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Instruction Manual



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

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Telephone +49 (0)93 52 / 40-0, Tx 68 94 21, Fax +49 (0)93 52 / 40-48 85
<http://www.boschrexroth.de>
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Table of Contents

	Page
1	Important Notes..... 5
1.1	Safety Instructions..... 5
1.1.1	General Information..... 5
1.1.2	Protection Against Contact With Electrical Parts and Housings..... 6
1.1.3	Protection Against Dangerous Movements..... 7
1.1.4	Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting..... 9
1.1.5	Protection Against Contact With Hot Parts..... 9
1.1.6	Protection During Handling and Mounting..... 10
1.2	Appropriate Use..... 10
2	Identification..... 11
2.1	Type Code..... 11
2.2	Type Plates..... 12
2.3	Scope of Supply..... 12
3	Ratings and Dimensions..... 13
4	Reference Documentations 15
4.1	Drive Systems, System Components..... 15
4.2	Motors..... 15
4.3	Cables..... 15
4.4	Firmware..... 15
5	Instructions for Use..... 17
5.1	Overcurrent Protection..... 17
5.2	Connection Points..... 18
5.2.1	Wiring Diagram..... 18
5.2.2	Connection Diagram..... 19
5.2.3	Connection of Equipment Grounding Conductor..... 20
5.2.4	X3, Mains Connection..... 21
	Important Notes..... 21
	HCS01.1E-W0003...W0013-x-02, HCS01.1E-W0005-x-03, HCS01.1E-W0008-x-03..... 22
	HCS01.1E-W0018-x-03, HCS01.1E-W0028-x-03..... 22
5.2.5	X5, Motor Connection..... 23
	Important Notes..... 23
	X5, Motor Connection HCS01.1E-W0003...W0013-x-02, -W0005-x-03, -W0008-x-03..... 23
	X5, Motor Connection HCS01.1E-W0018-x-03, -W0028-x-03..... 24
5.2.6	X6, Motor Temperature Monitoring and Motor Holding Brake 25
5.2.7	X9, Integrated/External Braking Resistor..... 26
5.2.8	X13, 24V Supply (Control Voltage)..... 27
5.2.9	X77, L+ L-, DC Bus Connection..... 28
5.2.10	Shield Connection..... 31
5.2.11	Ground Connection..... 32

Table of Contents

	Page
5.3	Installation..... 32
5.3.1	General Information on How to Install the Drive Controller..... 32
5.3.2	Sizing of Enclosure and Control Cabinet..... 34
	Mounting HCS01 Devices in the Control Cabinet..... 34
	Multiple-Line Design of the Control Cabinet..... 35
	Arrangement of Cooling Units..... 36
6	EMC Measures for Design and Installation..... 39
6.1	Rules for Design of Installations With Drive Controllers in Compliance With EMC..... 39
6.2	EMC-Optimal Installation in Facility and Control Cabinet..... 40
6.2.1	General Information..... 40
6.2.2	Division Into Areas (Zones)..... 40
6.2.3	Control Cabinet Mounting According to Interference Areas - Exemplary Arrangements..... 42
6.2.4	Design and Installation in Area A - Interference-Free Area of Control Cabinet..... 43
6.2.5	Design and Installation in Area B - Interference-Susceptible Area of Control Cabinet..... 45
6.2.6	Design and Installation in Area C - Strongly Interference-Susceptible Area of Control Cabinet..... 45
6.3	Ground Connections..... 46
6.4	Installing Signal Lines and Signal Cables..... 47
6.5	General Measures of Radio Interference Suppression for Relays, Contactors, Switches, Chokes and Inductive Loads..... 48
7	Accessories..... 49
7.1	HAS09..... 49
7.2	DC Bus Connector..... 50
7.3	SUP-E01-MSM-BATTERYBOX..... 51
7.4	SUP-E03-DKC*CS-BATTERY..... 52
8	Service and Support..... 55
9	Environmental Protection and Disposal 57
9.1	Environmental Protection..... 57
9.2	Disposal..... 57
10	Appendix..... 59
10.1	Discharging of Capacitors..... 59
10.1.1	Discharging of DC Bus Capacitors..... 59
10.1.2	Discharging Device..... 59
	Operating Principle..... 59
	Dimensioning..... 60
	Installation..... 60
	Activation..... 60
	Index..... 61

1 Important Notes

1.1 Safety Instructions

1.1.1 General Information

- Do not attempt to install and operate the components of the electric drive and control system without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation prior to working with these components. If you do not have the user documentation for the components, contact your responsible Rexroth sales partner. Ask for these documents to be sent immediately to the person or persons responsible for the safe operation of the components.
- If the supplied documents contain some information you do not understand, it is absolutely necessary that you ask Rexroth for explanation before you start working at or with the components.
- If the component is resold, rented and/or passed on to others in any other form, these safety instructions must be delivered with the component in the official language of the user's country.
- Only qualified persons may work with components of the electric drive and control system or within its proximity.

In terms of this Instruction Manual, qualified persons are those persons who are familiar with the installation, mounting, commissioning and operation of the components of the electric drive and control system, as well as with the hazards this implies, and who possess the qualifications their work requires. To comply with these qualifications, it is necessary, among other things,

- to be trained, instructed or authorized to switch electric circuits and components safely on and off, to ground them and to mark them,
- to be trained or instructed to maintain and use adequate safety equipment,
- to attend a course of instruction in first aid.
- The technical data, connection and installation conditions of the components are specified in the respective application documentations and must be followed at all times.
- If the components 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 components or alter source codes.
- Do not mount damaged or faulty components or use them in operation.
- Only use accessories and spare parts approved by Rexroth.
- Follow the safety regulations and requirements of the country in which the electric components of the electric drive and control system are operated.
- Proper and correct transport, storage, mounting and installation, as well as care in operation and maintenance, are prerequisites for optimal and safe operation of the component.



WARNING

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

Observe the safety instructions!

Important Notes

1.1.2 Protection Against Contact With Electrical Parts and Housings



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

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



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

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

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

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

- Before switching on and before commissioning, ground or connect the components of the electric drive and control system to the equipment grounding conductor at the grounding points.
- Connect the equipment grounding conductor of the components of the electric drive and control system permanently to the main power supply at all times. The leakage current is greater than 3.5 mA.
- Establish an equipment grounding connection with a copper wire of a cross section of at least 10 mm² (8 AWG) or additionally run a second equipment grounding conductor of the same cross section as the original equipment grounding conductor.

1.1.3 Protection Against Dangerous Movements

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

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

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

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

Important Notes

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

- A **risk assessment** must be prepared for the installation or machine, with its specific conditions, in which the components of the electric drive and control system are installed. As a result of the risk assessment, the user must provide for monitoring functions and higher-level measures on the installation side for personal safety. The safety regulations applicable to the installation or machine must be taken into consideration. Unintended machine movements or other malfunctions are possible if safety devices are disabled, bypassed or not activated.

To avoid accidents, injury and/or property damage:

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

1.1.4 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

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



WARNING

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

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

1.1.5 Protection Against Contact With Hot Parts



CAUTION

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

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

Important Notes

1.1.6 Protection During Handling and Mounting



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

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

1.2 Appropriate Use

This product may only be used for the applications mentioned in the reference documentations (see index entry "Reference documentations") and under the described application, ambient and operating conditions.

This product is exclusively intended for use in machines and systems in an industrial environment. This is to be understood as applications according to IEC 60204-1 "Safety of machinery, Electric equipment of machines" and NFPA 79 "Electrical Standard for Industrial Machinery".



Components of the drive system Rexroth IndraDrive Cs are **products of category C3** (with restricted distribution) according to IEC 61800-3. These components are not provided for use in a public low-voltage mains supplying residential areas. If these components are used in such a mains, high-frequency interference is to be expected. This can require additional measures of radio interference suppression.

2 Identification

2.1 Type Code

Abbrev. column	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40			
Example:	H	C	S	0	1	.	1	E	-	W	0	0	1	3	-	A	-	0	2	-	E	-	S	3	-	E	C	-	N	N	-	N	N	-	N	N	-	N	N	-	F	W	0
Product	HCS = HCS																																										
Line	Up to 3 kW. = 01																																										
Design	1 = 1																																										
Power supply	Infeeding. = E																																										
Cooling mode	Air, internal = W																																										
Maximum current																																											
At mains connection voltage "02"																																											
3 A	= 0003																																										
6 A	= 0006																																										
9 A	= 0009																																										
13 A	= 0013																																										
At mains connection voltage "03"																																											
5 A	= 0005																																										
8 A	= 0008																																										
18 A	= 0018																																										
28 A	= 0028																																										
Degree of protection																																											
IP 20	= A																																										
Mains connection voltage																																											
3 x AC 110 to 230 V ±10%	= 02																																										
3 x AC 200 to 500 V ±10%	= 03																																										
Control section design																																											
Basic	= B																																										
Economy	= E																																										
Communication																																											
MultiEthernet	= ET ①																																										
SERCOS III	= S3 ②																																										
Interface 1																																											
Encoder IndraDyn / Hiperface® / 1Vpp / TTL / EnDat 2.1/2.2.	= EC																																										
Interface 2																																											
Encoder IndraDyn / Hiperface® / 1Vpp / TTL / EnDat 2.1/2.2.	= EC ①																																										
Not equipped	= NN																																										
PROFIBUS	= PB ①																																										
Interface 3																																											
Starting lockout SIL/PL	= L2																																										
Not equipped	= NN																																										
Safety technology I/O SIL/PL	= S2 ①																																										
Other design																																											
None	= NN																																										
Firmware																																											
Denotes that firmware must be ordered as separate subposition	= FW																																										
Note																																											
① Not available with control section design "E"																																											
② Only available with control section design "E"																																											
Standard reference																																											
Standard	Edition	Title																																									
DIN EN 60529	2000-09	Degrees of protection provided by enclosures (IP code)																																									

DT000063v01_en.fh11

Fig.2-1: Type Code HCS01

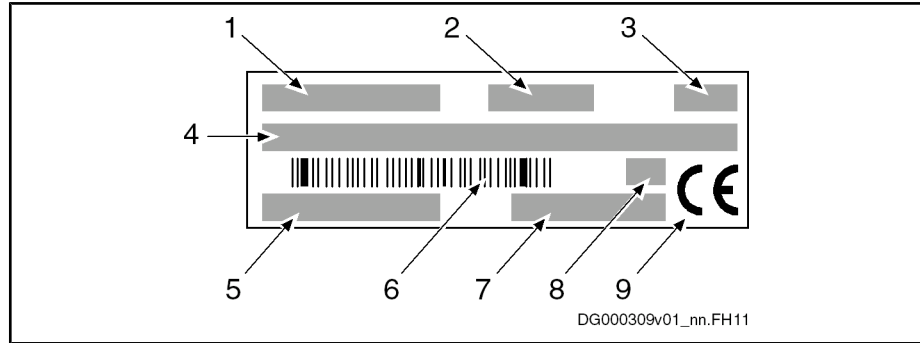
Identification



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

2.2 Type Plates

Type Plate (Device)



- 1 Part number
- 2 Production week; 09W23, for example, means year 2009, week 23
- 3 Factory identifier
- 4 Device type
- 5 Serial number
- 6 Bar code
- 7 Country of manufacture
- 8 Hardware index
- 9 Identification

Fig.2-2: Type Plate (Device)

2.3 Scope of Supply

Standard	To be ordered separately
Mounting and connection accessories HAS09	DC bus connector X77 (DC bus connection; for HCS01.1E-W00xx-x-03 devices) Order code: RLS0778/K06
Connectors X3, X5, X6, X13, X31, X32, X47	
Touch guard X77 (DC bus connection; for HCS01.1E-W00xx-x-03 devices)	
Instruction Manual (in the English language)	

Fig.2-3: Scope of Supply HCS01

3 Ratings and Dimensions

UL Ratings and Dimensions

Description	Symbol	Unit	HCS0	HCS0	HCS0	HCS0	HCS0	HCS0	HCS0	HCS0	
			1.1E- W000 3-_-02	1.1E- W000 6-_-02	1.1E- W000 9-_-02	1.1E- W001 3-_-02	1.1E- W000 5-_-03	1.1E- W000 8-_-03	1.1E- W001 8-_-03	1.1E- W002 8-_-03	
Listing according to UL standard (UL)			UL 508 C								
Listing according to CSA standard (UL)			Canadian National Standard(s) C22.2 No. 14-05								
UL files (UL)			E 134201								
Ambient temperature with nominal data (UL)	T _{amax}	°C	40								
Ambient temperature with reduced nominal data (UL)	T _{amax_red}	°C	55								
Mass (weight)	m	kg	0,72						1,70		
Device height (UL) ¹⁾	H	mm	215						268		
Device depth (UL) ²⁾	T	mm	196								
Device width (UL) ³⁾	B	mm	50						70		
Minimum distance on the top of the device ⁴⁾	d _{top}	mm	100								
Minimum distance on the bottom of the device ⁵⁾	d _{bot}	mm	100								
Horizontal spacing on the device ⁶⁾	d _{hor}	mm	10						0		
Rated control voltage input (UL) ⁷⁾	U _{N3}	V	24 ± 5%								
Rated power consumption control voltage input at U _{N3} (UL) ⁸⁾	P _{N3}	W	27	28	27	28	34				
Short circuit current rating (UL)	SCCR	A rms	42000								
Rated input voltage, power (UL) ⁹⁾	U _{LN_nenn}	V	3 x AC 110...230				3 x AC 200...500				
Tolerance rated input voltage (UL)		%	± 10								
Input frequency (UL)	f _{LN}	Hz	50...60								
Tolerance input frequency (UL)		Hz	± 2								
Rated input current (UL)	I _{LN}	A	0,6	1,2	2,3	4,5	1,5	2,5	5,0	10,0	
Branch circuit protection fuse (UL) ¹⁰⁾			2	4	6	2	4	10	16		
Required wire size according to EN 60204-1 ¹¹⁾	A _{LN}	mm ²	1,5								
Required wire size according to UL 508 A (internal wiring); (UL) ¹²⁾	A _{LN}	AWG	AWG 14								
Output voltage (UL)	U _{out}	V	3 x AC 0...230				3 x AC 0...500				

Last modification: 2009-07-28

Ratings and Dimensions

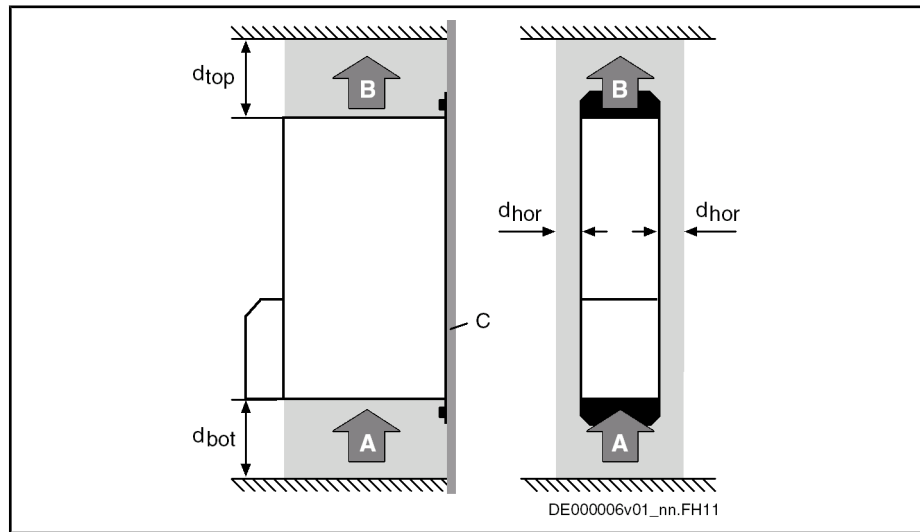
Description	Symbol	Unit	HCS0	HCS0	HCS0	HCS0	HCS0	HCS0	HCS0	HCS0
			1.1E-W000 3-_-02	1.1E-W000 6-_-02	1.1E-W000 9-_-02	1.1E-W001 3-_-02	1.1E-W000 5-_-03	1.1E-W000 8-_-03	1.1E-W001 8-_-03	1.1E-W002 8-_-03
Output current (UL)	I_{out}	A	1,1	2,0	3,0	4,5	1,7	2,7	6,0	11,5
Output frequency range (UL) ¹³⁾	f_{out}	Hz	0...1600							
Power dissipation at continuous current and continuous DC bus power respectively (UL) ¹⁴⁾	P_{Diss_cont}	W	8,00	10,00	12,00	20,00	11,00	46,00	80,00	120,00

Last modification: 2009-07-28

- 1) 2) 3) Housing dimension; see also related dimensional drawing
- 4) 5) 6) See fig. "Air Intake and Air Outlet at Device"
- 7) Observe supply voltage for motor holding brakes
- 8) HMS, HMD, HCS plus motor holding brake and control section; HCS01 including control section
- 9) DC bus L+, L-; mains input L1, L2, L3
- 10) Use listed AC input line fuses (class J; 600 V AC) or listed circuit breakers (600 V AC) at the mains supply
- 11) Copper wire; PVC-insulation (conductor temperature 70 °C); installation method B1; table 6
- 12) Copper wire; PVC-insulation (conductor temperature 90 °C); table 13.5.1; $T_a \leq 40$ °C
- 13) Depending on switching frequency which was set in parameter P-0-0001
- 14) Plus dissipation of braking resistor and control section

Fig.3-1: HCS - UL Ratings and Dimensions

Distances



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

Fig.3-2: Air Intake and Air Outlet at Device

4 Reference Documentations

4.1 Drive Systems, System Components

Title	Kind of documentation	Document typecode ¹⁾	Part number
Rexroth IndraDrive ...		DOK-INDRV*-...	R911...
Cs Drive Systems	Project Planning Manual	HCS01*****-PRxx-EN-P	322210

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

Fig.4-1: Documentations – Drive Systems, System Components

4.2 Motors

Title	Kind of documentation	Document typecode ¹⁾	Part number
Rexroth IndraDyn ...		DOK-MOTOR*-...	R911...
S MSK Synchronous Motors	Project Planning Manual	MSK*****-PRxx-EN-P	296289
S Synchronous Motors MSM	Data Sheet	MSM*****-DAxx-EN-P	329338

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

Fig.4-2: Documentations – Motors

4.3 Cables

Title	Kind of documentation	Document typecode ¹⁾	Part number
Rexroth Connection Cables		DOK-CONNEC-...	R911...
	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.4-3: Documentations – Cables

4.4 Firmware

Title	Kind of documentation	Document typecode ¹⁾	Part number
Rexroth IndraDrive ...		DOK-INDRV*-...	R911...
MPB-16, MPM-16, MPE-16 Functions	Application Manual	MP*-16VRS**-APxx-EN-P	326767
MPB-16, MPM-16, MPE-16 Version Notes	Release Notes	MP*-16VRS**-RNxx-EN-P	329272
MPx-16 Parameters	Reference Book	GEN1-PARA**-RE01-EN-P	328651
MPx-16 Diagnostic Messages	Reference Book	GEN1-DIAG**-RE01-EN-P	326738

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

Fig.4-4: Documentations – Firmware

5 Instructions for Use

5.1 Overcurrent Protection

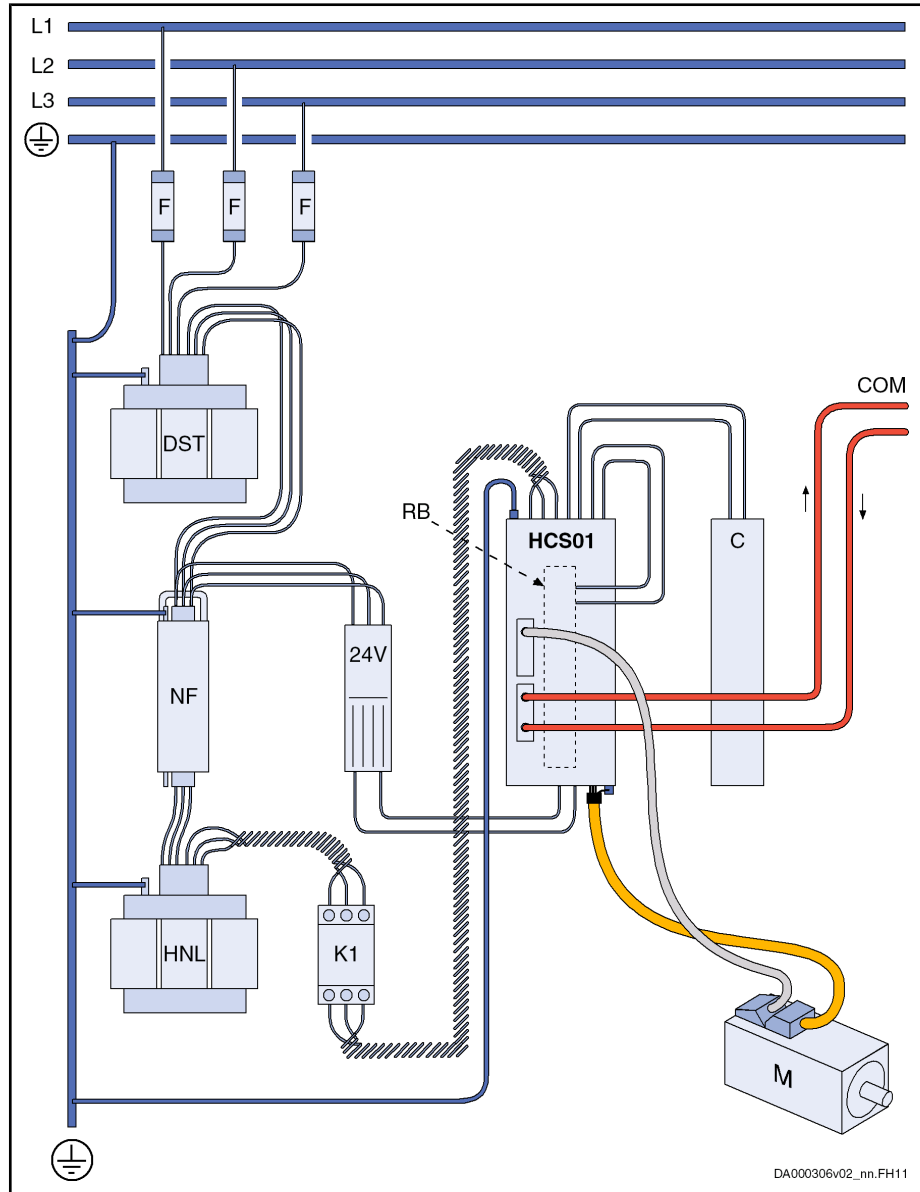
Protect the components against overcurrent:

- Branch circuit protection has to be provided externally
- Dimension the branch circuit protection according to the data "Branch circuit protection fuse (UL)" (see Ratings and Dimensions)

Instructions for Use

5.2 Connection Points

5.2.1 Wiring Diagram

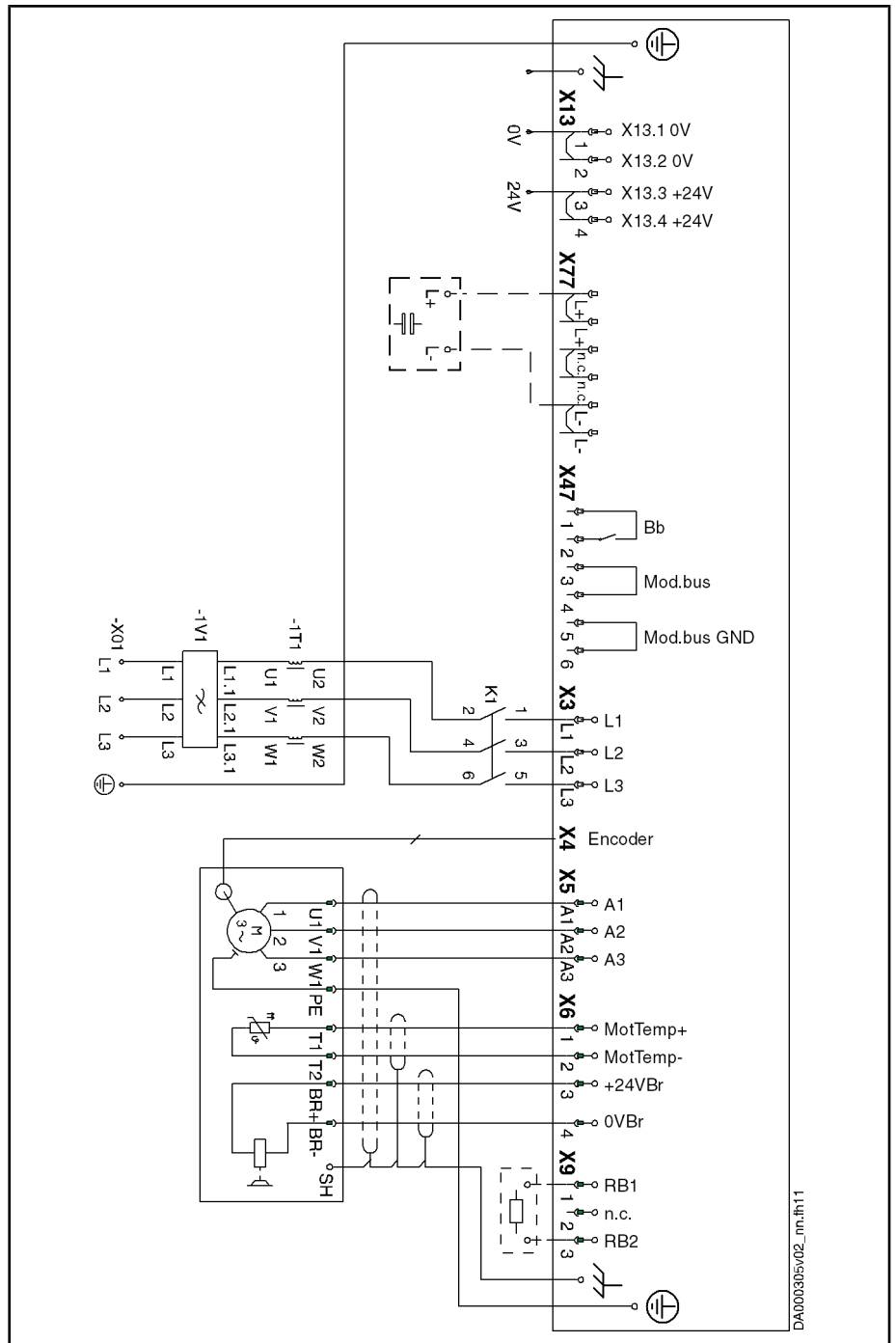


DA000306v02_nn.FH11

24V	Control voltage supply
C	DC bus capacitor unit (for devices with DC bus connection)
COM	Communication
DST	Autotransformer; optional
F	Fuses
HCS01	Converter
NF	Mains filter; optional (depends on EMC requirements)
HNL	Mains choke; optional
K1	External mains contactor
M	Motor (MSM, MSK)
RB	Braking resistor (at the back of the drive controller)

Fig.5-1: Drive System Rexroth IndraDrive Cs

5.2.2 Connection Diagram



- X47 Module bus (X47.3...6) only at HCS01.1E-W00xx-x-03 devices; for signaling the readiness for operation of the device, the Bb relay contact (X47.1, X47.2) must be wired, too
 - X77 (L+, L-) Only at HCS01.1E-W00xx-x-03 devices
 - T1, T2 Not available at MSM motors
- Fig. 5-2: Connection Diagram

5.2.3 Connection of Equipment Grounding Conductor



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

- Before switching on and before commissioning, ground or connect the components of the electric drive and control system to the equipment grounding conductor at the grounding points.
 - Connect the equipment grounding conductor of the components of the electric drive and control system permanently to the main power supply at all times. The leakage current is greater than 3.5 mA.
 - Establish an equipment grounding connection with a copper wire of a cross section of at least 10 mm² (8 AWG) or additionally run a second equipment grounding conductor of the same cross section as the original equipment grounding conductor.
-



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

Exclusively operate the device

- with plugged on connectors (even if there haven't been any lines connected to the connectors) and
 - with connected equipment grounding conductor!
-



Equipment grounding conductor: Material and cross section


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

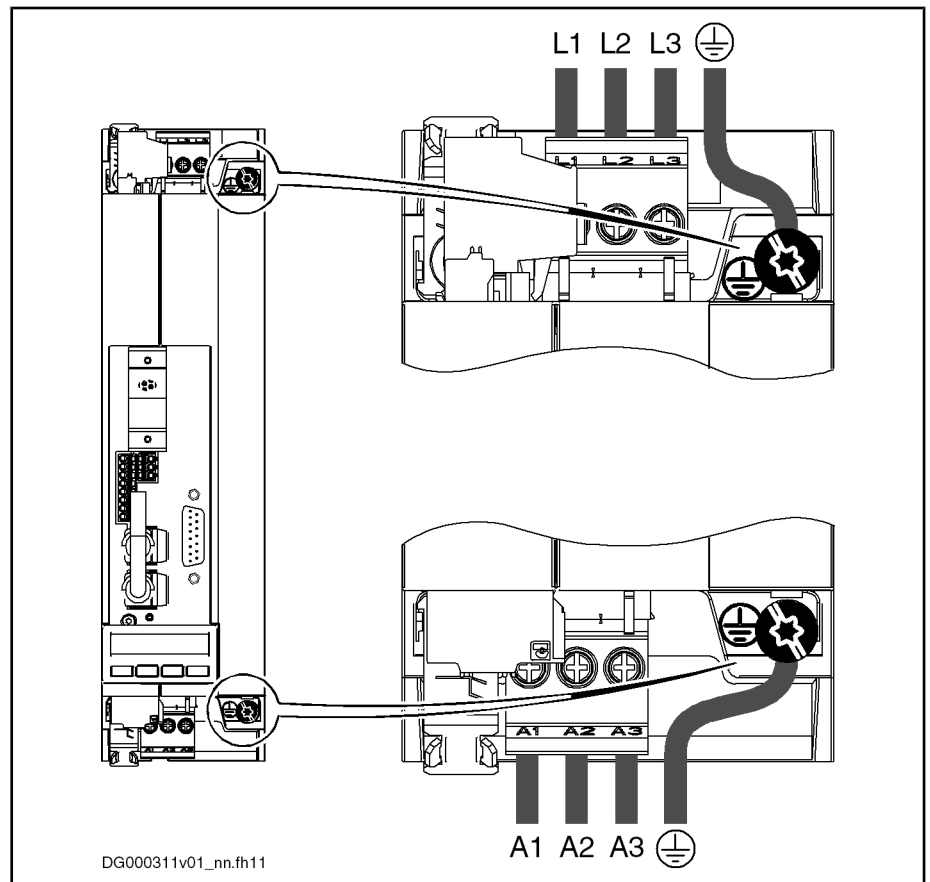
For the connections from the equipment grounding conductor connection of the device to the equipment grounding conductor system in the control cabinet, make sure the cross sections of the lines are sufficient.

Cross sections of the equipment grounding connections:

For **HCS01** drive controllers, **at least 10 mm²**, but not smaller than the cross sections of the outer conductors of the mains supply feeder.

Additionally, mount the housing to a bare metal mounting plate. Connect the mounting plate, too, with at least the same cross section to the equipment grounding conductor system in the control cabinet.

Installation Connect the equipment grounding conductor of the mains or motor cable via thread **M5** to the housing of the device (identification mark ). The screws **M5×12** required for this purpose are part of the supplied accessory HAS09.



L1, L2, L3 Mains connection
A1, A2, A3 Motor connection

Fig.5-3: Connection Point of Equipment Grounding Conductor

5.2.4 X3, Mains Connection

Important Notes



WARNING

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

Exclusively operate the device

- with plugged on connectors (even if there haven't been any lines connected to the connectors) and
- with connected equipment grounding conductor!

Notes on Installation

The equipment grounding conductor is connected directly to the device and not via the connection point X3 (see description for connection of equipment grounding conductor).

Dimension the **required cross section** of the connection cables according to the determined phase current I_{LN} and the mains fuse.



CAUTION

Risk of damage to the device!

Provide strain relief for the terminal connectors of the device in the control cabinet.

Instructions for Use

HCS01.1E-W0003...W0013-x-02, HCS01.1E-W0005-x-03, HCS01.1E-W0008-x-03

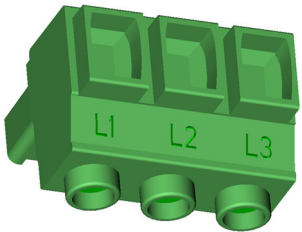
HCS01.1E-W0003...W0013-x-02, HCS01.1E-W0005-x-03, HCS01.1E-W0008-x-03			
View	Identification	Function	
	L1	Connection to supply mains (L1)	
	L2	Connection to supply mains (L2)	
	L3	Connection to supply mains (L3)	
Terminal block	Unit	Min.	Max.
Connection cable	mm ²	0,25	2,5
Stranded wire	AWG	24	12
Stripped length	mm	8	
Occurring current load and minimum required connection cross section		See technical data of device used (I_{LN} and A_{LN})	
Occurring voltage load		See technical data of device used (U_{LN} or $U_{LN,enn}$)	

Fig.5-4: Function, Pin Assignment, Properties

HCS01.1E-W0018-x-03, HCS01.1E-W0028-x-03

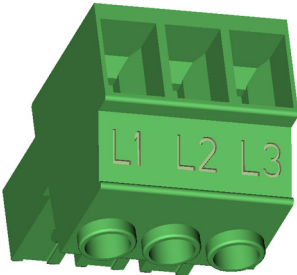
HCS01.1E-W0018-x-03, HCS01.1E-W0028-x-03			
View	Identification	Function	
	L1	Connection to supply mains (L1)	
	L2	Connection to supply mains (L2)	
	L3	Connection to supply mains (L3)	
Terminal block	Unit	Min.	Max.
Connection cable	mm ²	0,25	6,0
Stranded wire	AWG	24	8
Stripped length	mm	10	
Occurring current load and minimum required connection cross section		See technical data of device used (I_{LN} and A_{LN})	
Occurring voltage load		See technical data of device used (U_{LN} or $U_{LN,enn}$)	

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

5.2.5 X5, Motor Connection

Important Notes



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

Exclusively operate the device

- with plugged on connectors (even if there haven't been any lines connected to the connectors) and
- with connected equipment grounding conductor!



CAUTION

Risk of damage to the device!

Provide strain relief for the terminal connectors of the device in the control cabinet.

Notes on Installation

The equipment grounding conductor is connected directly to the device and not via the connection point X5 (see description for connection of equipment grounding conductor).

The indicated connection cross sections are the cross sections which can be connected. Dimension the **required cross section** of the connection lines according to the occurring current load.



- For optimum shield contact of the motor power cable, use the supplied accessory HAS09.
- For the connection between drive controller and motor, use our ready-made motor power cables, where possible (see documentation "Rexroth Connection Cables").
- When using NFD03.1 mains filters, the maximum allowed conductor cross section is limited to 4 mm².

X5, Motor Connection HCS01.1E-W0003...W0013-x-02, -W0005-x-03, -W0008-x-03

View	Identification	Function	
	A1	For power connection U1 at motor	
	A2	For power connection V1 at motor	
	A3	For power connection W1 at motor	
Screw connection at connector	Unit	Min.	Max.
Connection cable	mm ²	0,25	2,5
	AWG	24	12
Stripped length	mm	8	
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})	

Instructions for Use


Short circuit protection		A1, A2, A3 against each other and each of them against ground
Connection of equipment grounding conductor		Via connection point of equipment grounding conductor  at device (see index entry "Connection → Equipment grounding conductor")

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

X5, Motor Connection HCS01.1E-W0018-x-03, -W0028-x-03

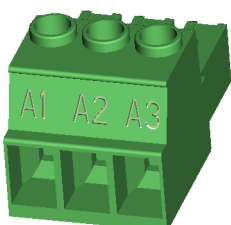

View	Identification	Function	
	A1	For power connection U1 at motor	
	A2	For power connection V1 at motor	
	A3	For power connection W1 at motor	
Screw connection at connector			
	Unit	Min.	Max.
Connection cable	mm ²	0,25	6,0
Stranded wire	AWG	24	8
Stripped length	mm	10	
Occurring current load and minimum 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	
Connection of equipment grounding conductor		Via connection point of equipment grounding conductor  at device (see index entry "Connection → Equipment grounding conductor")	

Fig.5-7: Function, Pin Assignment, Properties

5.2.6 X6, Motor Temperature Monitoring and Motor Holding Brake



WARNING

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

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

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

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

Function The connection point X6 contains 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	Con- nec- tion	Signal name	Function
	1	MotTemp+	Input motor temperature evaluation
	2	MotTemp-	
	3	+24VBr	Output for controlling the motor holding brake
	4	0VBr	
Spring terminal (connector)	Unit	Min.	Max.
Connection cable	mm ²	0,25	1,5
Stranded wire	AWG	24	16
Stripped length	mm	10	
Current carrying capacity outputs X6:			
HCS01.1	A	-	1,25
Time constant of load	ms	-	50
Number of switching actions at maximum time constant of load		250.000	
Switching frequency	Hz	-	0,5

Instructions for Use

Short circuit protection		X6.3 against X6.4 (output for controlling the motor holding brake)
Overload protection		X6.3 against X6.4 (output for controlling the motor holding brake)

Fig.5-8: Function, Pin Assignment

Notes on Installation



Make sure the **power supply** for the motor holding brake at the motor is sufficient. You have to take into account that voltage drops on the supply line. Use connection lines with the highest possible cross section of the single strands.

An **external contact element** is required, if motor holding brakes with higher currents than the allowed current load are to be supplied at X6.

Connection Diagram

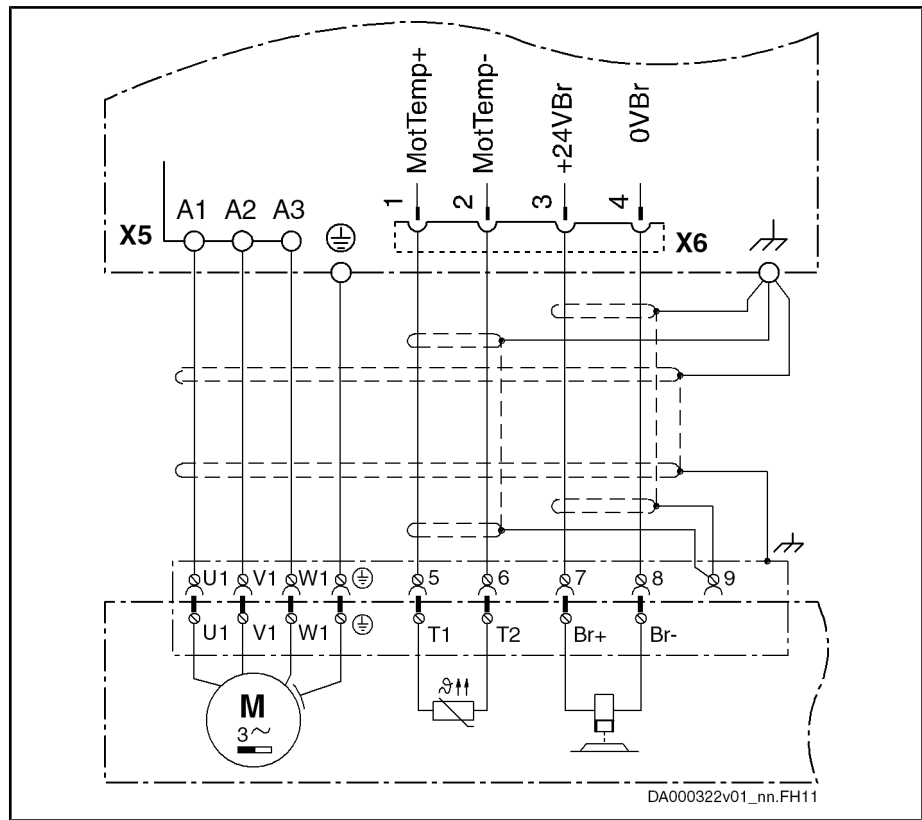


Fig.5-9: Connection of Motor Temperature Monitoring and Motor Holding Brake

5.2.7 X9, Integrated/External Braking Resistor



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

Exclusively operate the device

- with plugged on connectors (even if there haven't been any lines connected to the connectors) and
- with connected equipment grounding conductor!

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



Parameterize the external braking resistor by means of the firmware to protect the drive controller and the braking resistor against over-load:

- P-0-0860, Converter configuration
- P-0-0858, Data of external braking resistor

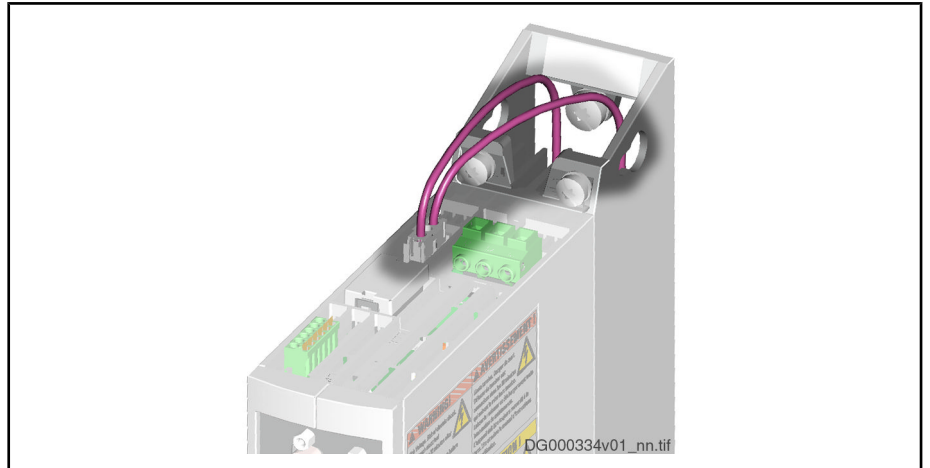


Fig.5-10: Connection of Braking Resistor

Notes on Installation Maximum allowed line length to external braking resistor: **5 m**
Twist unshielded lines.

5.2.8 X13, 24V Supply (Control Voltage)

Function, Pin Assignment The external 24V supply is applied via connection point X13 for

- the control section and power section of the drive controller
- brake control via X6
- the digital inputs and the digital output to X31 / X32

View	Conne- ction	Signal name	Function
	1	0V	Reference potential for power supply
	2	0V	
	3	+24V	Power supply
	4	+24V	
Spring terminal (connector)	Unit	Min.	Max.
Connection cable	mm ²	1,0	2,5
Stranded wire	AWG	16	12
Stripped length	mm	10	
Power consumption	W	P _{N3} (see data for control voltage)	
Voltage load capacity	V	U _{N3} (see data for control voltage)	

Instructions for Use

Current carrying capacity "looping through" from 0V to 0V, 24V to 24V	A	10
Polarity reversal protection		Within the allowed voltage range by internal protective diode
Insulation monitoring		Possible

Fig.5-11: Function, Pin Assignment, Properties

Notes on Installation

Requirements on the connection to the 24V supply:

- Minimum cross section: 1 mm²
- Maximum allowed inductance: 100 µH (2 twisted single strands, 75 m long)
- Parallel line routing where possible

Depending on the power consumption of the devices and the current carrying capacity of the connector X13, check via how many devices one line for 24V supply can be looped through. You might possibly have to connect another device directly to the 24V supply and then loop through the control voltage from this device to other devices.

5.2.9 X77, L+ L-, DC Bus Connection



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

Before working on live parts: De-energize installation and secure power switch against unintentional or unauthorized re-energization.

Before accessing the device, wait at least **30 minutes** after switching off the supply voltages to allow discharging. To shorten the waiting time until voltage has fallen below 50 V, you can use a discharging device (see chapter "Appendix").

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

Never operate the drive controller without touch guard or without DC bus connector. Only remove the touch guard, if you want to use the DC bus connector at the drive controller. If you do not use the DC bus connector any longer, you have to cover the DC bus connection with the supplied touch guard.

Function, Pin Assignment

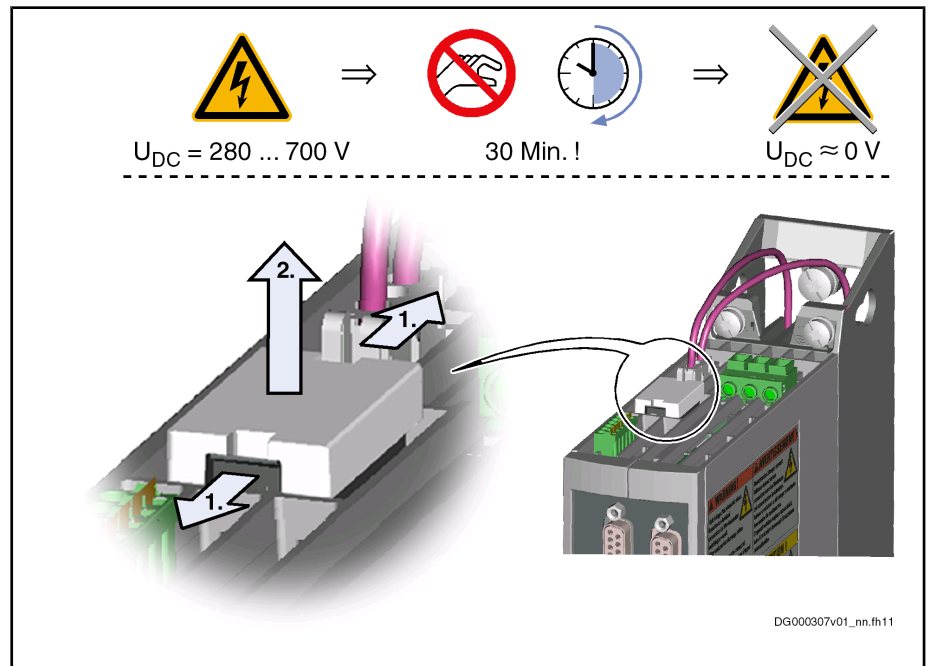
The DC bus connection connects

- several HCS01.1E-W00xx-x-03 to each other
- one drive controller to a DC bus capacitor unit (to backup the DC bus voltage)

Touch Guard

The DC bus connection has been provided with a touch guard at the factory. To plug the DC bus connector, you have to remove the touch guard.

How to Remove the Touch Guard:



- | | |
|---|--|
| <p>U_{DC}</p> <p>30 Min. !</p> <p>1.</p> <p>2.</p> <p>3.</p> | <p>DC bus voltage</p> <p>Before accessing the device, wait at least 30 minutes after switching off the supply voltages to allow discharging.</p> <p>With a small screwdriver (blade width < 3 mm), push the fixing device outwards and simultaneously lever out the touch guard.</p> <p>Pull off touch guard.</p> <p>Store the touch guard in a place where you can find it later on. If you want to operate the device without DC bus connector, you have to have to plug the touch guard on connection point X77 again.</p> |
|---|--|

Fig. 5-12: How to Remove the Touch Guard

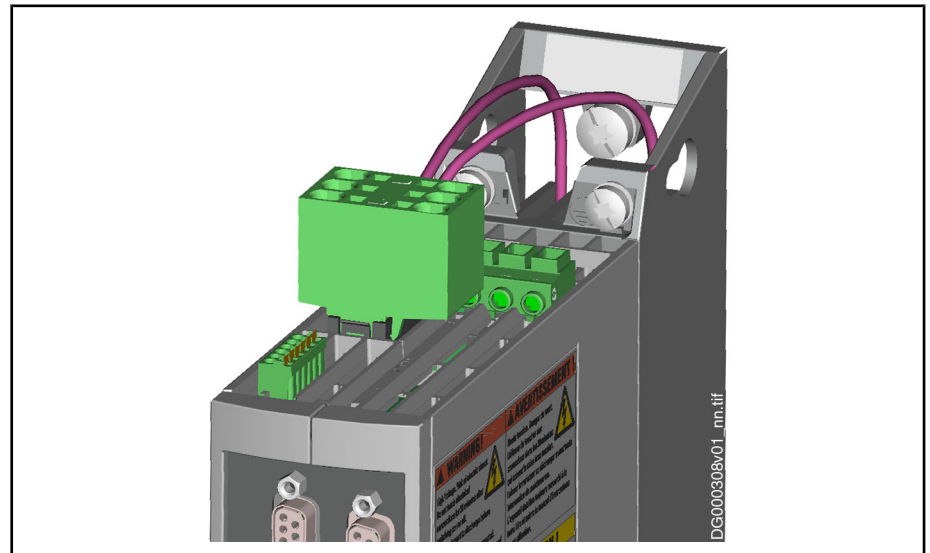


Fig. 5-13: DC Bus Connector at Device

Instructions for Use

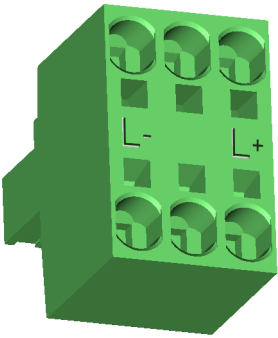
View	Identification	Function	
	L-	Connection points for connecting DC bus connections of several devices (The DC bus connector is available as an accessory; see index entry "Accessories → DC bus connector")	
	L-		
	n. c.		
	n. c.		
	L+		
	L+		
	Unit	Min.	Max.
Connection cable	mm ²	0,25	6
Stranded wire	AWG	24	10
Stripped length	mm	15	
Short circuit protection		Via fusing elements connected in the incoming circuit to the mains connection	
Overload protection		Via fusing elements connected in the incoming circuit to the mains connection	
Current carrying capacity "looping through" from L+ to L+, L- to L-	A	-	31

Fig.5-14: Function, Pin Assignment, Properties

Notes on Installation To wire the DC bus, use the shortest possible flexible, **twisted** wires.



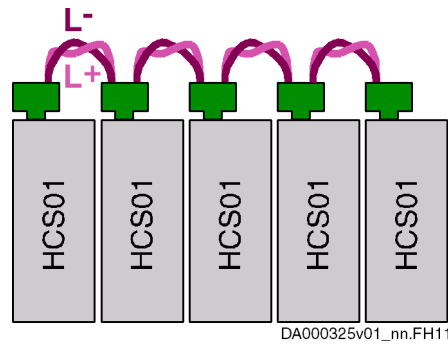
Risk of damage by reversing the polarity of the DC bus connections L- and L+
 Make sure the polarity is correct.

Length of twisted wire	Max. 2 m
Line cross section	Min. 4 mm ² , but not smaller than cross section of supply feeder
Line protection	By means of fuses in the mains connection
Dielectric strength of single strand against ground	≥ 750 V (e.g.: strand type – H07)

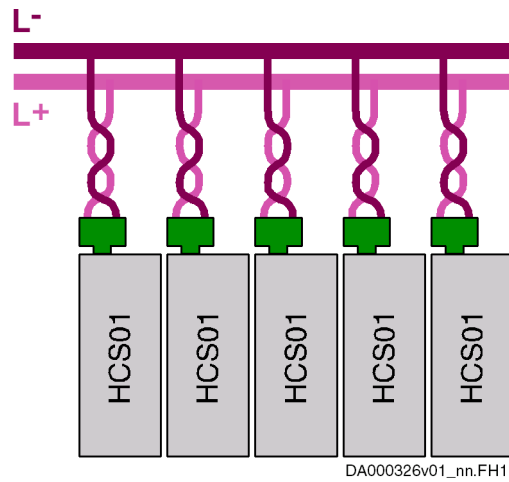
Fig.5-15: DC Bus Line

There are two options for interconnecting the DC buses of several devices:

- Direct connection of the DC bus connections:



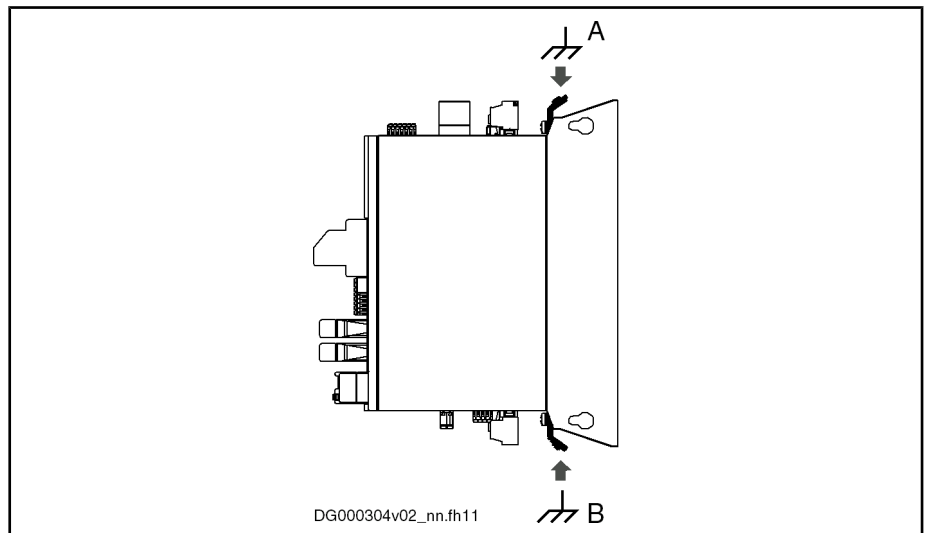
- Connection of DC bus connections via connecting bars:



5.2.10 Shield Connection

Special plates are used for shield connection of cables which are connected to the device. The cables are fixed to the plates with clips. This also provides strain relief for the cables.

The plates are part of the accessory **HAS09** and are screwed to the device.



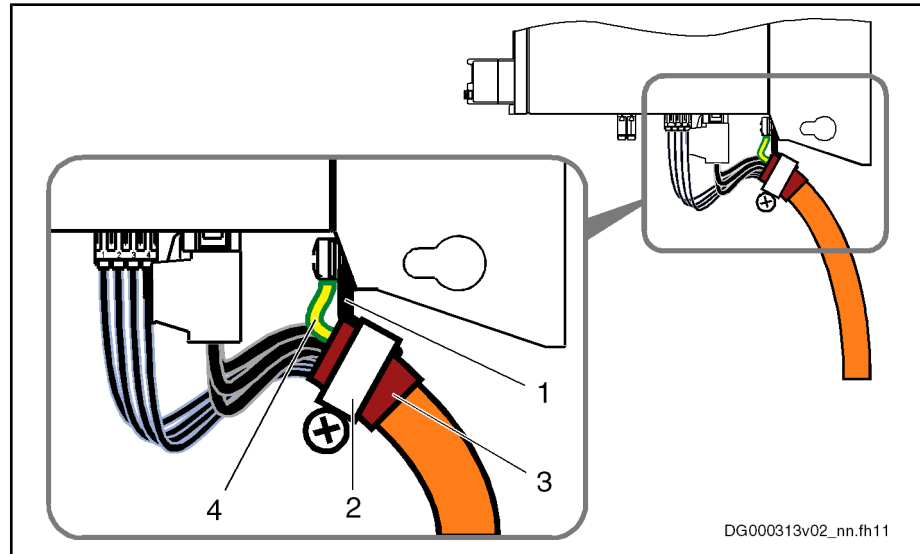
- A Shield connection control lines
- B Shield connection motor cable

Fig.5-16:

Shield Connection

Instructions for Use

Shield Connection Motor Cable



DG000313v02_nn.fh11

- 1 Plate (accessory HAS09)
 - 2 Clip (accessory HAS09)
 - 3 Shield of motor cable
 - 4 Equipment grounding conductor
- Fig.5-17: Shield Connection Motor Cable

5.2.11 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.

5.3 Installation

5.3.1 General Information on How to Install the Drive Controller



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

Before working on live parts: De-energize the installation and secure the power switch against unintentional or unauthorized re-energization.

Wait at least **30 minutes** after switching off the supply voltages to allow discharging. To shorten the waiting time until voltage has fallen below 50 V, you can use a discharging device (see chapter "Appendix").

Check whether voltages have fallen below 50 V before touching live parts!

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



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

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

Such exposed conductive parts include:

- The copper bit when soldering
- The human body (ground connection by touching a conductive, grounded object)
- Parts and tools (place them on a conductive support)

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



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

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



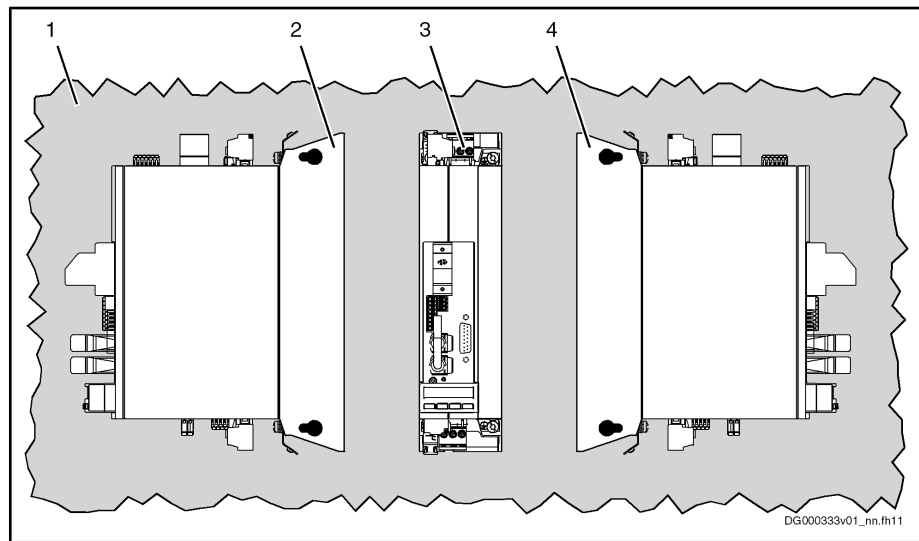
Risk of damage to the drive controller by connecting and disconnecting live connections!

Do not connect and disconnect live connections.

Instructions for Use

5.3.2 Sizing of Enclosure and Control Cabinet

Mounting HCS01 Devices in the Control Cabinet



- 1 Control cabinet wall
- 2 Left-hand mounting
- 3 Back-side mounting (standard mounting)
- 4 Right-hand mounting

Fig.5-18: Options for Mounting HCS01 Devices in the Control Cabinet

Notes on Mounting

- The **back-side mounting** (back of device directly mounted to control cabinet wall) is the standard and should be used, if possible.
- The **left-hand or right-hand mounting** (left or right side of device directly mounted to control cabinet wall) can be used, if the mounting clearance between control cabinet wall and control cabinet front is not sufficient for back-side mounting.

CAUTION! Risk of damage by high temperatures! At the **back of the HCS01 devices**, there are **braking resistors** which can become very hot during operation. When arranging the devices in the control cabinet, make sure there aren't any heat-sensitive materials close to the braking resistors.

In the case of left-hand or right-hand mounting, you must not **pile the devices**. Each device must have immediate contact to the control cabinet wall.

- Observe the **minimum distances** to be complied with for mounting (see technical data or dimensional drawings).
The specified horizontal minimum distance refers to the distance to neighboring devices and not to the distance to the control cabinet wall.
- **Tightening torque** of the mounting screws: **6 Nm**
- On the sides of the devices, there are **adhesive labels with notes on safety**. The supplied accessory HAS09 additionally contains these adhesive labels. If the adhesive labels at the devices are no longer visible after mounting, place the adhesive labels from the accessory HAS09 clearly visibly at the device or in the immediate vicinity of the device.

Required Steps to Follow

HCS01 drive controllers were designed for control cabinet mounting. They are mounted with two screws (M6×20; contained in the supplied accessory HAS09).

Mounting the drive controller

1. Fix screws to the back panel of the control cabinet.
2. Attach the drive controller to the screws.
3. Fix the screws with 6 Nm.

Multiple-Line Design of the Control Cabinet



Arrangement of the devices, air guides/drip protections, blowers

Pay particular attention to the maximum allowed air intake temperature of devices when they are arranged in multiple lines in the control cabinet.

If possible, place devices with a high degree of power dissipation (e.g. supply units with braking resistors, DC bus resistor units)

- in the top line and
- near the outlet air aperture to the cooling unit

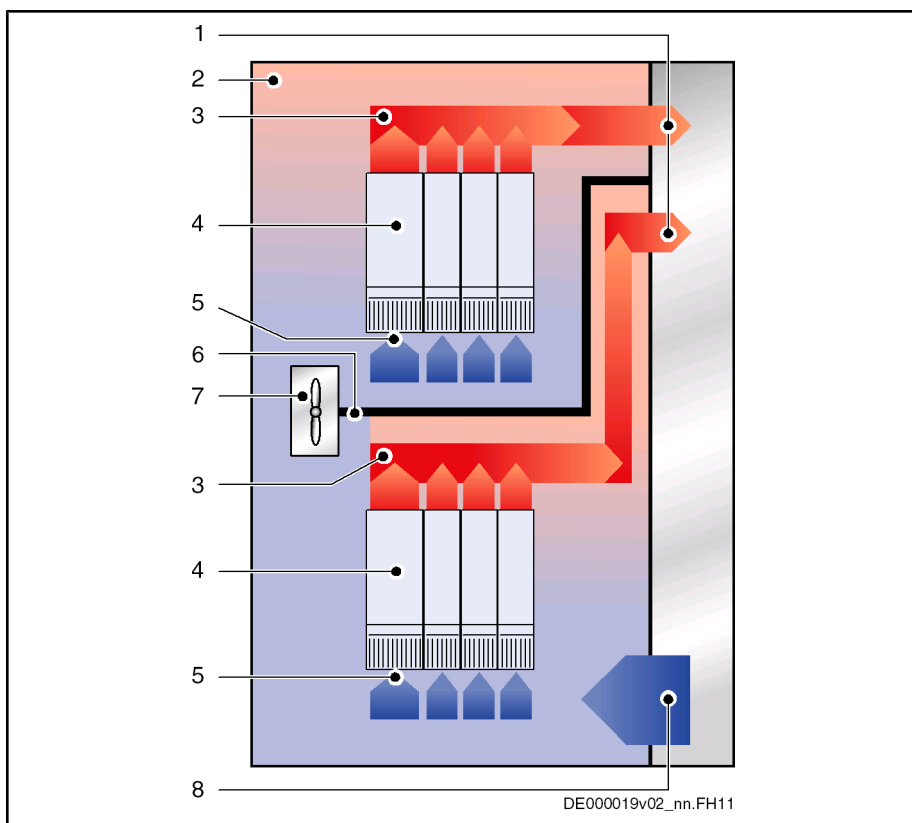
Mount **air guides** between the lines to

- protect the devices in the upper lines against the warm outlet air of the devices beneath and
- protect the devices beneath against penetration of liquids (e.g. dripping condensation water or leaking cooling liquid)

Additional blowers convey the outlet air to the cooling unit and cooling air to the upper lines.

At the installed control cabinet, check the air intake temperature of all devices.

Instructions for Use



- 1 Discharge of heated air to cooling unit
- 2 Interior of control cabinet
- 3 Conveying direction of heated air in area where air flows off
- 4 Device in control cabinet
- 5 Air intake at device
- 6 Air guide in control cabinet (for liquid cooling, this is also the drip protection for the devices beneath)
- 7 Blower in control cabinet
- 8 Supply of cooled air from cooling unit

Fig.5-19: Example of Arrangement for Double-Line Design

Arrangement of Cooling Units

Unless the nominal data are reduced, the drive controller may only be operated up to a specified maximum ambient temperature. A cooling unit might therefore be required.



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

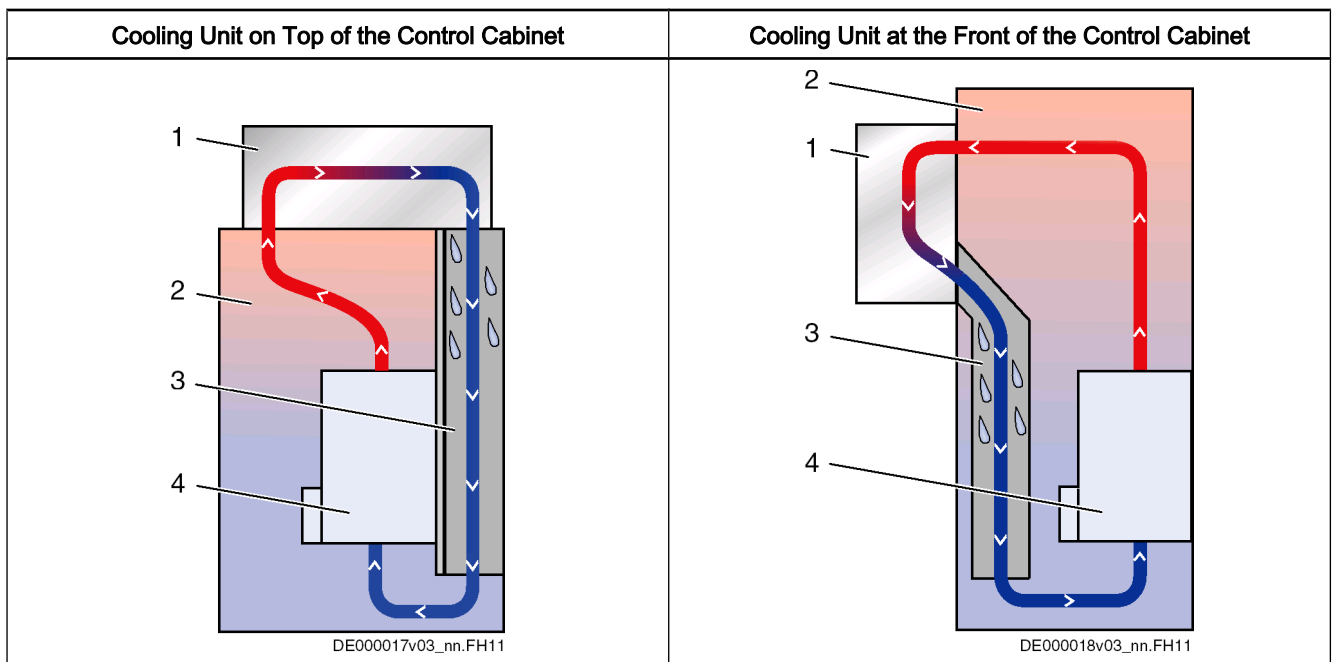
Observe the instructions below.

Avoiding Dripping or Spraying Water

Due to their operating principle, condensation water is formed when cooling units are used.

For this reason, observe the following aspects:

- Always position cooling units in such a way that condensation water cannot drip onto the devices in the control cabinet.
- Position the cooling unit in such a way that the blower of the cooling unit does not spray accumulated condensation water onto the devices in the control cabinet. Mount the air duct in the control cabinet accordingly.



- 1 Cooling unit
- 2 Interior of control cabinet
- 3 Air duct (protects devices against condensation water)
- 4 Device in control cabinet

Fig.5-20: Arrangement of Cooling Units

Avoiding Moisture Condensation

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

- Set cooling units with temperature adjustment to the maximum surrounding temperature and not lower!
- Set cooling units with follow-up temperature in such a way that the interior temperature of the control cabinet is not lower than the temperature of the surrounding air. Set the temperature limitation to the maximum surrounding temperature!
- Only use well-sealed control cabinets so that moisture condensation cannot arise as a result of warm and moist external air entering the cabinet.
- In the event that control cabinets are operated with the doors open (commissioning, servicing etc.), it is essential to ensure that after the doors are closed the drive controllers cannot at any time be cooler than the air in the control cabinet. For this reason, sufficient circulation must be provided inside the control cabinet.

6 EMC Measures for Design and Installation

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

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

Mains Filter	Correctly use a mains filter recommended by Rexroth for radio interference suppression in the supply feeder of the drive system.
Control Cabinet Grounding	Connect all metal parts of the cabinet with one another over the largest possible surface area to establish a good electrical connection. This, too, applies to the mounting of the mains filter. If required, use serrated washers which cut through the paint surface. Connect the cabinet door to the control cabinet using the shortest possible grounding straps.
Line Routing	<p>Avoid coupling routes between lines with high potential of noise and noise-free lines; therefore, signal, mains and motor lines and power cables have to be routed separately from another. Minimum distance: 10 cm. Provide separating sheets between power and signal lines. Ground separating sheets several times.</p> <p>The lines with high potential of noise include:</p> <ul style="list-style-type: none"> • Lines at the mains connection (incl. synchronization connection) • Lines at the motor connection • Lines at the DC bus connection <p>Generally, interference injections are reduced by routing cables close to grounded sheet steel plates. For this reason, cables and wires should not be routed freely in the cabinet, but close to the cabinet housing or mounting panels. Separate the incoming and outgoing cables of the radio interference suppression filter.</p>
Interference Suppression Elements	<p>Provide the following components in the control cabinet with interference suppression combinations:</p> <ul style="list-style-type: none"> • Contactors • Relays • Solenoid valves • Electromechanical operating hours counters <p>Connect these combinations directly at each coil.</p>
Twisted Wires	Twist unshielded wires belonging to the same circuit (feeder and return cable) or keep the surface between feeder and return cable as small as possible. Wires that are not used have to be grounded at both ends.
Lines of Measuring Systems	Lines of measuring systems must be shielded. Connect the shield to ground at both ends and over the largest possible surface area. The shield may not be interrupted, e.g. using intermediate terminals.
Digital Signal Lines	Ground the shields of digital signal lines at both ends (transmitter and receiver) over the largest possible surface area and with low impedance. In the case of bad ground connection between transmitter and receiver, additionally route a bonding conductor (min. 10 mm ²). Braided shields are better than foil shields.
Analog Signal Lines	Ground the shields of analog signal lines at one end (transmitter or receiver) over the largest possible surface area and with low impedance. This avoids low-frequency interference current (in the mains frequency range) on the shield.

EMC Measures for Design and Installation

Connection of Mains Choke	Keep connection lines of the mains choke at the drive controller as short as possible and twist them.
Installation of Motor Power Cable	<ul style="list-style-type: none">• Use shielded motor power cables or run motor power cables in a shielded duct• Use the shortest possible motor power cables• Ground shield of motor power cable at both ends over the largest possible surface area to establish a good electrical connection• Run motor lines in shielded form inside the control cabinet• Do not use any steel-shielded lines• The shield of the motor power cable mustn't be interrupted by mounted components, such as output chokes, sine filters or motor filters

6.2 EMC-Optimal Installation in Facility and Control Cabinet

6.2.1 General Information

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



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

6.2.2 Division Into Areas (Zones)

Exemplary arrangements in the control cabinet: See section [Control Cabinet Mounting According to Interference Areas - Exemplary Arrangements](#), page 42.

We distinguish three areas:

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

This includes:

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

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

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

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

- Motor power cables including single cores

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

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

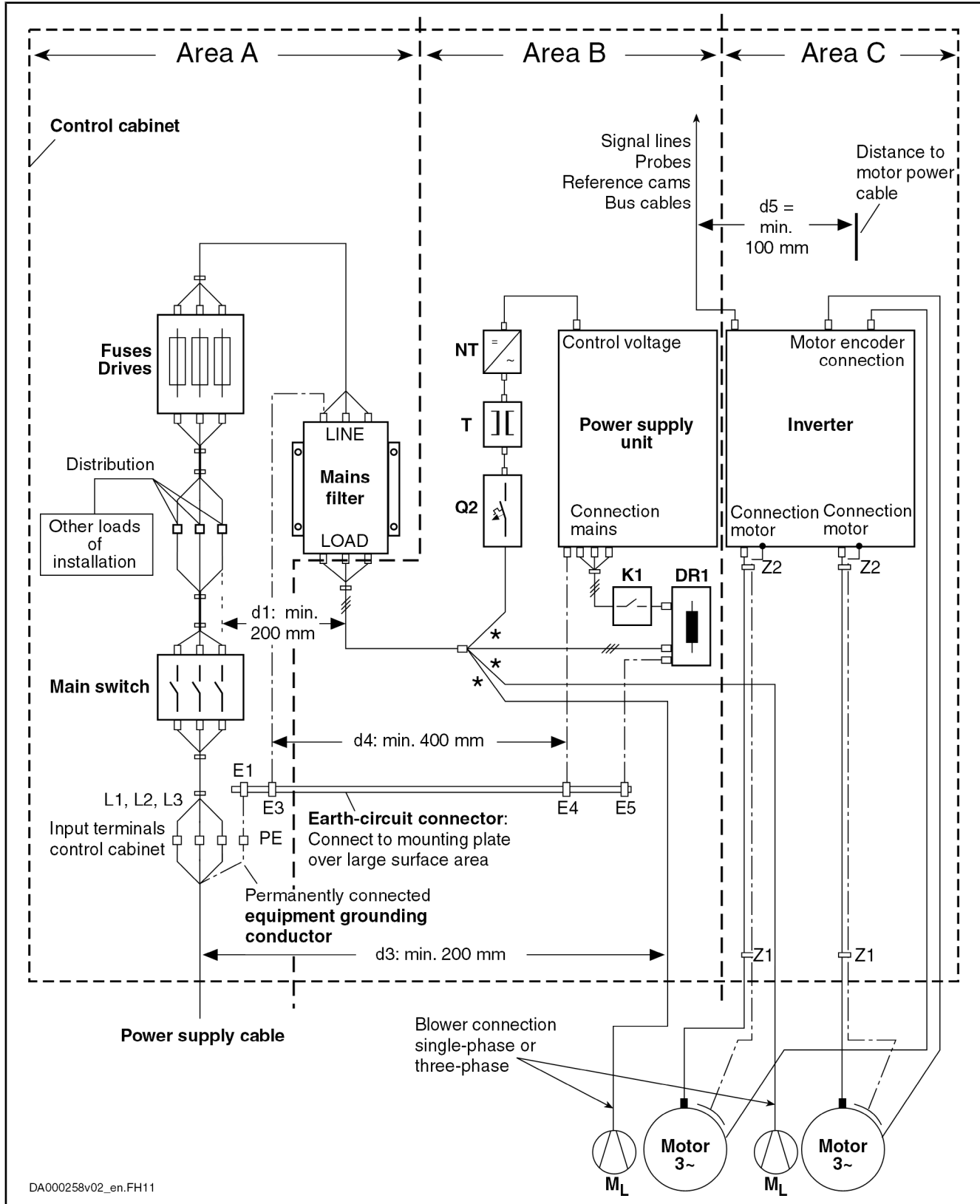
EMC Measures for Design and Installation

Badly grounded control cabinet doors act as antennas. Therefore, connect the control cabinet doors to the cabinet on top, in the middle and on the bottom via short equipment grounding conductors with a cross section of at least 6 mm² or, even better, via grounding straps with the same cross section. Make sure connection points have good contact.

EMC Measures for Design and Installation

6.2.3 Control Cabinet Mounting According to Interference Areas - Exemplary Arrangements

HMVxx.xE Supply Unit or HCSxx.xE Converter



DA000258v02_en.FH11

DR1 Mains choke (optional)

E1...E5	Equipment grounding conductor of the components
K1	External mains contactor for supply units and converters without integrated mains contactor
M _L	Motor blower
NT	Power supply unit
Q2	Fusing
T	Transformer
Z1, Z2	Shield connection points for cables
*	Not allowed at HNF mains filter

Fig. 6-1: *HMVxx.xE; HCSxx.xE – EMC Areas in the Control Cabinet*

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

Arrangement of the Components in the Control Cabinet

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

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

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

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

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

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

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

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

If this is impossible, there are two alternatives:

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

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

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




In case you do not observe the information on cable routing given in this section, the effect of the mains filter is totally or partly neutralized. This will cause the noise level of the interference emission to be higher within the range of 150 kHz to 40 MHz and the limit values at the connection points of the machine or installation will thereby be exceeded.

Routing and Connecting a Neutral Conductor (N)

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

EMC Measures for Design and Installation

Motor Blower at Mains Filter	<p>Single-phase or three-phase supply lines of motor blowers, that are usually routed in parallel with motor power cables or interference-susceptible lines, must be filtered:</p> <ul style="list-style-type: none"> • In drive systems with regenerative supply units, via a separate single-phase (NFE type) or three-phase filter (HNF type) near the mains connection of the control cabinet • In drive systems with only infeeding supply units, via the available three-phase filter of the drive system <p>When switching power off, make sure the blower is not switched off.</p>
Loads at Mains Filter of Drive System	<p> Only operate allowed loads at the mains filter of the drive system!</p> <p>At the three-phase filter for the power connection of regenerative supply units, it is only allowed to operate the following loads:</p> <ul style="list-style-type: none"> • HMV supply unit with mains choke and, if necessary, mains contactor <p>Do not operate any motor blowers, power supply units etc. at the mains filter of the drive system.</p>
Shielding Mains Supply Lines in Control Cabinet	<p>If there is a high degree of interference injection to the mains supply line within the control cabinet, although you have observed the above instructions (to be found out by EMC measurement according to standard), proceed as follows:</p> <ul style="list-style-type: none"> • Only use shielded lines in area A • Connect shields to the mounting plate at the beginning and the end of the line by means of clips <p>The same procedure may be required for long cables of more than 2 m between the point of power supply connection of the control cabinet and the filter within the control cabinet.</p>
Mains Filters for AC Drives	<p>Ideally, mount the mains filter on the parting line between area A and B. Make sure the ground connection between filter housing and housing of the drive controllers has good electrically conductive properties.</p> <p>If single-phase loads are connected on the load side of the filter, their current may be a maximum of 10% of the three-phase operating current. A highly imbalanced load of the filter would deteriorate its interference suppression capacity.</p> <p>If the mains voltage is more than 480 V, connect the filter to the output side of the transformer and not to the supply side of the transformer.</p>
Grounding	<p>In the case of bad ground connections in the installation, the distance between the lines to the grounding points E1, E2 in area A and the other grounding points of the drive system should be at least $d_4 = 400 \text{ mm}$, in order to minimize interference injection from ground and ground cables to the power input lines.</p> <p>See also 6.2.2 Division Into Areas (Zones), page 40.</p>
Point of Connection for Equipment Grounding Conductor at Machine, Installation, Control Cabinet	<p>The equipment grounding conductor of the power cable of the machine, installation or control cabinet has to be permanently connected at point PE and have a cross section of at least 10 mm^2 or to be complemented by a second equipment grounding conductor via separate terminal connectors (according to EN50178/ 1997, section 5.3.2.1). If the cross section of the outer conductor is bigger, the cross section of the equipment grounding conductor must be accordingly bigger.</p>

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

Arranging Components and Lines	<p>Modules, components and lines in area B should be placed at a distance of at least d1 = 200 mm from modules and lines in area A.</p> <p>Alternative: Shield modules, components and lines in area B by distance plates mounted vertically on the mounting plate from modules and lines in area A or use shielded lines.</p> <p>Only connect power supply units for auxiliary or control voltage connections in the drive system to the mains via a mains filter. See 6.2.2 Division Into Areas (Zones), page 40.</p> <p>Install the shortest possible lines between drive controller and filter.</p>
Control Voltage or Auxiliary Voltage Connection	<p>Only in exceptional cases should you connect power supply unit and fusing for the control voltage connection to phase and neutral conductor. In this case, mount and install these components in area A far away from the areas B and C of the drive system. For details see section 6.2.4 Design and Installation in Area A - Interference-Free Area of Control Cabinet, page 43.</p> <p>Run the connection between control voltage connection of the drive system and power supply unit used through area B over the shortest distance.</p>
Line Routing	<p>Run the lines along grounded metal surfaces, in order to minimize radiation of interference fields to area A (transmitting antenna effect).</p>

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

Influence of the Motor Power Cable	<p>Area C mainly concerns the motor power cables, especially at the connection point at the drive controller.</p> <p>The longer the motor power cable, the greater its leakage capacitance. To comply with a certain EMC limit value, the allowed leakage capacitance of the mains filter is limited. For the calculation of the leakage capacitance, see the documentation on the drive system of the drive controller used.</p>
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- Run the shortest possible motor power cables.
- Only use **shielded** motor power cables by Rexroth.

Routing the Motor Power Cables and Motor Encoder Cables	<p>Route the motor power cables and motor encoder cables along grounded metal surfaces, both inside the control cabinet and outside of it, in order to minimize radiation of interference fields. If possible, route the motor power cables and motor encoder cables in metal-grounded cable ducts.</p> <p>Route the motor power cables and motor encoder cables</p> <ul style="list-style-type: none"> • with a distance of at least d5 = 100 mm to interference-free lines, as well as to signal cables and signal lines (alternatively separated by a grounded distance plate) • in separate cable ducts, if possible
Routing the Motor Power Cables and Mains Connection Lines	<p>For converters (drive controllers with individual mains connection), route motor power cables and (unfiltered) mains connection lines in parallel for a maximum distance of 300 mm. After that distance, route motor power cables and power supply cables in opposite directions and preferably in separate cable ducts.</p> <p>Ideally, the outlet of the motor power cables at the control cabinet should be provided in a distance of at least d3 = 200 mm from the (filtered) power supply cable.</p>

EMC Measures for Design and Installation

IndraDrive C and Cs - Routing the Motor Power Cables

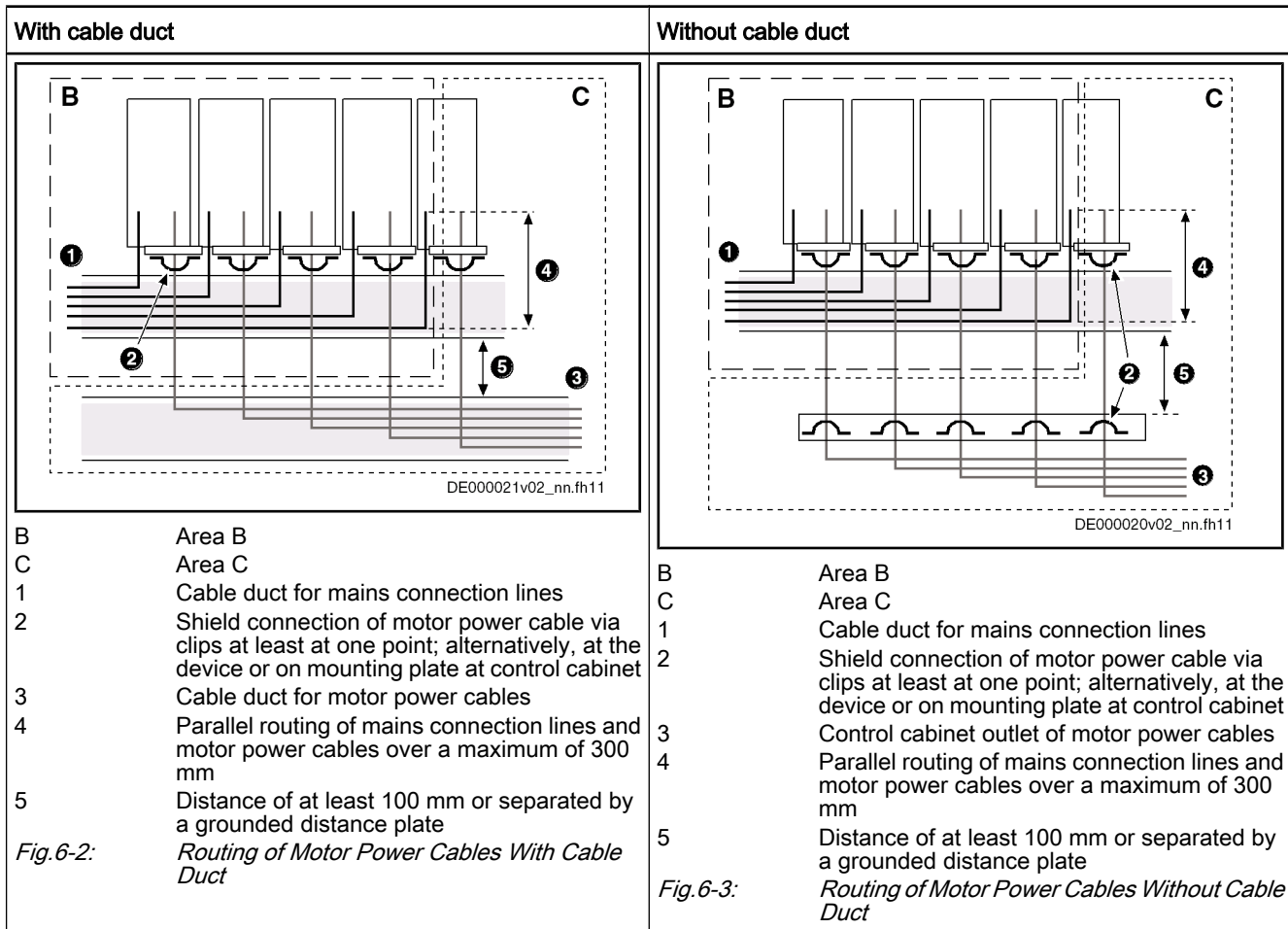


Fig. 6-4: Routing of Cables for IndraDrive C and Cs

6.3 Ground Connections

Housing and Mounting Plate

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

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

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

Connection Elements

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

EMC Measures for Design and Installation

Metal Surfaces	<p>Always use connection elements (screws, nuts, plain washers) with good electroconductive surface.</p> <p>Bare zinc-coated or tinned metal surfaces have good electroconductive properties.</p> <p>Anodized, yellow chromated, black gunmetal finish or lacquered metal surfaces have bad electroconductive properties.</p>
Ground Wires and Shield Connections	<p>For connecting ground wires and shield connections, it is not the cross section but the size of contact surface that is important, as the high-frequency interference currents mainly flow on the surface of the conductor.</p> <p>Always connect cable shields, especially shields of the motor power cables, to ground potential over a large surface area.</p>

6.4 Installing Signal Lines and Signal Cables

Line Routing	<p>For measures to prevent interference, see the Project Planning Manuals of the respective device. In addition, we recommend the following measures:</p> <ul style="list-style-type: none"> • Route signal and control lines separately from the power cables with a minimum distance of d5 = 100 mm (see 6.2.2 Division Into Areas (Zones), page 40) or with a grounded separating sheet. The optimum way is to route them in separate cable ducts. If possible, lead signal lines into the control cabinet at one point only. • If signal lines are crossing power cables, route them in an angle of 90° in order to avoid interference injection. • Ground spare cables, that are not used and have been connected, at least at both ends so that they do not have any antenna effect. • Avoid unnecessary line lengths. • Run cables as close as possible to grounded metal surfaces (reference potential). The ideal solution are closed, grounded cable ducts or metal pipes which, however, is only obligatory for high requirements (sensitive instrument leads). • Avoid suspended lines or lines routed along synthetic carriers, because they are functioning like reception antennas (noise immunity) and like transmitting antennas (emission of interference). Exceptional cases are flexible cable tracks over short distances of a maximum of 5 m.
Shielding	<p>Connect the cable shield immediately at the devices in the shortest and most direct possible way and over the largest possible surface area.</p> <p>Connect the shield of analog signal lines at one end over a large surface area, normally in the control cabinet at the analog device. Make sure the connection to ground/housing is short and over a large surface area.</p> <p>Connect the shield of digital signal lines at both ends over a large surface area and in short form. In the case of potential differences between beginning and end of the line, run an additional bonding conductor in parallel. This prevents compensating current from flowing via the shield. The guide value for the cross section is 10 mm².</p> <p>You absolutely have to equip separable connections with connectors with grounded metal housing.</p> <p>In the case of non-shielded lines belonging to the same circuit, twist feeder and return cable.</p>

EMC Measures for Design and Installation

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

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

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

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

If possible, mechanical switches and contacts should only be realized as snap contacts. Contact pressure and contact material must be suited for the corresponding switching currents.

Slow-action contacts should be replaced by snap switches or by solid-state switches, because slow-action contacts strongly bounce and are in an undefined switching status for a long time which emits electromagnetic waves in the case of inductive loads. These waves are an especially critical aspect in the case of manometric or temperature switches.

7 Accessories

7.1 HAS09

The accessory contains:

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


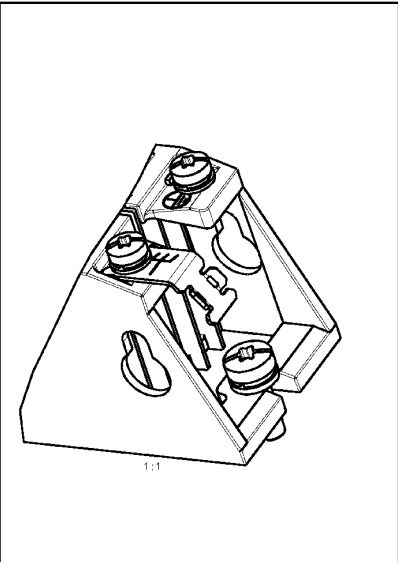
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Material-Nr.	R911325368	Zeich-Nr. 109-1304-4223-01																																							
Datei	08232747	Ers.durch .. ABM-Nr. 3-048292																																							

Fig.7-1: Product Insert HAS09

DL000105v02_mn.tif

Accessories

7.2 DC Bus Connector

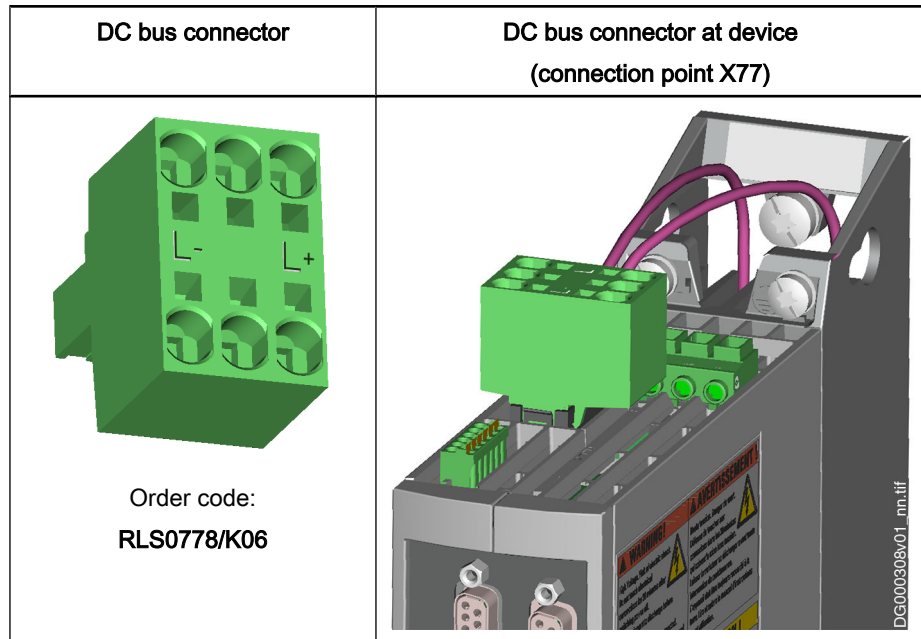


Fig.7-2: DC Bus Connector

7.3 SUP-E01-MSM-BATTERYBOX

"SUP-E01-MSM-BATTERYBOX" is a set of accessories used to operate MSM motors with absolute value encoder and to backup the encoder data in case voltage is switched off.

Scope of Supply

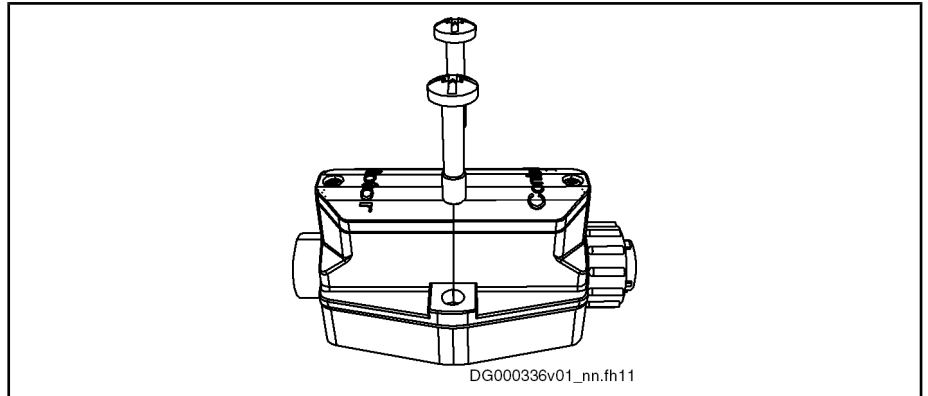


Fig.7-3: Battery Box

Battery box complete with

- Battery, type: ERC6, 3,6 V; 1800 mA, lithium
- Mounting screws: M6×30; Screw head: Torx and slot

Dimensions

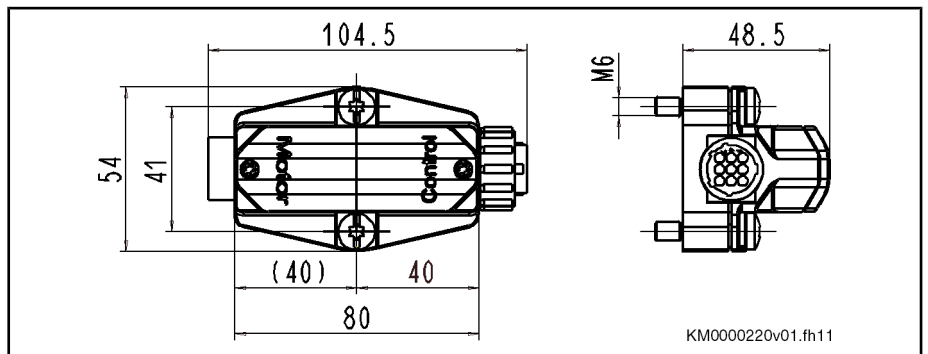


Fig.7-4: Dimensions

Weight 120 g

Mounting



Mount the battery box as near as possible to the motor (maximum distance approx. 2 m).

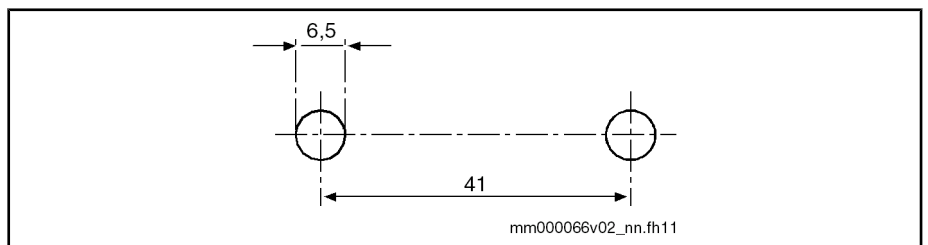


Fig.7-5: Boring Diagram for Battery Box

- Mounting screws: M6×30
- Tightening torque M_A : 3 Nm

The battery box "SUP-E01-MSM-BATTERYBOX" is supplied in ready-for-operation status with battery.

Wiring: MSM encoder plug-in connector → Battery box → HCS01

Accessories

7.4 SUP-E03-DKC*CS-BATTERY

"SUP-E03-DKC*CS-BATTERY" contains accessories according to the enclosed product insert used to operate MSM motors with absolute value encoder. Use these accessories when it is necessary to replace the battery of the battery box "SUP-E01-MSM-BATTERYBOX".

Battery Type: ERC6, 3,6 V; 1800 mA, lithium
Resistance 10 ohm

<h2 style="margin: 0;">SUP-E03-DKC*CS-BATTERY</h2> <p style="text-align: center;">R911295648</p>		
1	BGR STECKER ECODRIVE*CS REFRESH	R911297815
1	BATTERIE-PRMI-03V6-1800C-D2-LITH-ZNR-100	R911296949
Stck	Benennung	MN

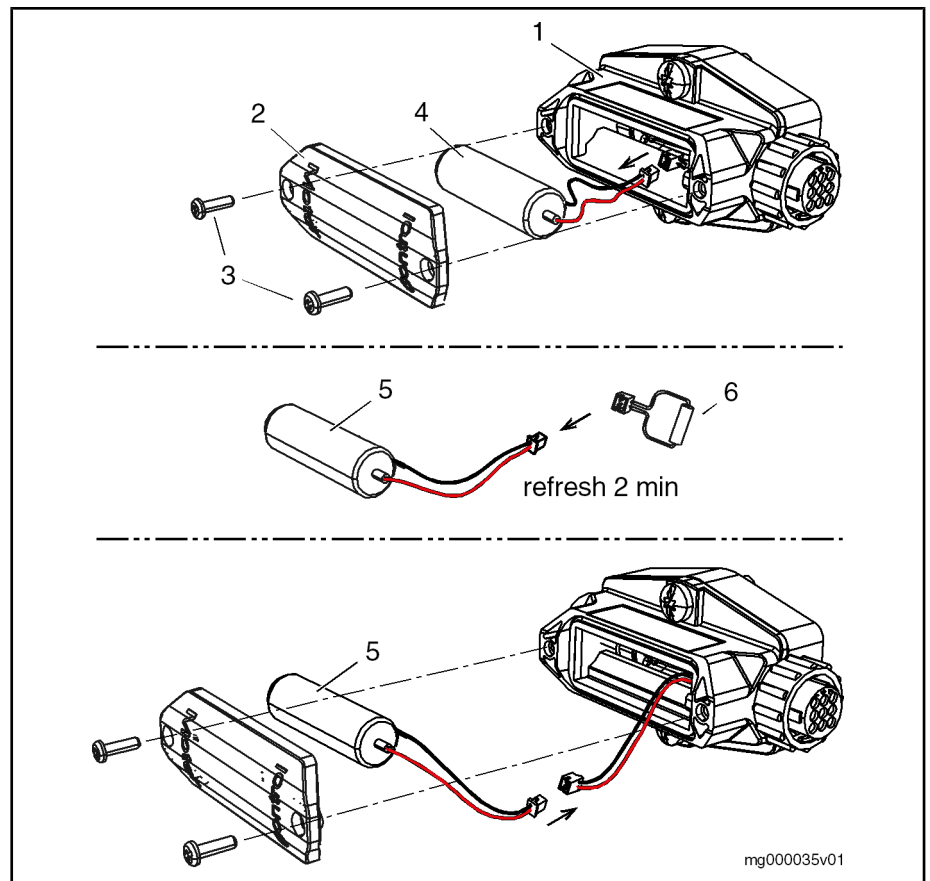
BEIPACKZETTEL SUP-E03-DKC*CS-BATTERY		
Stck	Benennung	MN
1	BATTERIE-PRMI-03V6-1800C-D2-LITH-ZNR-100	R911296949
1:1		
1	BGR STECKER ECODRIVE*CS REFRESH	R911297815
2:1		
<p style="font-size: 8px;">Abbildung figure ilustration illustrazione ilustración</p>		
Datum	2004-08-30	Benennung
Name	Merz	BEIPACKZETTEL SUP-E03-DKC*CS-BATTERY
Material-Nr.	R911295648	Zeich-Nr. 109-1230-4202-03
Datei	08145279	Ers.durch ... AEM-Nr. 5-06096

SUP-E03-DKC-DKC*CS-BATTERY

Fig.7-6: SUP-E03-DKC*CS-BATTERY

Refresh / Replacing the Battery

Before using a new battery, you must always carry out the so-called "refresh" procedure:



- 1 Battery box housing
- 2 Battery box housing cover
- 3 Battery box housing screw (self-shaping screw 30×10; tightening torque 0.8 Nm)
- 4 Dispose of exhausted battery
- 5 Replacement battery from SUP-E03-DKC*CS-BATTERY
- 6 Refresh resistor from SUP-E03-DKC*CS-BATTERY

Fig.7-7: Battery Box

How to replace the battery

1. Loosen housing screws (3) of battery box (1) and remove cover (2) of battery box
2. Remove old battery (4)
3. Carry out "refresh" procedure for new battery (5): Connect battery for 2 minutes to refresh resistor
4. Insert new battery (5) into battery compartment
5. Connect connector of battery to mating connector in battery compartment
6. Put cover (2) of battery box (1) onto housing and screw down housing screws (3) with 0.8 Nm
7. Dispose of old battery (4) according to directives valid in your country

8 Service and Support

Our service helpdesk at our 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.

9 Environmental Protection and Disposal

9.1 Environmental Protection

Production Processes	The products are made with energy- and resource-optimized production processes which allow re-using and recycling the resulting waste. We regularly try to replace pollutant-loaded raw materials and supplies by more environment-friendly alternatives.				
Prohibited Substances	We guarantee that our products include no substances according to the chemicals-ban-decree. We furthermore declare that our products are free of mercury, asbestos, PCB and chlorinated hydrocarbons.				
No Release of Hazardous Substances	Our products do not contain any hazardous substances which may be released in the case of appropriate use. Normally, our products will not have any negative influences on the environment.				
Significant Components	Basically, our products contain the following components: <table border="0" style="margin-left: 20px;"> <tr> <td style="vertical-align: top;">Electronic devices</td> <td style="vertical-align: top;">Motors</td> </tr> <tr> <td> <ul style="list-style-type: none"> • Steel • Aluminum • Copper • Synthetic materials • Electronic components and modules </td> <td> <ul style="list-style-type: none"> • Steel • Aluminum • Copper • Brass • Magnetic materials • Electronic components and modules </td> </tr> </table>	Electronic devices	Motors	<ul style="list-style-type: none"> • Steel • Aluminum • Copper • Synthetic materials • Electronic components and modules 	<ul style="list-style-type: none"> • Steel • Aluminum • Copper • Brass • Magnetic materials • Electronic components and modules
Electronic devices	Motors				
<ul style="list-style-type: none"> • Steel • Aluminum • Copper • Synthetic materials • Electronic components and modules 	<ul style="list-style-type: none"> • Steel • Aluminum • Copper • Brass • Magnetic materials • Electronic components and modules 				

9.2 Disposal

Return of Products	<p>Our products can be returned to our premises free of charge for disposal. It is a precondition, however, that the products are free of oil, grease or other dirt. Furthermore, the products returned for disposal must not contain any undue foreign material or foreign components.</p> <p>Send the products "free domicile" to the following address:</p> <p style="text-align: center;">Bosch Rexroth AG Electric Drives and Controls Buergermeister-Dr.-Nebel-Strasse 2 97816 Lohr am Main, Germany</p>
Packaging	<p>The packaging materials consist of cardboard, wood and polystyrene. These materials can be recycled anywhere without any problem.</p> <p>For ecological reasons, please refrain from returning the empty packages to us.</p>
Recycling	<p>Most of the products can be recycled due to their high content of metal. In order to recycle the metal in the best possible way, the products must be disassembled into individual modules.</p> <p>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.</p> <p>If the products contain batteries or accumulators, these have to be removed before recycling and disposed of.</p>

10 Appendix

10.1 Discharging of Capacitors

10.1.1 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.

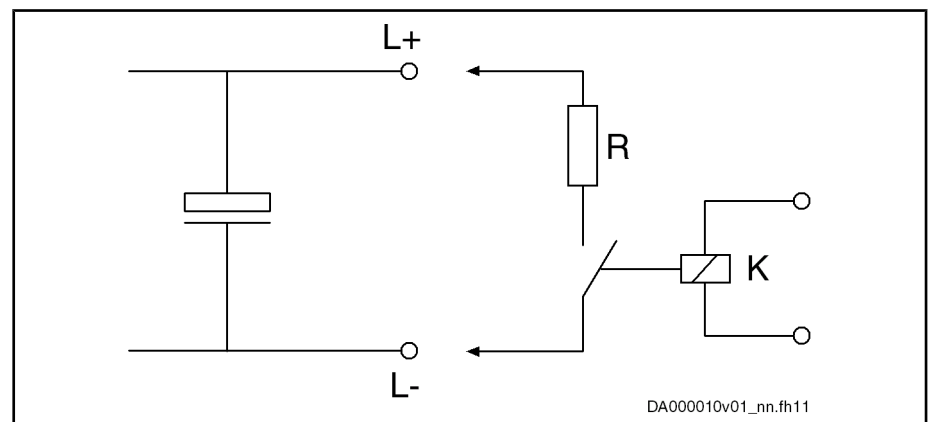
To shorten the waiting time until voltage has fallen below 50 V, you can take the following measures:

- When using HMV01 supply units (exception: HMV01.1R-W0120):
Activate the function "ZKS" (ZKS = DC bus short circuit)
- Use the discharging device described below

10.1.2 Discharging Device

Operating Principle

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



R Discharging resistor
K Contactor contact

Fig. 10-1: Operating Principle of Discharging Device

Appendix

Dimensioning

The individual components have to be sufficiently dimensioned:

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

Installation



WARNING

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

Before working on live parts: De-energize the installation and secure the power switch against unintentional or unauthorized re-energization.

Wait at least **30 minutes** after switching off the supply voltages to allow discharging.

Check whether voltages have fallen below 50 V before touching live parts!



CAUTION

Risk of damage by intense heat!

During the discharging process, the discharging resistor generates intense heat. Therefore, place the discharging resistor as far as possible from heat-sensitive components.

How to install the discharging device

1. Preferably install discharging device **before switching on supply voltage for the first time**.

If you install discharging device after having switched on supply voltage for the first time, wait 30 minutes to allow discharging. Check whether voltage has fallen below 50 V before touching live parts!

2. Place discharging resistor as far as possible from heat-sensitive components.

Activation

Observe the following order for activating the discharging device:

1. De-energize installation and secure power switch against unintentional or unauthorized re-energization.
2. Activate discharging device.

Index

Symbols

24V supply	
Connection point	27

A

Accessories	
Battery	52
DC bus connector	50
HAS09	49
Mounting and connection accessories (HAS09)	49
Replacement battery	52
SUP-E01-MSM-BATTERYBOX	51
SUP-E03-DKC*CS-BATTERY	52
X77, DC bus connector	50
Ambient conditions.....	13

B

Battery	
Refresh	52
SUP-E03-DKC*CS-BATTERY	52
Braking resistor	
External, connection	26
Integrated, connection	26
Parameterization	27

C

Cables	
Documentation	15
Shield connection	31
Strain relief	31
Capacitors	
Discharging	59
Connection	
24V supply (X13)	27
Braking resistor (X9)	26
Control voltage (X13)	27
DC bus (X77)	28
Equipment grounding conductor	20
Ground	32
Mains (X3)	21
Motor (X5)	23
Motor holding brake (X6)	25
Motor temperature monitoring (X6)	25
Shield	31
Connection diagram.....	19
Connection points.....	18
Contained substances	
see "Significant components"	57
Control cabinet	
Area A, interference-free	43
Area B, interference-susceptible	45
Area C, strongly interference-susceptible	45
Avoiding moisture condensation	37

C

...Control cabinet	
Cooling unit	36
Interference areas	42
Multiple-line arrangement of drive control- lers	35
Control voltage	
Connection point X13	27
Loop-through contacts (X13)	27
Cooling unit	
Arrangement	36

D

DC bus	
Connection point X77	28
Connector, accessories	50
DC bus capacitors	
Discharging	59
Dimensions.....	13
Discharging	
Of DC bus capacitors	59
Discharging device.....	59
Distances.....	14
Documentation	
Cables	15
Drive systems	15
Firmware	15
Motors	15
Overview	15
Reference documentations	15
System components	15
Drive controllers	
Multiple-line arrangement	35

E

EMC	
Measures for design and installation	39
Equipment grounding conductor	
Connection	20

F

Firmware	
Documentation	15

G

Ground	
Connection	32
Ground connection.....	32
Ground connections.....	46

Index

H		
HAS09		
Accessories (for mounting and installation) .	49	
Hazardous substances.....	57	
HCS01		
Mounting in the control cabinet	34	
Scope of supply	12	
Technical data	13	
Type code	11	
Type plate	12	
I		
Identification.....	11	
Installation.....	32	
EMC measures	39	
General information	32	
Ground connections	46	
Signal lines	47	
Instructions for use.....	17	
L		
L+, L-		
DC bus	28	
M		
Mains connection		
X3	21	
Mains filter		
Motor blower	44	
Other loads	44	
Measures of radio interference suppression		
For relays, contactors, switches, chokes, inductive loads	48	
Moisture condensation		
Avoiding	37	
Motor		
Connection (X5)	23	
Connection motor holding brake (X6)	25	
Connection motor temperature monitoring (X6)	25	
Documentation	15	
Motor holding brake	25	
Motor output (X5)	23	
Motor temperature monitoring	25	
Motor blower		
Mains filter	44	
Motor cable		
Shield connection	32	
Mounting		
HCS01 in the control cabinet	34	
Multiple-line arrangement of drive controllers.....	35	
O		
Operating conditions.....	13	
Overcurrent protection.....	17	
P		
Packaging.....	57	
Power consumption.....	13	
Production processes.....	57	
Prohibited substances.....	57	
Project planning manuals		
Reference	15	
R		
Ratings.....	13	
Reference documentations.....	15	
Refresh		
Battery (SUP-E03-DKC*CS-BATTERY)	52	
Return of products.....	57	
S		
Safety instructions.....	5	
Scope of supply		
HCS01	12	
Service Hotline.....	55	
Shield		
Connection	31	
Motor cable	32	
Signal lines		
Installation	47	
Significant components.....	57	
Strain relief		
Cables	31	
SUP-E01-MSM-BATTERYBOX.....	51	
SUP-E03-DKC*CS-BATTERY.....	52	
Support		
see Service Hotline	55	
T		
Technical data.....	13	
Type code		
HCS01	11	
Type plate		
HCS01	12	
Type plates.....	12	
U		
UL ratings.....	13	
Use		
Instructions	17	
V		
Voltage load capacity.....	13	
W		
Wiring diagram.....	18	

X

X13 Control voltage (24 V) 27

X3 Mains connection 21

X5 Motor output 23

X6 Motor temperature monitoring and motor holding brake 25

X

X77 DC bus connection 28

DC bus connector 50

X9 Braking resistor 26

Notes

Bosch Rexroth AG
Electric Drives and Controls
P.O. Box 13 57
97803 Lohr, Germany
Bgm.-Dr.-Nebel-Str. 2
97816 Lohr, Germany
Tel. +49 (0)93 52-40-0
Fax +49 (0)93 52-48 85
www.boschrexroth.com

