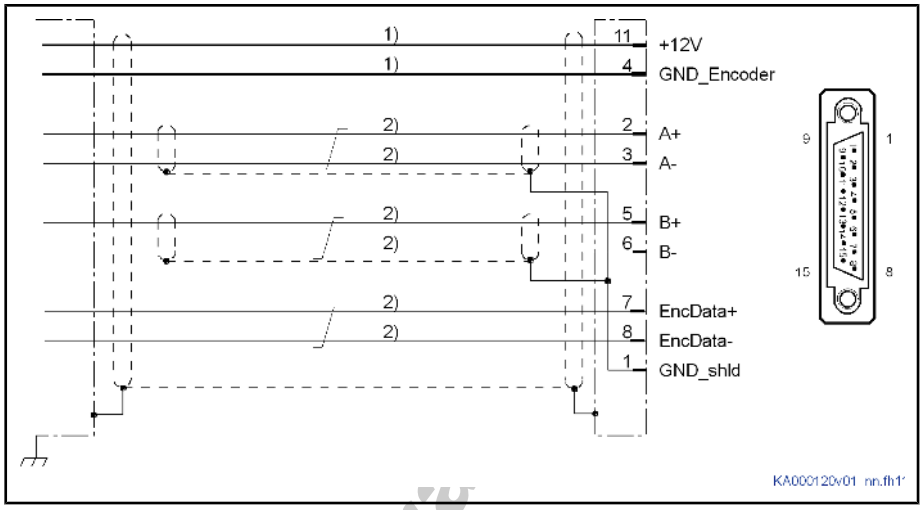
Connection Diagrams for 12V Third-Party Encoder Systems

☞ 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.

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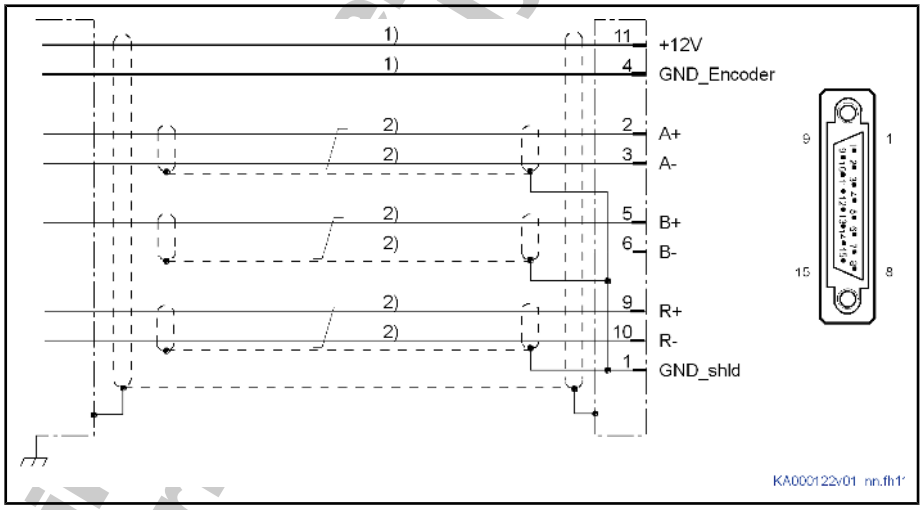
ES With Encoder System "HIPER-FACE®", 12 V



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



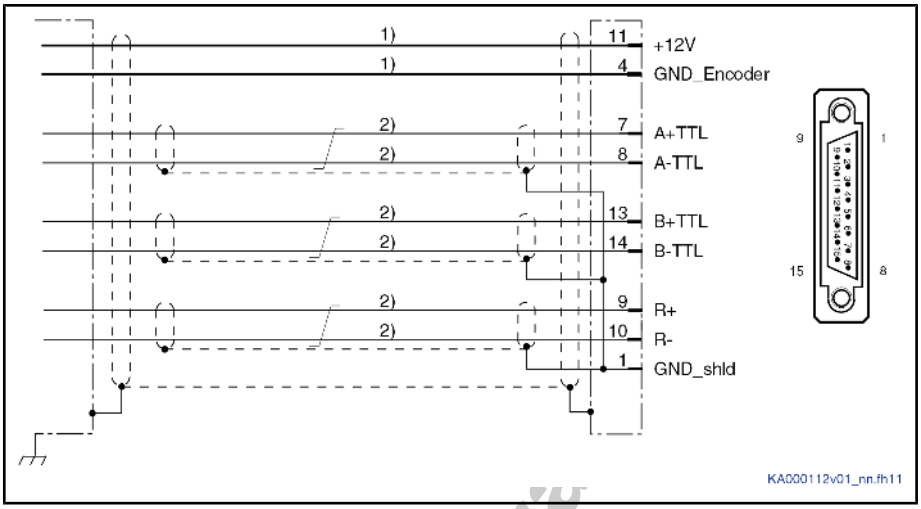
1) Cable cross section ≥ 0.5 mm²; observe allowed encoder cable length
2) Cable cross section ≥ 0.14 mm²

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

Nur für Intern

Technical Data - Functions

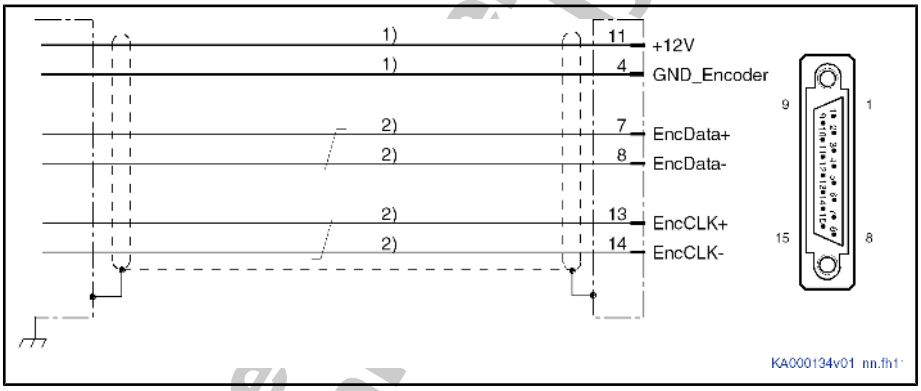
ES With Encoder System "TTL", 12 V



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"

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
D.C. resistance of load	ohm	35		

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**.

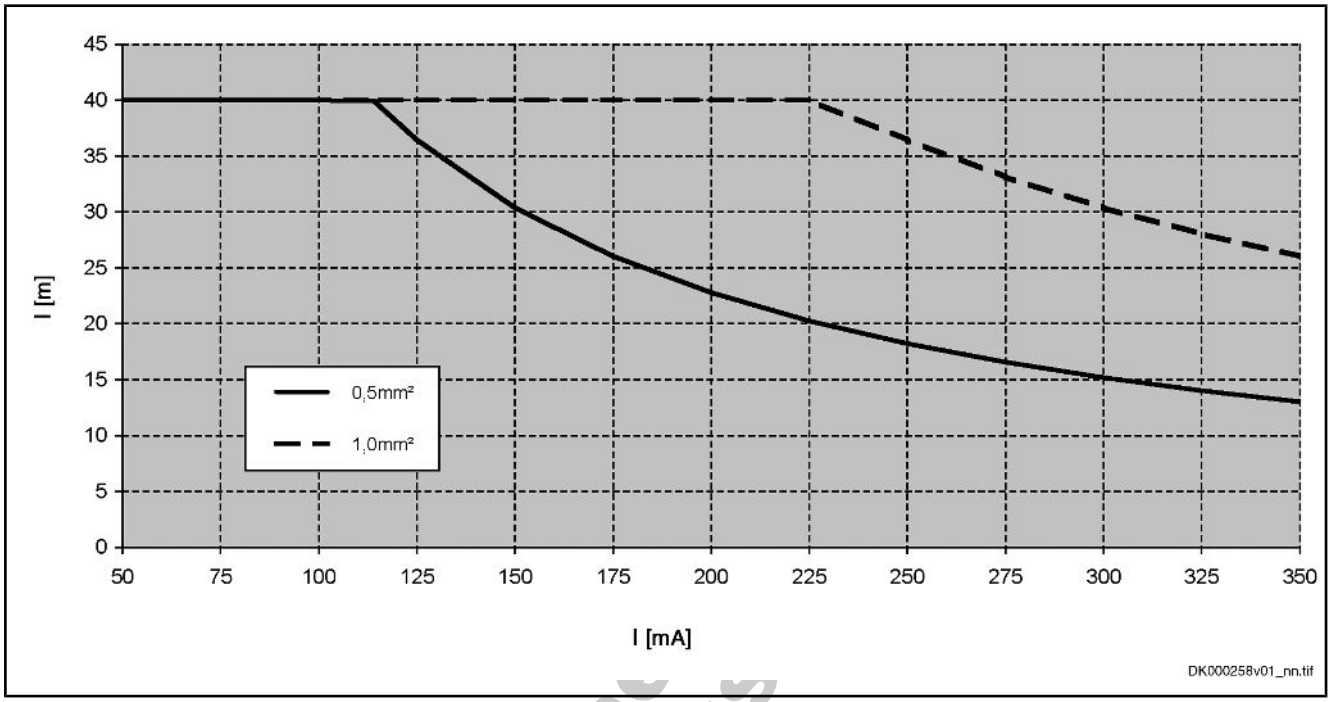
The current consumption of the connected encoder system generates a voltage drop due to the ohmic resistance of the encoder cable (line cross section and line length). This reduces the signal at the encoder input.

Nur für interne Zwecke

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 mm²	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

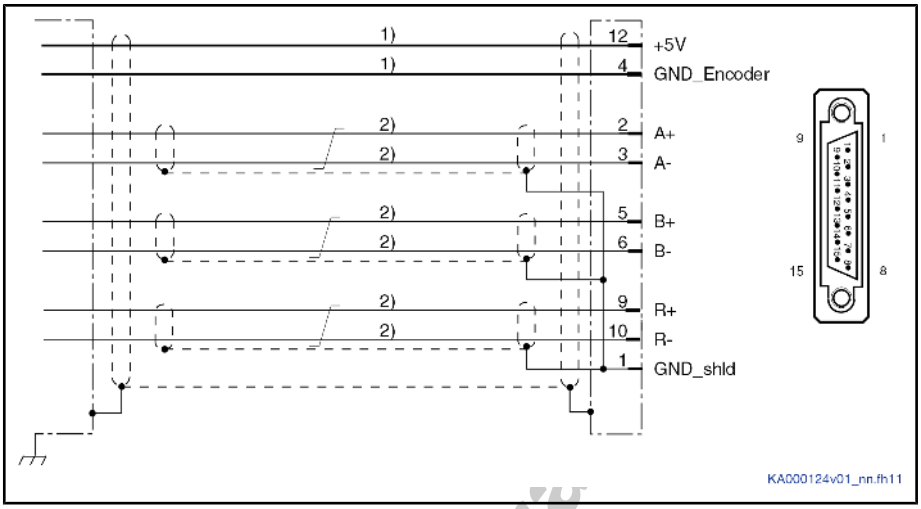
☞ For encoder supply, use lines with the same line cross section.

☞ 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.

Nur für interne Interessen

Technical Data - Functions

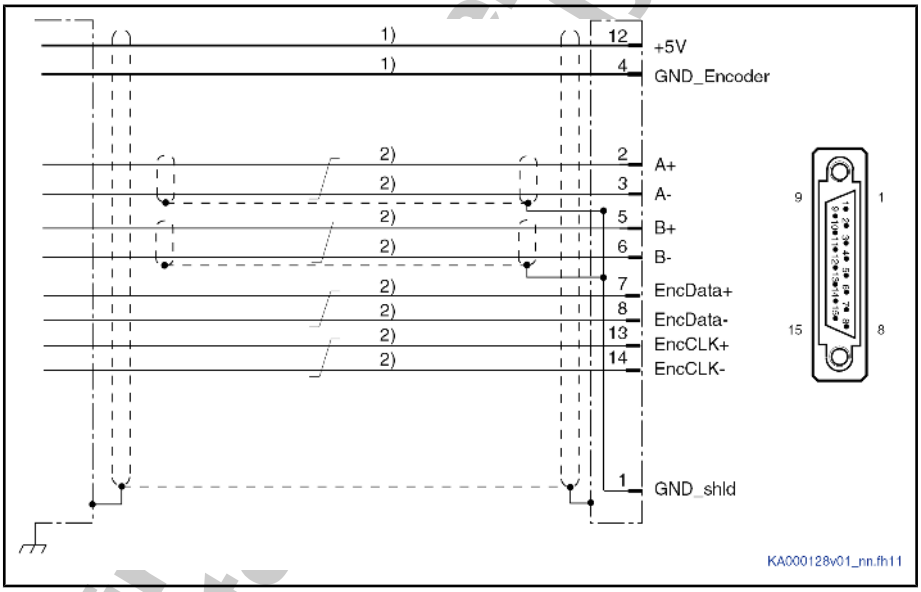
ES With Encoder System "1V$_{pp}$", 5 V



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"

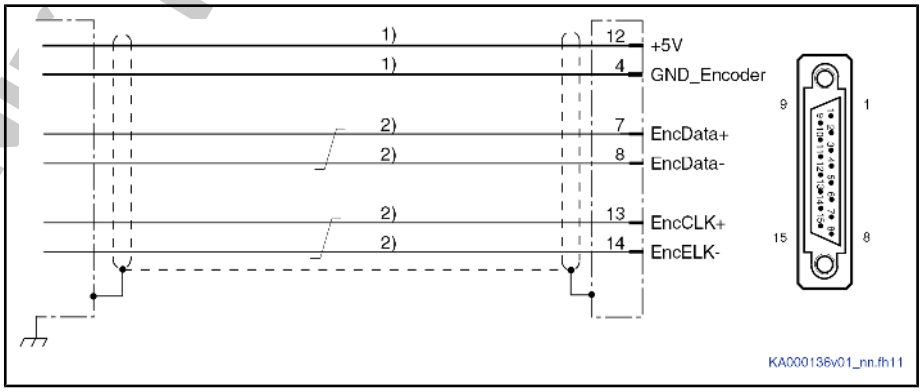
ES With Encoder System "EnDat 2.1" (According to Heidenhain Standard), 5 V



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"

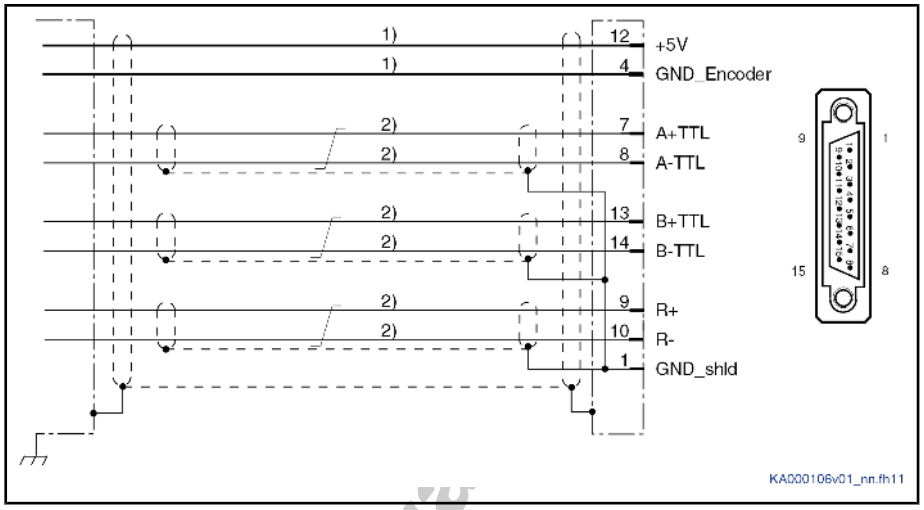
ES With Encoder System "SSI", 5 V



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"

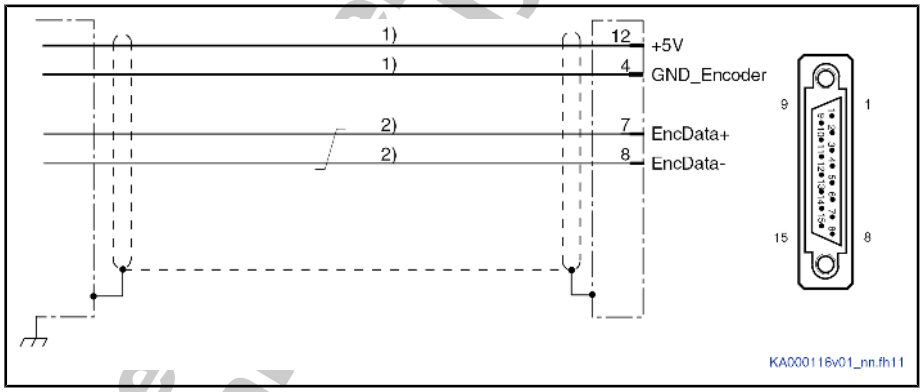
ES With Encoder System "TTL", 5 V



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"

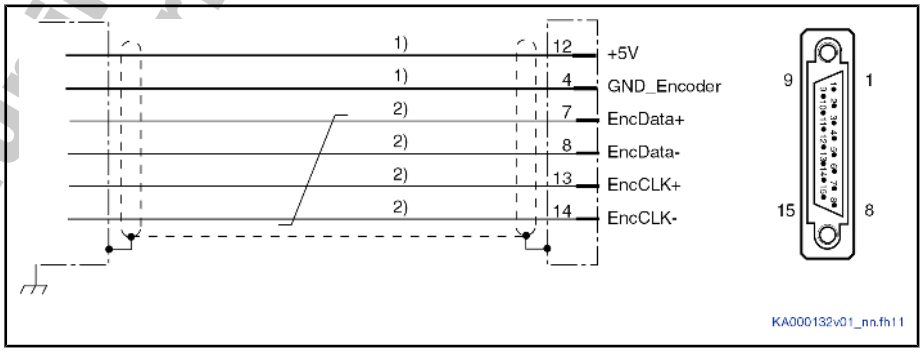
ES With Encoder System "Panasonic", 5 V



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"

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 Encoder System "EnDat 2.2"

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

Nur für interne Zwecke

13.2 Relay Contacts

13.2.1 Relay Contact Type 2

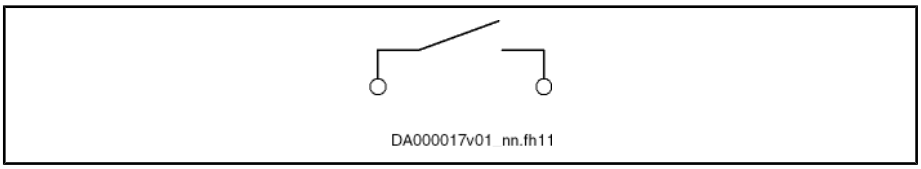


Fig.13-22: Relay Contact

Data	Unit	Min.	Typ.	Max.
Current load 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.13-23: Relay Contacts Type 2

13.3 Digital Inputs/Outputs

13.3.1 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 of the control section, particularly the parameter "P-0-0302, Digital I/Os, direction".

13.3.2 Digital Inputs

Digital Inputs Type 1 (Standard)

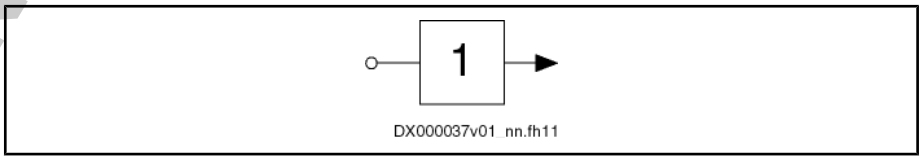


Fig.13-24: Symbol

Data	Unit	Min.	Typ.	Max.
Allowed input voltage	V	-3		30
On	V	15		

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Data	Unit	Min.	Typ.	Max.
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. 13-25: Digital Inputs Type 1

Digital Inputs - Probe

Digital Inputs Type 2 (Probe)

Function

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

Technical Data

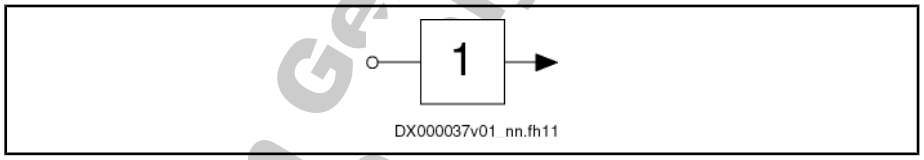
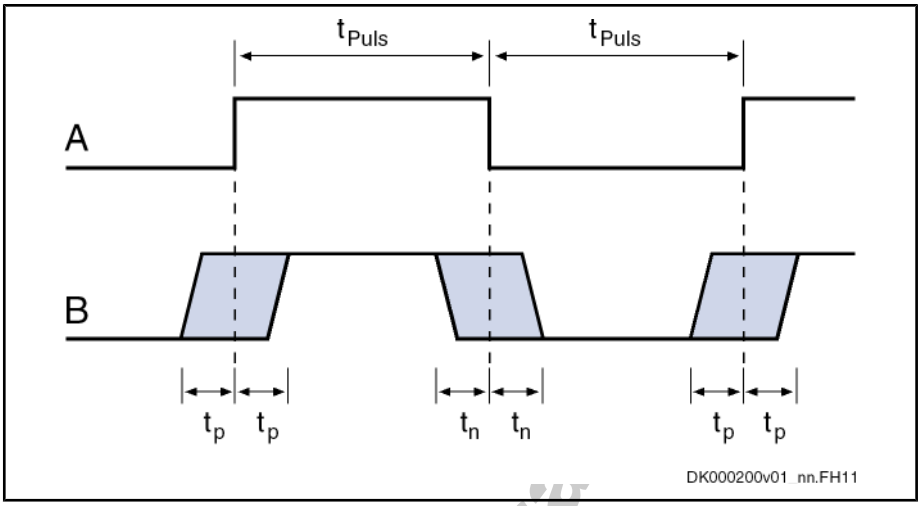


Fig. 13-26: Symbol

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. 13-27: Digital Inputs Type 2

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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. 13-28: Signal detection at probe input

Use For detecting sophisticated measuring marks, e.g. when positioning glue dots.

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

13.3.3 Digital Outputs

The digital outputs correspond to IEC 61131.

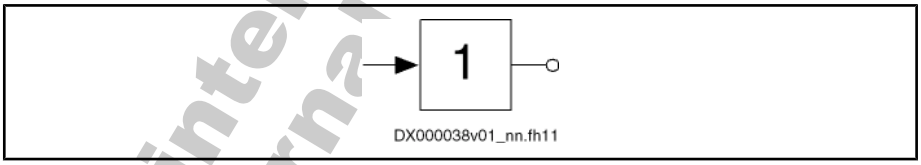


Fig. 13-29: Symbol

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		

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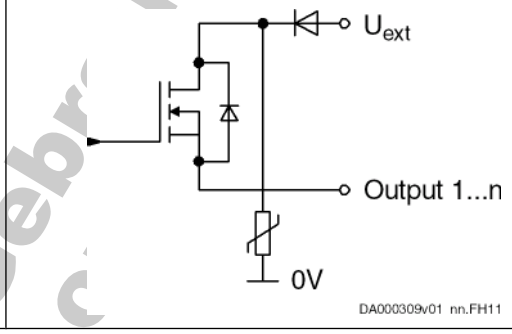
Data	Unit	Min.	Typ.	Max.
Allowed energy content of connected inductive loads, e.g. relay coils; only allowed as single pulse Per output	mJ			250
Allowed energy content of connected inductive loads, e.g. relay coils; only allowed as single pulse Per group (8 outputs)	mJ			1000
Block diagram output:				

Fig. 13-30: Digital Outputs

☞ The digital outputs have been realized with high-side switches. This means that these outputs can actively supply current, but not sink it.

☞ 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.

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14 Accessories

In preparation

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15 Environmental Protection and Disposal

15.1 Environmental Protection

15.1.1 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.

15.1.2 Prohibited Substances

We guarantee that our products do not contain any of the substances specified in the German regulation of prohibited chemicals ("Chemikalien-Verbotsverordnung"). We furthermore declare that our products are free of mercury, asbestos, PCB and chlorinated hydrocarbons.

15.1.3 No Release of Hazardous Substances

Our products do not contain any hazardous substances which may be released in the case of appropriate use. Accordingly, our products will normally not have any negative effect on the environment.

15.1.4 Principal Components

The principal components contained in our products are listed below:

Electronic devices	Motors
• steel • aluminum • copper • synthetic materials • electronic components and modules	• steel • aluminum • copper • brass • magnetic materials • electronic components and modules

Fig.15-1: Principal components

15.2 Disposal

15.2.1 Return of Products

Our products can be returned to us 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 mustn't contain any undue foreign matter or foreign component.

Please send the products free domicile to the following address:

Bosch Rexroth AG

Electric Drives and Controls

Bürgermeister-Dr.-Nebel-Strasse 2

D-97816 Lohr am Main

15.2.2 Packaging Materials

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

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

15.2.3 Recycling

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

Metals contained in electric and electronic modules can also be recycled by means of special separation processes. The synthetic materials remaining after these processes can be thermally recycled.

If the products contain batteries or accumulators, these have to be removed before recycling and disposed of.

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16 Service and Support

Our service helpdesk at out headquarters in Lohr, Germany, will assist you with all kinds of enquiries. Out of helpdesk hours please contact our German service department directly.

	Helpdesk	Service Hotline Germany	Service Hotline Worldwide
Time [1]	Mo-Fr 7:00 am - 6:00 pm CET	Mo-Fr 6:00 pm - 7:00 am CET Sa-Su 0:00 am - 12:00 pm CET	Outwith Germany please contact our sales/service office in your area first. For hotline numbers refer to the sales office addresses on the Internet.
Phone	+49 (0) 9352 40 50 60	+49 (0) 171 333 88 26 or +49 (0) 172 660 04 06	
Fax	+49 (0) 9352 40 49 41	–	
e-mail	service.svc@boschrexroth.de	–	
Internet	http://www.boschrexroth.com You will also find additional notes regarding service, maintenance (e.g. delivery addresses) and training.		

1) Central European Time (CET)

Preparing Information

For quick and efficient help please have the following information ready:

- detailed description of the fault and the circumstances
- information on the type plate of the affected products, especially type codes and serial numbers
- your phone, fax numbers and e-mail address so we can contact you in case of questions.

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17 Appendix

17.1 Discharging of DC Bus Capacitors

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

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

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

If additional capacitors (such as DC bus capacitor units) are connected, these capacitors, too, have to be discharged before somebody gets in contact with them.

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

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

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

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