The Drive & Control Company

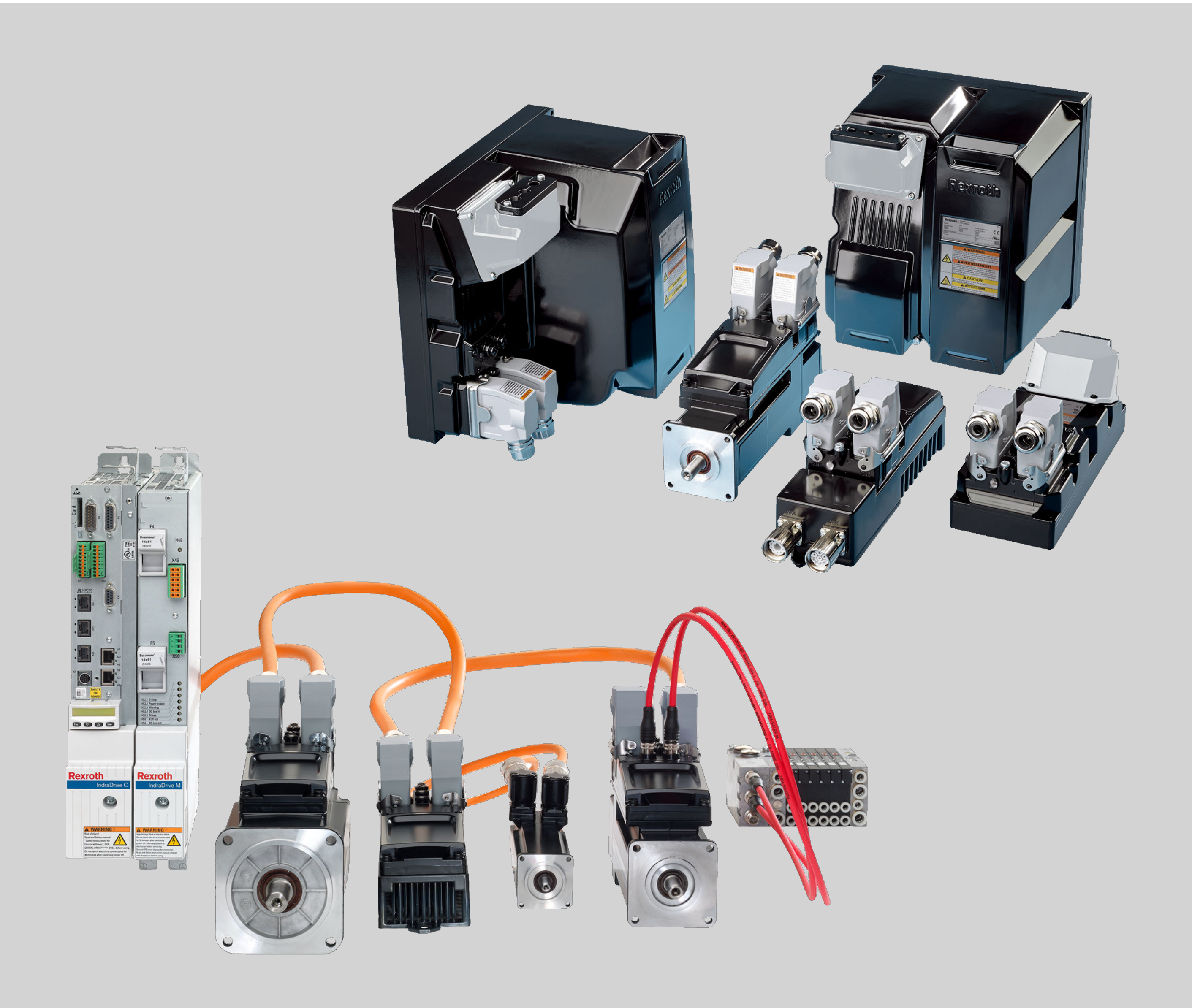
Rexroth
Bosch Group

Rexroth IndraDrive Mi

Drive Systems with KCU02
KSM02, KMS02/03, KMV03, KNK03

Project Planning Manual
R911335703

Edition 03



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03	2016-03	3rd edition; changes in comparison to edition 02: See index entry "Editions"
02	2014-02	2nd edition; changes in comparison to edition 01: See index entry "Editions"
01	2012-03	First edition

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1 System presentation

1.1 Introduction

1.1.1 Rexroth IndraDrive Mi

Rexroth IndraDrive Mi is an innovative system solution within the Rexroth IndraDrive platform with

- **KSM02** motor-integrated servo drives

  ⇒ Synchronous servo motors (on the basis of Rexroth IndraDyn S) with integrated inverters and control sections
- **KMS02** and **KMS03** near motor servo drives

  ⇒ Very compact inverters with control sections
- **KCU02** drive connection box

  ⇒ Component used to connect the servo drives to HMV supply units or HCS converters
- **KMV03** supply unit

  ⇒ Component used to supply servo drives
- **KNK03** mains filter (with integrated mains choke)

  ⇒ Mains connection component for KMV03 supply units

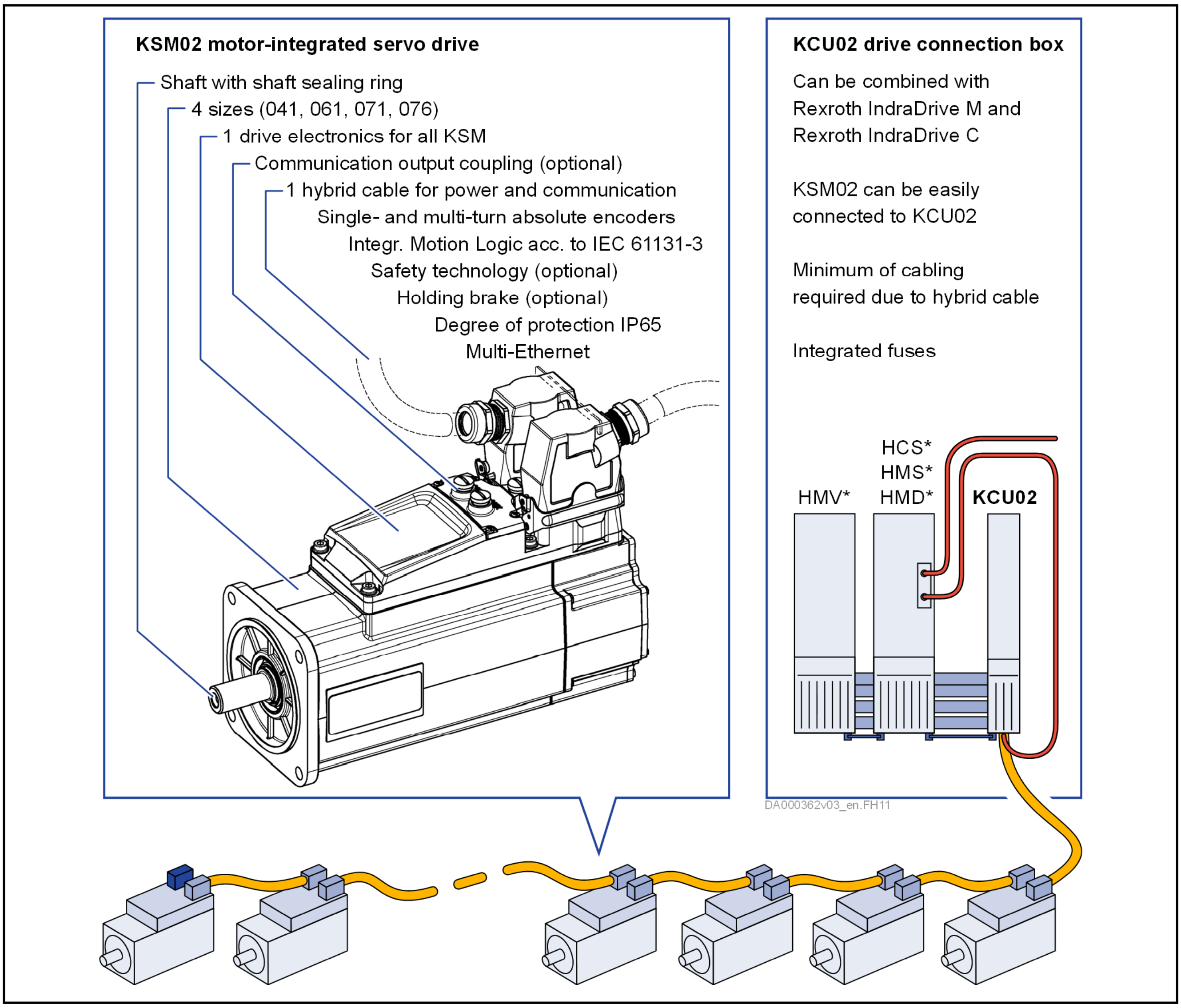
The KNK03 and KMV03 components allow a drive system to be designed **without** a control cabinet.

The KCU02 component with the assigned supply unit (e.g., HMV or HCS) always requires a control cabinet.

System presentation

1.1.2 Features

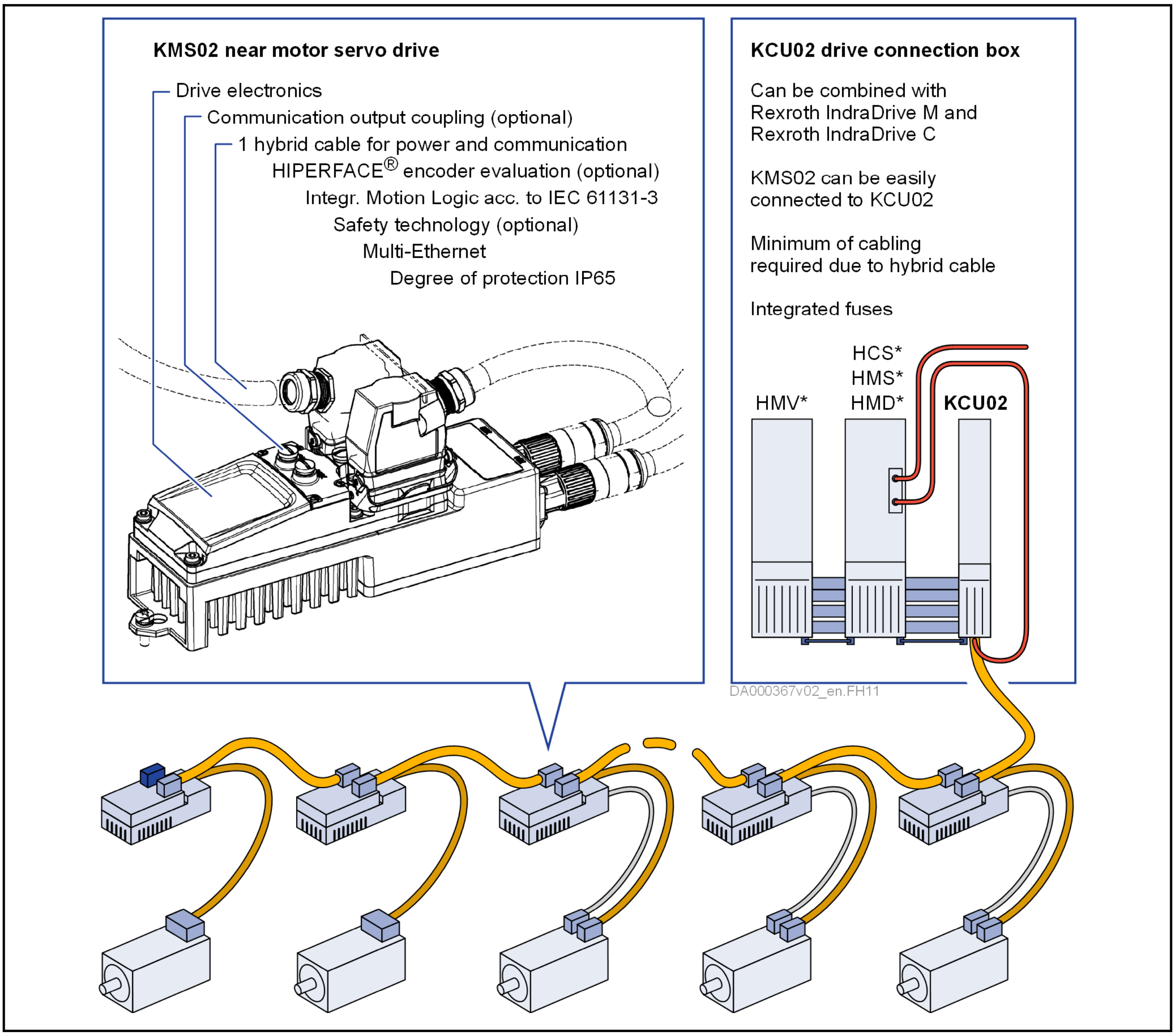
KSM02 motor-integrated servo drive



* Power is supplied to the drives via HMV or HCS (alternative power supply: KMV); HMS, HMD: optional

Fig. 1-1: Rexroth IndraDrive Mi with KSM02 – Features

KMS02 near motor servo drive



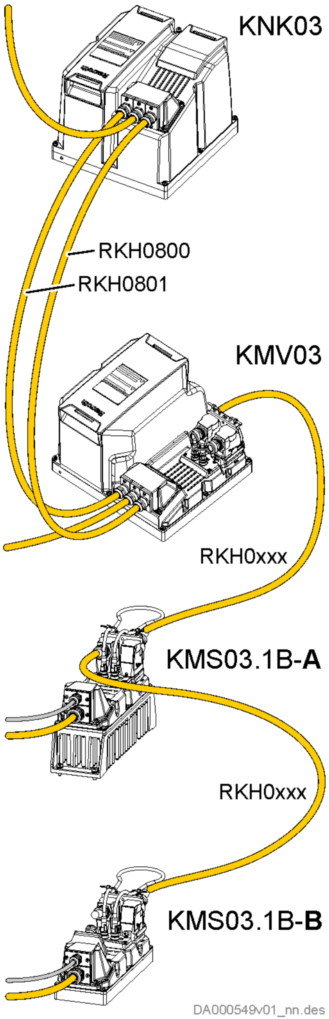
* Power is supplied to the drives via HMV or HCS (alternative power supply: KMV); HMS, HMD: optional

Fig. 1-2: Rexroth IndraDrive Mi with KMS02 – Features

System presentation

KNK03 mains filter, KMV03 supply unit, KMS03 near motor servo drive

<table>
<tr><th>Components</th><th>Features</th></tr>
<tr><td>



</td><td>

Cabinet free, distributed drive technology

KNK03, mains filter

- Degree of protection IP65
- Integrated mains choke
- Integrated mains contactor
- Thermal interface for cold plate mounting

KMV03, supply unit

- Degree of protection IP65
- Integrated brake chopper
- Multi-Ethernet communication
- Thermal interface for cold plate mounting
- KSM02 and KMS02 can also be supplied

KMS03, near motor servo drive

- Degree of protection IP65
- With heat sink (KMS03.1B-**A**)
- With thermal interface for cold plate mounting (KMS03.1B-**B**)
- MultiEncoder interface: Hiperface, Endat 2.1/2.2, SSI, Safety 4 Wire, 1 V_{pp}
- 4 digital inputs and outputs, two thereof can be used as fast probe inputs
- Multi-Ethernet communication
- External Multi-Ethernet communication (optional)
- MultiEthernet communication output coupling (optional)
- Safe Torque Off or Safe Motion safety technology (optional)
- Integrated Motion Logic in accordance with IEC 61131-3

RKH, hybrid cable

- *RKH0xxx*
  - DC bus connection
  - Control voltage and signal exchange cable
  - Communication cable
- *RKH0800*
  - Mains voltage
  - Mains contactor
- *RKH0801*
  - Mains choke
  - Mains voltage synchronization
- The hybrid cable is supplied in ready-made form with connectors.

  The bulk cable (hybrid cable without connector) is named **REH0800** (hybrid cable incl. communication) or **REH0803** (hybrid cable without communication; devices with external communication (ES option) use separate cables for communication).

</td></tr>
</table>

Tab. 1-1: Rexroth IndraDrive Mi with KMS03 – Features

Maximum number of drives per drive line

Power supply	Drive	Maximum number
HMV, HCS	KSM02, KMS02, KMS03	30 [1)]
KMV03	KSM02, KMS02, KMS03	30 [1)]

1) The maximum power dissipation of the control voltage supply should not be exceeded. Observe power requirements of any available motor holding brakes.

Tab. 1-2: Maximum number of drives per drive line

1.2 Rexroth IndraDrive Mi drive system

1.2.1 Components

Cabinet-bound, distributed drive technology

Components: See chapter "KSM02 motor-integrated servo drive" on page 12 or chapter "KMS02 near motor servo drive" on page 13

KSM motor-integrated servo drive

The KSM motor-integrated servo drive consists of 2 parts:

- Servo motor (on the basis of Rexroth IndraDyn S)
- Drive electronics, consisting of control section and power section

KMS near motor servo drive

The KMS near motor servo drive consists of a control section and a power section.

RKH hybrid cable

The RKH hybrid cable replaces the following individual cables:

- DC bus connection
- Control voltage and signal exchange cable
- Communication cable

  (Devices with external communication (ES option) use separate cables for communication. For this case, hybrid cables without communication lines are available.)

The hybrid cable is supplied in ready-made form with connectors.

The bulk cable (hybrid cable without connector) is named **REH0800** (hybrid cable incl. communication) or **REH0803** (hybrid cable without communication).

Drive Connection Box KCU02

The drive connection box KCU02

- supplies the motor-integrated servo drives KSM and the near motor servo drives KMS
  - with power (from the DC bus connection to an HMV supply unit or HCS converter)
  - with 42V control voltage
- with integrated fuses protects the hybrid cable RKH against electric overload
- allows communication between the higher-level control unit and the motor-integrated servo drives KSM and near motor servo drives KMS

Cabinet free, distributed drive technology

Components: See chapter "KNK03 mains filter, KMV03 supply unit, KMS03 near motor servo drive" on page 14.

KMV03 supply unit

The KMV03 supply unit

- supplies the KSM motor-integrated servo drives and KMS near motor servo drives
  - with power
  - with 42V control voltage
- allows the higher-level control unit to communicate with the KSM motor-integrated servo drives and KMS near motor servo drives

KSM motor-integrated servo drive, KMS near motor servo drive, RKH hybrid cable

See chapter "Cabinet-bound, distributed drive technology" on page 16.

Series

See section "Type code"

- KCU02 drive connection box
- KSM02 motor-integrated servo drive
- KMS02 near motor servo drive
- KMS03 near motor servo drive
- KMV03 supply unit
- KNK03 mains filter

1.2.2 Firmware

Firmware required to operate a Rexroth IndraDrive Mi drive system:

Product Series	Features	Supported as of firmware version
KSM02.1B	041C … 076C	MPB-17V08 "Safe Motion" safety technology: MPB-18V08
KMS02	B-A018-P-D7-ET-***-**-**	MPB-17V10 "Safe Motion" safety technology: MPB-18V08
KMS03	*-A036-P-D7-ET-***-**-** *-B036-P-D7-ET-***-**-**	MPB-20VRS
KMV03	*-B0007-P-D7-ET-****-**	PSB-20VRS

Tab. 1-3: Required firmware versions for KMS

1.2.3 System structure

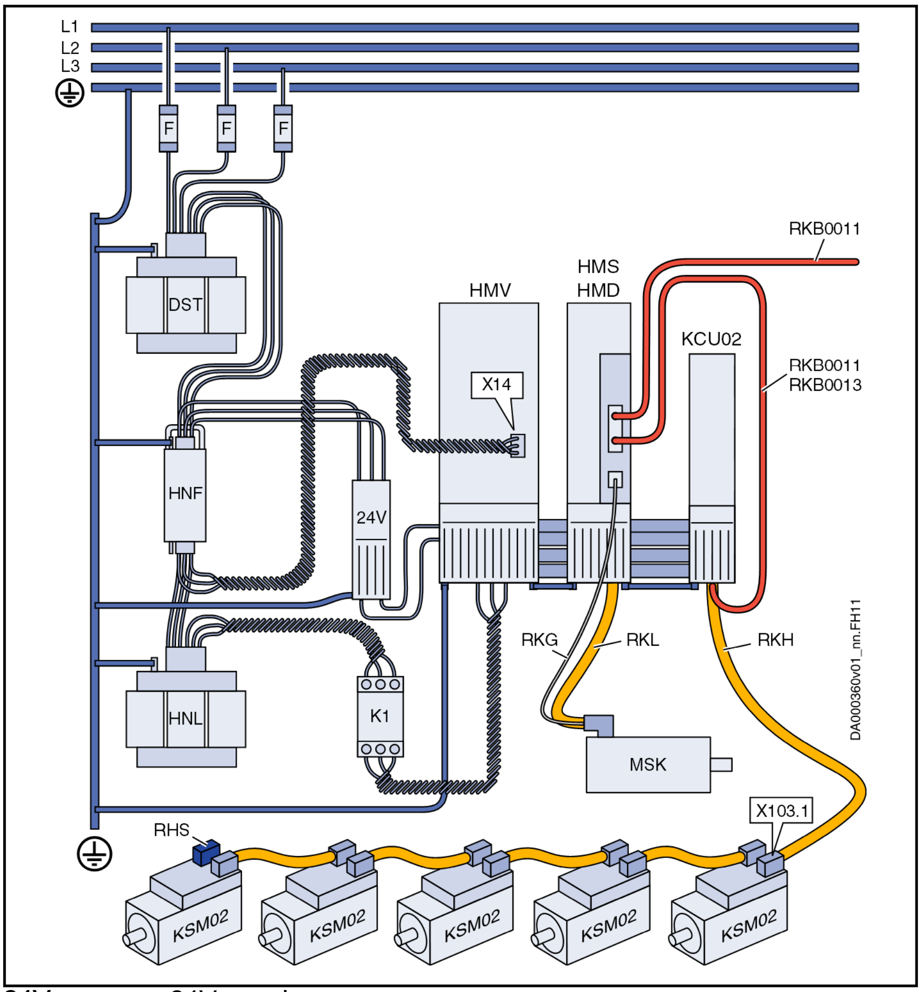
The supply unit that is used significantly defines the system structure.

Possible supply units:

- Rexroth IndraDrive **HMV01.1E/R** or **HMV02.1R supply unit**
- Rexroth IndraDrive **HCS02.1E** or **HCS03.1E converter** (makes sense if another axis is required)
- Rexroth IndraDrive **HCS01.1E-W0054 converter**
- Rexroth IndraDrive **KMV03.1R supply unit**

☞ The figure below shows a Rexroth IndraDrive Mi drive system containing KSM motor-integrated servo drives. This system structure also applies to Rexroth IndraDrive Mi drive systems with KMS near motor servo drives.

Rexroth IndraDrive Mi drive system with HMV01 supply unit:



24V	24V supply
DST	Transformer (optional)
F	Fuses
HMD, HMS	Inverter (optional)
HMV01	Supply unit
HNF	Mains filter
HNL	Mains choke
K1	Mains contactor (only for supply units without integrated mains contactor, e.g. HMV01.1R-W0120)
KCU02	Drive connection box
KSM02	Motor-integrated servo drive (alternative: KMS02 near motor servo drive and motor)
MSK	Servo motor (optional)
RHS	Terminal connector
RKB0011	Ethernet cable of variable length
RKB0013	Ethernet cable of defined length (max. 0.55 m)
RKG	Encoder cable (optional)
RKH	Hybrid cable
RKL	Motor cable (optional)
X14	Mains synchronization (only with regenerative HMVs)
X103.1	Connection of RKH hybrid cable at first KSM02

Fig. 1-3: Rexroth IndraDrive Mi drive system with HMV01

☞ For illustrations of Rexroth IndraDrive Mi drive systems with other supply units, please see chapter "Overall connection diagram" on page 259.

1.2.4 Overview of functions

Firmware functions (functional packages)

☞ For the available firmware functions, see chapter "Functional packages" in the Functional Description of the firmware used.

Hardware-related functional restrictions as compared to drive controllers with separate control sections:

- Safety technology: not all safety functions available
- No analog inputs or outputs
- No digital and analog I/O extensions
- No additional encoder evaluations or encoder emulations

1.3 Type code

1.3.1 Introduction

The type code is the basis of each purchase order of a Rexroth product.

The type code unequivocally describes all variants:

- **KSM02** motor-integrated servo drive
- **KMS02/KMS03** near motor servo drive
- **KCU02** drive connection box
- **KMV03** supply unit
- **KNK03** mains filter
- **MPB/PSB** firmware (observe the allowed firmware versions; see chapter 1.2.2 "Firmware" on page 18).

Product selection information

For product selection and purchase order, take the following aspects into account:

- Observe detailed information and instructions in chapter 5 "Technical data of the components" on page 63 and chapter 7 "Notes on project planning" on page 195
- Before placing a purchase order, have our sales representative check whether individual options are available

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

1.3.2 KSM02 motor-integrated servo drive

KSM02 type code

Short type designation	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:	K	S	M	0	2	.	1	B	-	0	6	1	C	-	3	5	N	-	M	1	-	H	P	0	-	E	T	-	N	N	-	D	7	-	N	N	-	F	W	
	①			②			③	④		⑤			⑥		⑦		⑧		⑨			⑩	⑪	⑫		⑬			⑭			⑮			⑯			⑰		

①	**Product:** KSM = KSM
②	**Series:** 02 = 2
③	**Design:** 1 = 1
④	**Performance:** B = Basic
⑤	**Size:** 041 = Size 041 061 = Size 061 071 = Size 071 076 = Size 076
⑥	**Length:** C = Length C
⑦	**Winding:** 24 = Winding 24 35 = Winding 35 42 = Winding 42 61 = Winding 61
⑧	**Cooling type:** N = Natural convection
⑨	**Encoder:** S1 = Optical encoder, Hiperface single-turn, 128 signal periods S3 = Capacitive encoder, Hiperface single-turn, 16 signal periods M1 = Optical encoder, Hiperface multi-turn absolute, 128 signal periods M3 = Capacitive encoder, Hiperface multi-turn absolute, 16 signal periods
⑩	**Electrical connection:** H = Connector, hybrid
⑪	**Shaft:** G = Plain shaft with shaft sealing ring P = Shaft with keyway according to DIN 6885-1 with shaft sealing ring

Short type designation	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:	K	S	M	0	2	.	1	B	-	0	6	1	C	-	3	5	N	-	M	1	-	H	P	0	-	E	T	-	N	N	-	D	7	-	N	N	-	F	W	
	①			②			③	④		⑤			⑥		⑦		⑧		⑨			⑩	⑪	⑫		⑬			⑭			⑮			⑯			⑰		

⑫	**Holding brake:** 0 = Without holding brake 2 = Holding brake, DC 24 V, electrically releasing
⑬	**Master communication:** ET = Multi-Ethernet
⑭	**Safety option:** L3 = Safe Torque Off (STO) NN = Without safety technology S3 = Safe Motion (without SBC) 1) SD = Safe Motion (with SBC) 1)
⑮	**Supply voltage:** D7 = DC 750 V
⑯	**Other design:** TO = Multi-Ethernet output coupling (2 × M12) NN = None ES = External master communication Multi-Ethernet (2 × M12)
⑰	**Firmware:** FW = Firmware has to be ordered as a separate subposition

Size	Length	Winding				
		24	35	42	61	
041	C	–	–	✓	–	
061	C	–	✓	–	✓	
071	C	✓	✓	–	–	
076	C	–	✓	–	–	

1) Safety options "S3" and "SD" only possible if encoder "S1" or "M1".

Tab. 1-4: Type code KSM02

1.3.3 KMS02 near motor servo drive

KMS02 type code

Short type designation	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	K	M	S	0	2	.	1	B	-	A	0	1	8	-	P	-	D	7	-	E	T	-	E	N	H	-	L	3	-	T	O	-	F	W						
	①			②			③	④		⑤	⑥				⑦		⑧			⑨			⑩				⑪			⑫			⑬							

①	**Product:** KMS = KMS
②	**Series:** 02 = 2
③	**Design:** 1 = 1
④	**Performance:** B = Basic
⑤	**Cooling type:** A = Natural convection (exterior heat sink)
⑥	**Maximum current:** 018 = 18 A
⑦	**Degree of protection:** P = IP65
⑧	**Nominal DC bus voltage:** D7 = DC 750 V
⑨	**Master communication:** ET = Multi-Ethernet
⑩	**Encoder interface:** ENH = Encoder Hiperface NNN = Without
⑪	**Safety option:** L3 = Safe Torque Off (STO) S3 = Safe Motion (without SBC) 1) SD = Safe Motion (with SBC) 1) NN = Without
⑫	**Other design:** NN = Without TO = Multi-Ethernet output coupling (2 × M12) ES = External master communication Multi-Ethernet (2 × M12)
⑬	**Firmware:** FW = Firmware has to be ordered as a separate subposition

1) Only if encoder interface = ENH

Tab. 1-5: Type code KMS02

1.3.4 KMS03 near motor servo drive

KMS03 type code

Short type designation	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	K	M	S	0	3	.	1	B	-	A	0	3	6	-	P	-	D	7	-	E	T	-	E	N	D	-	L	3	-	T	O	-	F	W						
	①			②			③	④		⑤	⑥				⑦		⑧			⑨			⑩				⑪			⑫			⑬							

①	**Product:** KMS = KMS
②	**Series:** 03 = 3
③	**Design:** 1 = 1
④	**Performance:** B = Basic
⑤	**Cooling type:** A = Natural convection (exterior heat sink) B = Thermal interface
⑥	**Maximum current:** 036 = 36 A
⑦	**Degree of protection:** P = IP65
⑧	**Nominal DC bus voltage:** D7 = DC 750 V
⑨	**Master communication:** ET = Multi-Ethernet
⑩	**Encoder interface:** END = Encoder Hiperface® and digital encoder
⑪	**Safety option:** L3 = Safe Torque Off (STO) SD = Safe Motion (with SBC) [1)] NN = Without
⑫	**Other design:** ES = External master communication Multi-Ethernet (2 × M12) NN = Without TO = Multi-Ethernet output coupling (2 × M12)
⑬	**Firmware:** FW = Firmware has to be ordered as a separate subposition

1) Only if encoder interface = END

Tab. 1-6: Type code KMS03

1.3.5 KCU02 drive connection box

KCU02.2 type code

Short type designation	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	K	C	U	0	2	.	2	N	-	E	T	-	E	T	*	-	0	2	5	-	N	N	-	N	-	N	N	-	F	W										
	①			②			③	④		⑤			⑥				⑦				⑧			⑨		⑩			⑪											

①	**Product:** KCU = KCU
②	**Series:** 02 = 2
③	**Design:** 2 = 2
④	**Configuration option:** N = Fixed configuration
⑤	**Master communication (input):** ET = Multi-Ethernet
⑥	**Master communication (output):** ET* = Multi-Ethernet
⑦	**DC fuse:** 025 = Nominal current: 25 A
⑧	**Interface:** NN = None
⑨	**Control panel:** N = Without
⑩	**Other design:** NN = None
⑪	**Firmware:** FW = Firmware has to be ordered as a separate subposition

Tab. 1-7: Type code KCU02

KCU02.2 vs. KCU02.1

KCU02.2 is fully downward compatible with version KCU02.1 and completely replaces this type.

1.3.6 KMV03 supply unit

KMV03 type code

Short type designation	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	K	M	V	0	3	.	1	R	-	B	0	0	0	7	-	P	-	D	7	-	E	T	-	N	N	N	N	-	F	W										
	①			②			③	④		⑤	⑥					⑦		⑧			⑨			⑩					⑪											

①	**Product:** KMV = Supply module
②	**Series:** 03 = 3
③	**Design:** 1 = 1
④	**Power supply unit:** R = Regenerative
⑤	**Cooling type:** B = Thermal interface (cold plate mounting) I = Thermal interface (insulated mounting)
⑥	**Rated power:** 0007 = 7.5 kW 1) 01K5 = 1.5 kW 2)
⑦	**Degree of protection:** P = IP65
⑧	**Nominal DC bus voltage:** D7 = DC 750 V
⑨	**Master communication:** ET = Multi-Ethernet
⑩	**Other design:** NNNN = None
⑪	**Firmware:** FW = Firmware has to be ordered as a separate subposition

1) Rated power "0007" only with cooling type "B"
2) Rated power "01K5" only with cooling type "I"

Tab. 1-8: Type code KMV03

1.3.7 KNK03 mains filter

KNK03 type code

Short type designation									1										2										3										4
	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
Example:	K	N	K	0	3	.	1	A	-	N	R	-	B	0	0	1	2	-	P	-	U	2	2	6	-	A	4	-	N	N	N	N								
	①			②			③	④		⑤	⑥		⑦	⑧					⑨		⑩					⑪			⑫											

①	**Product:** KNK = Mains filter with integrated mains choke
②	**Series:** 03 = 3
③	**Design:** 1 = 1
④	**EMC area:** A = Category C3 in accordance with DIN 61800-3
⑤	**Application:** N = Standard
⑥	**Supply system:** R = For regenerative devices only
⑦	**Cooling type:** B = Thermal interface (cold plate mounting) I = Thermal interface (insulated mounting)
⑧	**Nominal current:** 0002 = 2.3 A [1)] 0012 = 12 A [2)]
⑨	**Degree of protection:** P = IP65
⑩	**Leakage capacitance:** U226 = 226 nF
⑪	**Mains connection voltage:** A4 = 3 × AC 380 V -10% … 3 × AC 500 V +10%
⑫	**Other design:** NNNN = None

1) Nominal current "0002" with cooling type "I" only
2) Nominal current "0012" with cooling type "B" only

Tab. 1-9: KNK03 type code

1.3.8 Firmware

Type code: see Functional Description of firmware

1.4 About this documentation

1.4.1 Editions

Edition	Notes
03	Changes in comparison to previous edition: *New contents* • KMS03 (near motor servo drive) • KMV03 (supply unit) • KNK03 (mains filter with integrated mains choke) • ES option (external communication) • HAS05.1-018, -019, -020 accessories • Hybrid cable without communication lines (REH0803) • Drive systems with HCS01.1E-W0054 supply unit *Modified contents* • KSM02 type code • KMS02 type code • Allowed maximum number of KMS02/KSM02 devices per drive line increased from 20 to 30
02	Changes in comparison to previous edition: • Changed names of the KSM02 and KMS02 components: – KSM02: "motor-integrated servo drive" (previously: "distributed servo drive") – KMS02: "near motor servo drive" (previously: "distributed drive controller") • Included "Safe Motion" safety option • Updated type code • Revised E-Stop function • Revised sizing of hybrid cable length and control voltage power consumption • Included information on locking pins at connectors and connection points of hybrid cables • Included conductor colors of hybrid cable for connection points X52, X53 and X54 • Included internal design of digital inputs/outputs (X37, X38)
01	First edition

Tab. 1-10: Editions

1.4.2 Documentations

Drive systems, system components

Title Rexroth IndraDrive …	Type of documentation	Document typecode[1)] DOK-INDRV*-…	Material number R911…
Mi Drive Systems with KCU02, KSM02, KMS02/03, KMV03, KNK03	Project Planning Manual	KCU02+KSM02-PRxx-EN-P	335703
Drive Systems with HMV01/02 HMS01/02, HMD01, HCS02/03	Project Planning Manual	SYSTEM*****-PRxx-EN-P	309636
Cs Drive Systems with HCS01	Project Planning Manual	HCS01******-PRxx-EN-P	322210
Supply Units, Power Sections HMV, HMS, HMD, HCS02, HCS03	Project Planning Manual	HMV-S-D+HCS-PRxx-EN-P	318790
Drive Controllers Control Sections CSB01, CSH01, CDB01	Project Planning Manual	CSH********-PRxx-EN-P	295012
Drive Controllers Control Sections CSE02, CSB02, CDB02, CSH02	Project Planning Manual	Cxx02******-PRxx-EN-P	338962
Additional Components and Accesso-ries	Project Planning Manual	ADDCOMP****-PRxx-EN-P	306140

1) In the document typecodes, "xx” is a placeholder for the current edition of the documentation (e.g.: PR01 is the first edition of a Project Planning Manual)

Tab. 1-11: Documentations – overview

Title	Type of documentation	Document typecode[1)]	Material number R911…
Automation Terminals Of The Rexroth Inline Product Range	Application Manual	DOK-CONTRL-ILSYSINS***-AWxx-EN-P	317021

1) In the document typecodes, "xx" is a placeholder for the current edition of the documentation (e.g.: AW01 is the first edition of an Application Manual)

Tab. 1-12: Documentations – overview

Motors

Title Rexroth IndraDyn …	Type of documentation	Document typecode[1)] DOK-MOTOR*-…	Material number R911…
A Asynchronous Motors MAD / MAF	Project Planning Manual	MAD/MAF****-PRxx-EN-P	295781
H Synchronous Kit Spindle Motors	Project Planning Manual	MBS-H******-PRxx-EN-P	297895
L Synchronous Linear Motors	Project Planning Manual	MLF********-PRxx-EN-P	293635

System presentation

Title Rexroth IndraDyn …	Type of documentation	Document typecode[1)] DOK-MOTOR*-…	Material number R911…
S Synchronous Motors MSK	Project Planning Manual	MSK********-PRxx-EN-P	296289
T Synchronous Torque Motors	Project Planning Manual	MBT********-PRxx-EN-P	298798

1) In the document typecodes, "xx" is a placeholder for the current edition of the documentation (e.g.: PR01 is the first edition of a Project Planning Manual)

Tab. 1-13: Documentations – overview

Cables

Title	Type of documentation	Document typecode[1)] DOK-…	Material number R911…
Rexroth Connection Cables IndraDrive and IndraDyn	Selection Data	CONNEC-CABLE*INDRV-CAxx-EN-P	322949

1) In the document typecodes, "xx" is a placeholder for the current edition of the documentation (e.g.: CA02 is the second edition of the "Selection Data" documentation)

Tab. 1-14: Documentations – overview

Firmware

Title Rexroth IndraDrive ...	Type of documentation	Document typecode[1)] DOK-INDRV*-…	Material number R911…
MPx-20 Functions	Application Manual	MP*-20VRS**-APxx-EN-P	345608
MPx-20 Version Notes	Release Notes	MP*-20VRS**-RNxx-EN-P	345606
Power Supply Basic PSB-20 Functions	Application Manual	PSB-20VRS**-APxx-EN-P	345612
MPx-18 Functions	Application Manual	MP*-18VRS**-APxx-EN-P	338673
MPx-18 Version Notes	Release Notes	MP*-18VRS**-RNxx-EN-P	338658
MPx-17 Functions	Application Manual	MP*-17VRS**-APxx-EN-P	331236
MPx-17 Version Notes	Release Notes	MP*-17VRS**-RNxx-EN-P	331588
MPx-16 Functions	Application Manual	MP*-16VRS**-APxx-EN-P	326767
MPx-16 Version Notes	Release Notes	MP*-16VRS**-RNxx-EN-P	329272
MPx-16 to MPx-18 Parameters	Reference Book	GEN1-PARA**-RExx-EN-P	328651

Title Rexroth IndraDrive ...	Type of documentation	Document typecode[1)] DOK-INDRV*-…	Material number R911…
MPx-16 to MPx-18 Diagnostic Messages	Reference Book	GEN1-DIAG**-RExx-EN-P	326738
Integrated Safety Technology as of MPx-1x	Application Manual	SI3-**VRS**-APxx-EN-P	332634
Integrated Safety Technology as of MPx-1x (Safe Motion)	Application Manual	SI3*SMO-VRS-APxx-EN-P	338920

1) In the document typecodes, "xx" is a placeholder for the current edition of the documentation (e.g.: RE02 is the second edition of a Reference Book)

Tab. 1-15: Documentations – firmware

1.4.3 Your feedback

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

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

Please send your remarks to:

Address for your feedback

Bosch Rexroth AG

Dept. DC-IA/EDY1

Buergermeister-Dr.-Nebel-Str. 2

97816 Lohr, Germany

E-mail: dokusupport@boschrexroth.de

2 Important directions for use

2.1 Appropriate use

2.1.1 Introduction

Rexroth products represent state-of-the-art developments and manufacturing. They are tested prior to delivery to ensure operating safety and reliability.

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

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

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

Before using Rexroth products, make sure that all the pre-requisites for an appropriate use of the products are satisfied:

- Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with their appropriate use.
- If the products take the form of hardware, then they must remain in their original state, in other words, no structural changes are permitted. It is not permitted to decompile software products or alter source codes.
- Do not install damaged or faulty products or put them into operation.
- Make sure that the products have been installed in the manner described in the relevant documentation.

2.1.2 Areas of use and application

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

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

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

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

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

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

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

Typical applications include, for example:

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

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

2.2 Inappropriate use

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

Drive controllers may not be used, if …

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

☞ Components of the Rexroth IndraDrive Mi system are **products of Category C3** (with restricted distribution) in accordance with IEC 61800-3. This Category comprises EMC limit values for line-based and radiated noise emission. Compliance with this Category (limit values) requires the appropriate measures of interference suppression to be used in the drive system (e.g., mains filters, shielding measures).

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 interference suppression.

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3 Safety instructions for electric drives and controls

3.1 Definitions of terms

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

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

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

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

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

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

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

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

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

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

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

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

- to be trained, instructed or authorized to switch electric circuits and devices 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.

User

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

3.2 General information

3.2.1 Using the Safety instructions and passing them on to others

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

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

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

3.2.2 Requirements for safe use

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

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

- Applications for functional safety are only allowed if clearly and explicitly specified in the application documentation "Integrated Safety Technology". If this is not the case, they are excluded. Functional safety is a safety concept in which measures of risk reduction for personal safety depend on electrical, electronic or programmable control systems.
- The information given in the application documentation with regard to the use of the delivered components contains only examples of applications and suggestions.

  The machine and installation manufacturers must

  – make sure that the delivered components are suited for their individual application and check the information given in this application documentation with regard to the use of the components,
  – make sure that their individual application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.
- Commissioning of the delivered components is only allowed once it is sure that the machine or installation in which the components are installed complies with the national regulations, safety specifications and standards of the application.
- Operation is only allowed if the national EMC regulations for the application are met.
- The instructions for installation in accordance with EMC requirements can be found in the section on EMC in the respective application documentation.

  The machine or installation manufacturer is responsible for compliance with the limit values as prescribed in the national regulations.
- The technical data, connection and installation conditions of the components are specified in the respective application documentations and must be followed at all times.

National regulations which the user has to comply with

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

3.2.3 Hazards by improper use

- High electrical voltage and high working current! Danger to life or serious injury by electric shock!
- High electrical voltage by incorrect connection! Danger to life or injury by electric shock!
- Dangerous movements! Danger to life, serious injury or property damage by unintended motor movements!

- Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electric drive systems!
- Risk of burns by hot housing surfaces!
- Risk of injury by improper handling! Injury by crushing, shearing, cutting, hitting!
- Risk of injury by improper handling of batteries!
- Risk of injury by improper handling of pressurized lines!

3.3 Instructions with regard to specific dangers

3.3.1 Protection against contact with electrical parts and housings

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

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

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

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

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

- Secure built-in devices from penetrating foreign objects and water, as well as from direct contact, by providing an external housing, for example a control cabinet.

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

- Before switching on and before commissioning, ground or connect the components of the electric drive and control system to the equipment grounding conductor at the grounding points.
- Connect the equipment grounding conductor of the components of the electric drive and control system permanently to the main power supply at all times. The leakage current is greater than 3.5 mA.
- Establish an equipment grounding connection with a minimum cross section according to the table below. With an outer conductor cross section smaller than 10 mm² (8 AWG), the alternative connection of two equipment grounding conductors is allowed, each having the same cross section as the outer conductors.

Cross section outer conductor	Minimum cross section equipment grounding conductor Leakage current ≥ 3.5 mA	
	1 equipment grounding conductor	2 equipment grounding conductors
1.5 mm² (16 AWG)	10 mm² (8 AWG)	2 × 1.5 mm² (16 AWG)
2.5 mm² (14 AWG)		2 × 2.5 mm² (14 AWG)
4 mm² (12 AWG)		2 × 4 mm² (12 AWG)
6 mm² (10 AWG)		2 × 6 mm² (10 AWG)
10 mm² (8 AWG)		-
16 mm² (6 AWG)	16 mm² (6 AWG)	-
25 mm² (4 AWG)		-
35 mm² (2 AWG)		-
50 mm² (1/0 AWG)	25 mm² (4 AWG)	-
70 mm² (2/0 AWG)	35 mm² (2 AWG)	-
...	...	...

Tab. 3-1: Minimum cross section of the equipment grounding connection

3.3.2 Protective extra-low voltage as protection against electric shock

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

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

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

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

3.3.3 Protection against dangerous movements

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

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

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

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

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

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

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

To avoid accidents, injury and/or property damage:

- Keep free and clear of the machine’s range of motion and moving machine parts. Prevent personnel from accidentally entering the machine’s range of motion by using, for example:
  - Safety fences
  - Safety guards
  - Protective coverings
  - Light barriers
- Make sure the safety fences and protective coverings are strong enough to resist maximum possible kinetic energy.
- Mount emergency stopping switches in the immediate reach of the operator. Before commissioning, verify that the emergency stopping equip-

ment works. Do not operate the machine if the emergency stopping switch is not working.

- Prevent unintended start-up. Isolate the drive power connection by means of OFF switches/OFF buttons or use a safe starting lockout.
- Make sure that the drives are brought to safe standstill before accessing or entering the danger zone.
- Additionally secure vertical axes against falling or dropping after switching off the motor power by, for example,
  – mechanically securing the vertical axes,
  – adding an external braking/arrester/clamping mechanism or
  – ensuring sufficient counterbalancing of the vertical axes.
- The standard equipment **motor holding brake** or an external holding brake controlled by the drive controller is **not sufficient to guarantee personal safety**!
- Disconnect electrical power to the components of the electric drive and control system using the master switch and secure them from reconnection ("lock out") for:
  – Maintenance and repair work
  – Cleaning of equipment
  – Long periods of discontinued equipment use
- Prevent the operation of high-frequency, remote control and radio equipment near components of the electric drive and control system and their supply leads. If the use of these devices cannot be avoided, check the machine or installation, at initial commissioning of the electric drive and control system, for possible malfunctions when operating such high-frequency, remote control and radio equipment in its possible positions of normal use. It might possibly be necessary to perform a special electromagnetic compatibility (EMC) test.

3.3.4 Protection against electromagnetic and magnetic fields during operation and mounting

Electromagnetic and magnetic fields!

Health hazard for persons with active implantable medical devices (AIMD) such as pacemakers or passive metallic implants.

- Hazards for the above-mentioned groups of persons by electromagnetic and magnetic fields in the immediate vicinity of drive controllers and the associated current-carrying conductors.
- Entering these areas can pose an increased risk to the above-mentioned groups of persons. They should seek advice from their physician.
- If overcome by possible effects on above-mentioned persons during operation of drive controllers and accessories, remove the exposed persons from the vicinity of conductors and devices.

3.3.5 Protection against contact with hot parts

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

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

3.3.6 Protection during handling and mounting

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

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

3.3.7 Battery safety

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

Risk of injury by improper handling!

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

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

3.3.8 Protection against pressurized systems

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

Risk of injury by improper handling of pressurized lines!

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

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

3.4 Explanation of signal words and the Safety alert symbol

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

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

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

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

4 General data and specifications

4.1 Acceptance tests and approvals

Declaration of conformity

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

DX000011v01_nn.FH11	Drive controllers, Supply units	Motors
CE conformity regarding Low-Voltage Directive	EN 61800-5-1:2007	EN 60034-1:2010+Cor.:2010 EN 60034-5:2001+A1:2007
CE conformity regarding EMC product standard	EN 61800-3:2004 + A1:2012	

Tab. 4-1: CE - applied standards

C-UL-US listing

The components are listed by **UL** (Underwriters Laboratories Inc.®).

Proof of certification can be found online:

www.ul.com/database

Under "UL File Number" enter the file number or under "Company Name" enter the company name "Bosch Rexroth AG".

UL ratings

When using the component in the scope of CSA / UL, observe the UL ratings for each component.

Only the following components have been approved in the scope of CSA / UL for supplying KCU, KSM, KMS components:

- HMV01.1E
- HMV01.1R
- HMV02.1R
- HCS01.1E
- HCS02.1E
- HCS03.1E
- KMV03.1R

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

Wiring material UL

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

Allowed pollution degree

Comply with the allowed pollution degree of the components (see "Ambient and operating conditions").

c UL us Listed POW. CONV. EQ. 97Y4 DX000009v01_nn.tif	
	Company Name BOSCH REXROTH ELECTRIC DRIVES & CONTROLS GMBH Category Name: Power Conversion Equipment
	File numbers Rexroth IndraDrive Mi components: • E134201 • E227957

Tab. 4-2: C-UL listing

C-UR-US listing

The components are listed by **UL** (Underwriters Laboratories Inc.®).

Proof of certification can be found online:

www.ul.com/database

Under "UL File Number" enter the file number or under "Company Name" enter the company name "Bosch Rexroth AG".

c RU us CUR_Zeichen.fh11	• UL standard: UL 1004-1 • CSA standard: C22.2 No. 100
	Company Name BOSCH REXROTH ELECTRIC DRIVES & CONTROLS GMBH Category Name: Servo and Stepper Motors - Component
	File numbers MSK, MSM motors: E335445

Tab. 4-3: C-UR listing

Wiring material UL (ready-made cables by Rexroth)

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

Allowed pollution degree

Comply with the allowed pollution degree of the components (see "Ambient and operating conditions").

CCC (China Compulsory Certification)

The CCC mark is a compulsory certification of safety and quality for certain products mentioned in the product catalog "First Catalogue of Products Subject to Compulsory Certification" and in the CNCA document "Application

Scope for Compulsory Certification of Products acc. first Catalogue" and put in circulation in China. This compulsory certification has existed since 2003.

CNCA is the Chinese authority responsible for certification guidelines. When a product is imported in China, the certification will be checked at customs using the entries in a database. Three criteria are typically critical for certification being required:

1. Customs tariff number (HS code) according to CNCA document "Application Scope for Compulsory Certification of Products acc. first Catalogue".
2. Area of application according to CNCA document "Application Scope for Compulsory Certification of Products acc. first Catalogue".
3. For the IEC product standard used, a corresponding Chinese GB standard must exist.

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

4.2 Transport and storage

4.2.1 Transporting the components

Ambient and operating conditions for transport

Description	Symbol	Unit	Value
Temperature range	T_{a_tran}	°C	-20 … +70
Relative humidity		%	5 … 95
Absolute humidity		g/m³	1 … 60
Climatic category (IEC 721)			2K3
Moisture condensation			Not allowed
Icing			Not allowed

Tab. 4-4: Ambient and operating conditions for transport

4.2.2 Storing the components

NOTICE **Risk of damage to *KCU drive connection box* from long-term storage!**

The KCU drive connection box contains electrolytic capacitors which may deteriorate during storage. When storing the KCU drive connection box for a longer period of time, run it **once a year for at least 1 hour** at 24 V control voltage U_{N3}.

NOTICE **Risk of damage to *KMV supply unit* from long-term storage!**

The KMV supply unit contains electrolytic capacitors which may deteriorate during storage. When storing the KMV supply unit for a longer period of time, run it **once a year for at least 1 hour** at mains voltage U_{LN}.

Ambient and operating conditions for storage

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

Tab. 4-5: Ambient and operating conditions for storage

4.3 Installation conditions

4.3.1 Ambient and operating conditions

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

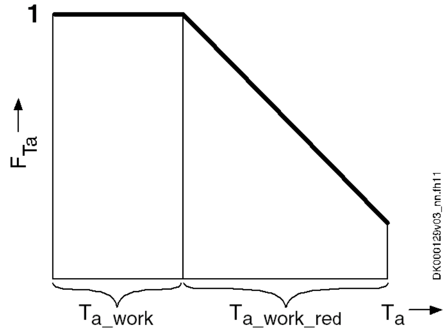
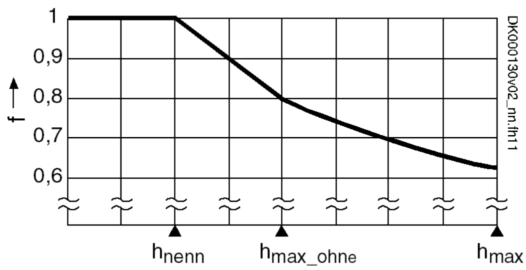
The power dissipation is indicated in the technical data of the individual components as an important input value for calculating the heat levels.

Devices with the degree of protection IP65, such as KSM motor-integrated servo drives and KMS near motor servo drives, are designed for use near the machines and are not installed in control cabinets.

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

Description	Symbol	Unit	Value
Conductive dirt contamination			Not allowed Protect the devices against conductive dirt contamination by mounting them in control cabinets with the degree of protection IP54 (in accordance with IEC529).
Degree of protection of the device (IEC529)			IP20
Use within scope of CSA / UL			For use in NFPA 79 Applications only.
Temperature during storage			see chapter 4.2.2 "Storing the components" on page 49
Temperature during transport			see chapter 4.2.1 "Transporting the components" on page 49
Allowed mounting position Definition of mounting positions: See chapter "Mounting positions of components" on page 60			G1 3)
Installation altitude	h_{nenn}	m	1000
Ambient temperature range	T_{a_work}	°C	0 … 40

General data and specifications

Description	Symbol	Unit	Value
Derating vs. ambient temperature: The performance data are reduced by the factor F_{Ta} in the ambient temperature range $T_{a\_work\_red}$: $F_{Ta} = 1 - [(T_a - 40) \times f_{Ta}]$ Using a KCU drive connection box reduces the rated power (P_{out}) at the 42V control voltage output. The rated power at the power section output (P_{DC_cont}) is not reduced.			
	$T_{a\_work\_red}$	°C	40 … 55
	f_{Ta}	%/K	2.0
Derating vs. installation altitude: At an installation altitude h > h_{nenn}, the performance data reduced by **factor f**[2] are available. At an installation altitude in the range h_{max_ohne} to h_{max}, an isolating transformer has to be installed at the drive system mains connection. Operation above h_{max} is not allowed!			
	h_{max_ohne}	m	2000
	h_{max}	m	4000
Simultaneous derating for ambient temperature **and** installation altitude			Allowed; reduce performance data with the product $f \times F_{Ta}$
Relative humidity		%	5 … 95
Absolute humidity		g/m³	1 … 29
Climatic category (IEC 60721-3-3)			3K3
Allowed pollution degree (EN 50178)			2
Resistance to chemically active substances (IEC 60721-3-3)			Class 3C1
Vibration sine: Amplitude (peak-peak) at 10 … 57 Hz [1]		mm	0.15
Vibration sine: Acceleration at 57 … 150 Hz [1]		g	1
Overvoltage category			III (according to IEC 60664-1)

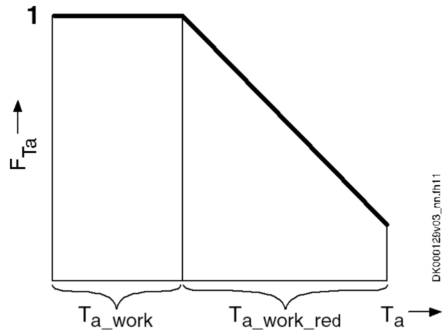
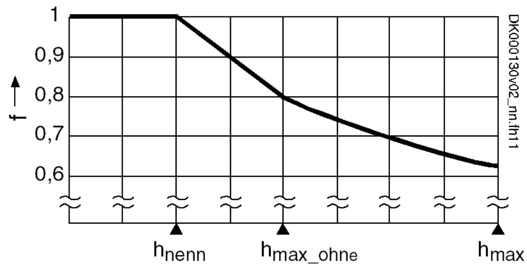
1) According to EN 60068-2-6

2) Reduced performance data for drive controllers: allowed DC bus continuous power, braking resistor continuous power, continuous current; additionally for HCS01, HCQ, HCT drive controllers: allowed mains voltage

3) Some components can be operated in mounting positions other than G1. The allowed mounting positions are specified in the technical data of the component.

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

Ambient and operating conditions (KSM)

Description	Symbol	Unit	Value
Degree of protection (IEC 60529)			IP65
Use within scope of CSA / UL			For use in NFPA 79 applications only.
Temperature during storage			see chapter 4.2.2 "Storing the components" on page 49
Temperature during transport			see chapter 4.2.1 "Transporting the components" on page 49
Allowed mounting position Definition of mounting positions: See chapter "Mounting positions of components" on page 60			IM B5, IM V1, IM V3
Installation altitude	h_{nenn}	m	1000
Ambient temperature range	T_{a_work}	°C	0 … 40
Derating vs. ambient temperature: The performance data are reduced by the factor F_{Ta} in the ambient temperature range $T_{a\_work\_red}$: $F_{Ta} = 1 - [(T_a - 40) \times f_{Ta}]$ Example: With an ambient temperature T_a = 50 °C and a capacity utilization factor f_{Ta} = 3 %/K, the rated power is reduced to $P_{DC\_cont\_red} = P_{DC\_cont} \times F_{Ta} =$ $P_{DC\_cont} \times (1 - [(50 - 40) \times 0.03]) = P_{DC\_cont} \times 0.7$ Operation at ambient temperatures outside of T_{a_work} and $T_{a\_work\_red}$ is not allowed!			
	$T_{a\_work\_red}$	°C	40 … 55
	f_{Ta}	%/K	3
Derating vs. installation altitude: At an installation altitude h > h_{nenn}, the performance data reduced by **factor** f[2) 3)] are available. At an installation altitude in the range h_{max_ohne} to h_{max}, an isolating transformer has to be installed at the drive system mains connection. Operation above h_{max} is not allowed!			
	h_{max_ohne}	m	2000
	h_{max}	m	4000
Simultaneous derating for ambient temperature **and** installation altitude	Allowed; reduce performance data with the product of factors f and F_{Ta} ($f \times F_{Ta}$)		
Relative humidity		%	5 … 95
Absolute humidity		g/m³	1 … 29
Climatic category (IEC721)			3K4
Allowed pollution degree (IEC 60664-1)			3 (only with connectors plugged in)

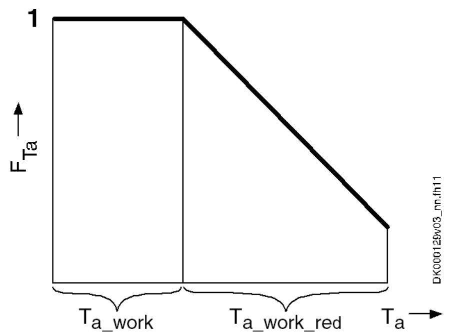
General data and specifications

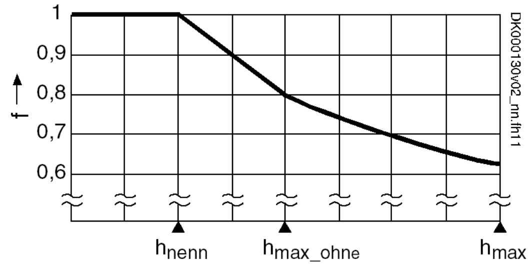
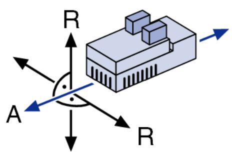
Description	Symbol	Unit	Value
Maximum concentration of corrosive gases			According to degree of protection
Vibration sine: axial Acceleration at 10 … 2000 Hz [1]		g	1
Vibration sine: radial Acceleration at 10 … 2000 Hz [1]		g	1 With HAS10.1-001-001-NN accessories: KSM: 3
Overvoltage category			III (according to IEC 60664-1)

1) According to EN 60068-2-6
2) Reduced performance data for drive controllers: allowed DC bus continuous power, braking resistor continuous power, continuous current
3) Reduced performance data for motors: performance, torque S1 and S3

Tab. 4-7: Ambient and operating conditions (KSM)

Ambient and operating conditions (KMS)

Description	Symbol	Unit	Value
Degree of protection (IEC 60529)			IP65
Use within scope of CSA / UL			For use in NFPA 79 applications only.
Temperature during storage			see chapter 4.2.2 "Storing the components" on page 49
Temperature during transport			see chapter 4.2.1 "Transporting the components" on page 49
Allowed mounting position Definition of mounting positions: See chapter "Mounting positions of components" on page 60			G1, G2, G3, G4, G5 (KMS03.1B-A: reduced performance with G2, G4, G5)
Installation altitude	h_{nenn}	m	1000
Ambient temperature range	T_{a_work}	°C	0 … 40
Derating vs. ambient temperature: The performance data are reduced by the factor F_{Ta} in the ambient temperature range $T_{a\_work\_red}$: $F_{Ta} = 1 - [(T_a - 40) \times f_{Ta}]$ Example: With an ambient temperature T_a = 50 °C and a capacity utilization factor f_{Ta} = 3 %/K, the rated power is reduced to $P_{DC\_cont\_red} = P_{DC\_cont} \times F_{Ta} =$ $P_{DC\_cont} \times (1 - [(50 - 40) \times 0.03]) = P_{DC\_cont} \times 0.7$ Operation at ambient temperatures outside of T_{a_work} and $T_{a\_work\_red}$ is not allowed!			
	$T_{a\_work\_red}$	°C	40 … 55
	f_{Ta}	%/K	3

Description	Symbol	Unit	Value
Derating vs. installation altitude: At an installation altitude h > h_{nenn}, the performance data reduced by **factor f** are available. At an installation altitude in the range h_{max_ohne} to h_{max}, an isolating transformer has to be installed at the drive system mains connection. Operation above h_{max} is not allowed!			
	h_{max_ohne}	m	2000
	h_{max}	m	4000
Simultaneous derating for ambient temperature **and** installation altitude			Allowed; reduce performance data with the product of factors f and F_{Ta} ($f \times F_{Ta}$)
Relative humidity		%	5 … 95
Absolute humidity		g/m^3	1 … 29
Climatic category (IEC721)			3K4
Allowed pollution degree (IEC 60664-1)			3 (only with connectors plugged in)
Maximum concentration of corrosive gases			According to degree of protection
Vibration sine: axial Acceleration at 10 … 2000 Hz [1)] Axial (A), radial (R) 		g	1 With HAS10.1-001-001-NN accessories: KMS: 3
Vibration sine: radial Acceleration at 10 … 2000 Hz [1)]		g	1 With HAS10.1-001-001-NN accessories: KMS: 3
Overvoltage category			III (according to IEC 60664-1)

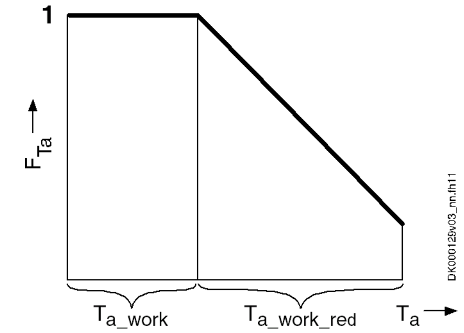
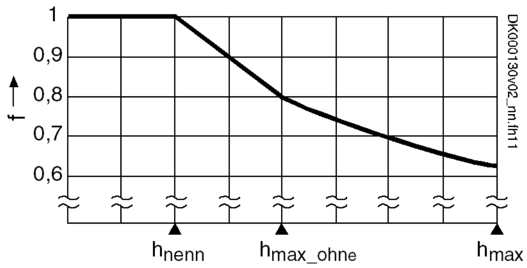
1) According to EN 60068-2-6

Tab. 4-8: Ambient and operating conditions (KMS)

Ambient and operating conditions (KMV, KNK)

Description	Symbol	Unit	Value
Degree of protection (IEC 60529)			IP65
Use within scope of CSA / UL			For use in NFPA 79 applications only.
Temperature during storage			see chapter 4.2.2 "Storing the components" on page 49
Temperature during transport			see chapter 4.2.1 "Transporting the components" on page 49

General data and specifications

Description	Symbol	Unit	Value
Allowed mounting position Definition of mounting positions: See chapter "Mounting positions of components" on page 60			G1, G2, G3, G4
Installation altitude	h_{nenn}	m	1000
Ambient temperature range	T_{a_work}	°C	0 … 40
Derating vs. ambient temperature: The performance data are reduced by the factor F_{Ta} in the ambient temperature range $T_{a\_work\_red}$: $F_{Ta} = 1 - [(T_a - 40) \times f_{Ta}]$ Example: With an ambient temperature T_a = 50 °C and a capacity utilization factor f_{Ta} = 3 %/K, the rated power is reduced to $P_{DC\_cont\_red} = P_{DC\_cont} \times F_{Ta} =$ $P_{DC\_cont} \times (1 - [(50 - 40) \times 0.03]) = P_{DC\_cont} \times 0.7$ Operation at ambient temperatures outside of T_{a_work} and $T_{a\_work\_red}$ is not allowed!			
	$T_{a\_work\_red}$	°C	40 … 55
	f_{Ta}	%/K	3
Derating vs. installation altitude: At an installation altitude h > h_{nenn}, the performance data reduced by **factor f** are available. At an installation altitude in the range h_{max_ohne} to h_{max}, an isolating transformer has to be installed at the drive system mains connection. Operation above h_{max} is not allowed!			
	h_{max_ohne}	m	2000
	h_{max}	m	4000
Simultaneous derating for ambient temperature **and** installation altitude	Allowed; reduce performance data with the product of factors f and F_{Ta} ($f \times F_{Ta}$)		
Relative humidity		%	5 … 95
Absolute humidity		g/m³	1 … 29
Climatic category (IEC721)			3K4
Allowed pollution degree (IEC 60664-1)			3 (only with connectors plugged in)
Maximum concentration of corrosive gases			According to degree of protection
Vibration sine: axial Acceleration at 5 … 200 Hz [2)]		g	3M6
Vibration sine: radial Acceleration at 5 … 200 Hz [2)]		g	3M6
Overvoltage category			III (according to IEC 60664-1)

1) According to EN 60068-2-6

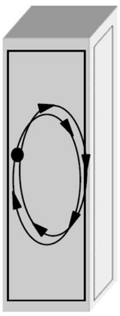
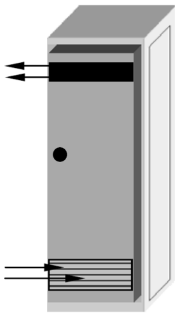
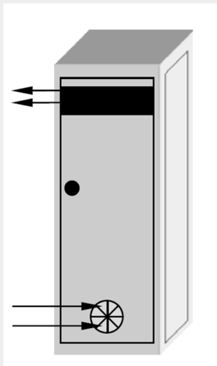
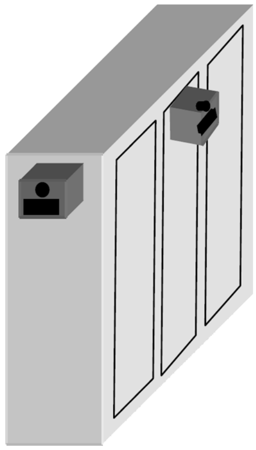
2) According to EN 60721-3-3

Tab. 4-9: Ambient and operating conditions (KMV, KNK)

4.3.2 Control cabinet design and cooling

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

Possibilities of heat dissipation

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

P_Q Dissipated heat output

Tab. 4-10: Possibilities of heat dissipation

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

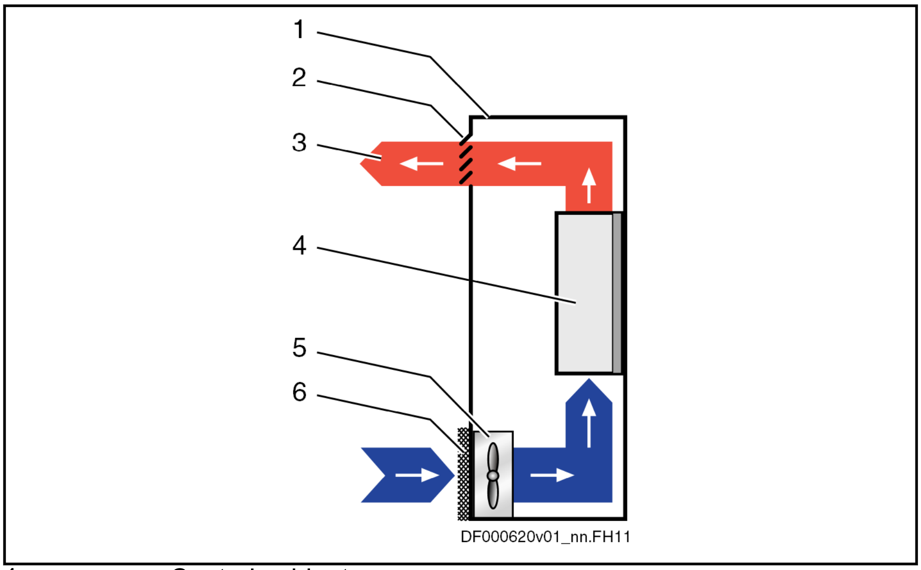
Requirements for control cabinets with fan

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

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

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

Control cabinet ventilation (schematic diagram)



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

Fig. 4-1: Control cabinet ventilation (schematic diagram)

Only clean air gets into the control cabinet through the filter at the air intake opening. The control cabinet fan behind the air intake opening conveys the air into the control cabinet and generates overpressure in the control cabinet. The overpressure prevents unclean air from getting into the control cabinet through possibly existing leaky points (leaky cable ducts, damaged seals, etc.).

4.3.3 Mounting position

Mounting positions of components

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

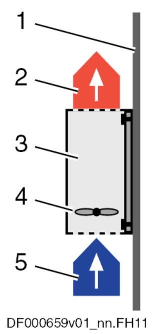
Only operate the components in their allowed mounting positions. The allowed mounting positions are specified in the technical data of the components.

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

Some components can also be operated in mounting positions other than G1. The allowed mounting positions are specified in the technical data of the component.

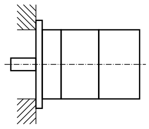
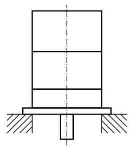
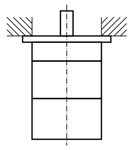
Mounting positions

The allowed mounting positions are specified with G1, G2, G3, G4 or G5 in the technical data of the components.

Mounting position	Description	
G1		**Normal mounting position** The air heated inside the component can flow unimpeded vertically upward. In the case of components with integrated fans, the natural convection supports the forced cooling air current. 1. Mounting surface 2. Outgoing, heated air 3. Component 4. Fan within the component (forces the cooling air current) 5. Cooling air
G2	180° to normal mounting position	
G3	90° to normal mounting position	
G4	bottom mounting; mounting surface on the bottom	
G5	top mounting; mounting surface at the top	

Tab. 4-11: Mounting positions

Mounting Positions of Motor-Integrated Servo Drives

IM B5	IM V1	IM V3
		
Flange mounting on drive side of flange The drive electronics of a motor-integrated servo drive can be oriented as desired.	Flange mounting on drive side of flange, drive side bottom	Flange mounting on drive side of flange, drive side top

Tab. 4-12: Allowed Types of Installation According to EN 60034-7:1993

NOTICE **Damage caused by penetration of fluids!**

If fluid is present at the output shaft over a prolonged time in mounting position IM V3, the fluid may enter the housing and cause damage.

Ensure that fluid cannot be present at the output shaft.

4.3.4 Compatibility with foreign matters

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

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

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

4.3.5 Motor Paint

As standard, the motors are black (RAL9005).

4.4 Voltage testing and insulation resistance testing

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

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

Tab. 4-13: Applied standards

4.5 Control voltage (24V supply)

PELV[1)] for 24V power supply unit

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

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

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

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

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

Description	Symbol	Unit	Value
Control voltage for drive systems	U_{N3}	V	**20.4 … 28.8** (24 +20% -15%) When using HMV01.1E, HMV01.1R, HMV02.1R, HLB01.1D supply units: **22.8 … 27.3** (24 -5%, 26 +5%)
Max. ripple content	w	-	The amplitudes of the alternating component on U_{N3} must be within the specified voltage range.
Maximum allowed overvoltage	U_{N3max}	V	33 (max. 1 ms)

Tab. 4-14: Control voltage

Overvoltage

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

This includes:

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

Applies to all devices except HCS01 and HMV02:

Insulation monitoring impossible

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

1) *Protective Extra Low Voltage*

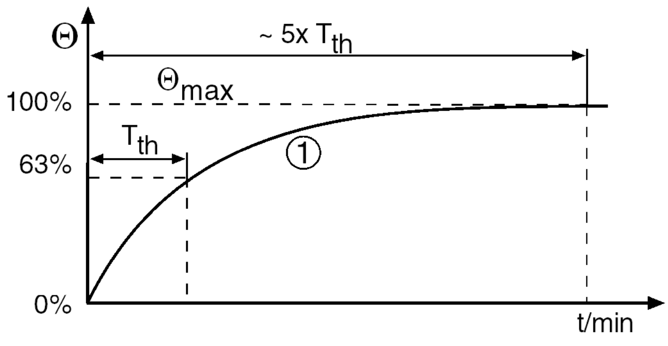
5 Technical data of the components

5.1 Explanation of terms and definitions

KSM02 data sheet with optional brake

Description	Symbol	Unit	Definition
Listing in accordance with UL standard (UL)			Standard according to which UL listing takes place
Listing according to CSA standard (UL)			Standard according to which CSA listing takes place
UL files (UL)			UL file number under which the components are listed
Short circuit current rating, SCCR, symmetrical amperes (UL) [1)]	I_{SCCR}	A_{rms}	Current which may flow at the point of infeed in the case of error (short circuit)
Ambient temperature during operation	T_{um}	°C	Ambient temperature during operation
Degree of protection			According to EN 60529
Ambient conditions according to UL50/50E			Ambient conditions according to UL50/50E
Mass	m_{mot}	kg	Mass of the component
Average sound pressure level (accuracy class 2) at P_{DC_cont} [2)]	L_P	dB (A)	According to DIN EN ISO 11205; comparative value at distance 1 m, out of cabinet
Control voltage supply			
Rated control voltage input (UL)	U_{N3}	V	Supply voltage of control electronics
Rated power consumption control voltage input at U_{N3} (UL)	P_{N3}	W	Power with which the power supply unit is loaded for 24V supply
Power section data			
Rated power (t > 10 min)	P_{LN_nenn}	W	Power consumption from the DC bus (L+, L-) at the point of maximum power (PML)
Power dissipation at continuous current and continuous DC bus power respectively (UL)	P_{Diss_cont}	W	Occurring power dissipation at P_{LN_nenn}
Rated input voltage, power (UL) [3)]	U_{LN_nenn}	V DC	Voltage supplied to the component at the power input
Capacitance in DC bus	C_{DC}	mF	Capacitance in DC bus
Allowed switching frequencies [4)]	f_s	kHz	Allowed switching frequencies
Motor stage data			
Continuous torque at standstill 60 K	M_{0_60}	Nm	Continuous torque that can be delivered at the motor output shaft at speed n ≥ 0.01 Hz and 4 kHz of switching frequency.
Maximum torque	M_{max}	Nm	Maximum torque that can be delivered for approx. 400 ms at maximum current I_{max} (manufacturing tolerances +5% / -20%).
Maximum current	$I_{max(rms)}$	A	Maximum, temporarily allowed phase current (rms value) in the motor winding without damaging effect on the permanent-magnet circuit of the motor.

Technical data of the components

Description	Symbol	Unit	Definition
Torque constant at 20 °C [5)]	K_{M_N}	Nm/A	Ratio of torque to current in the motor winding (r.m.s. value) at motor temperature 20 °C. Unit (Nm/A).
Voltage constant at 20 °C [6)]	K_{EMK_1000}	V/min^{-1}	R.m.s. value of the induced motor voltage at motor temperature 20 °C and 1000 revolutions per minute. Unit (V/ 1000 min^{-1}).
Rotor inertia	J_{rot}	kg*m^2	Rotor inertia
Thermal time constant	T_{th}	min	Time of the temperature rise to 63% of the end temperature of the motor housing with the motor loaded with the allowed S1 continuous torque. The thermal time constant is determined by the size of the motors and the method of cooling used.  1: course of the motor housing temperature over time Θ_{max}: highest temperature (motor housing) T_{th}: thermal time constant
Maximum speed	n_{max}	min^{-1}	Maximum allowed speed of the motor. Limiting factors can have mechanical (centrifugal forces, bearing stress) or electrical (DC bus voltage) causes.
Insulation class according to DIN EN 60034–1			Insulation class
Data of optional holding brake			
Holding torque	M_4	Nm	Transmittable holding torque
Clamping delay	t_1	ms	ON delay when clamping
Release delay	t_2	ms	Release delay
Brake mass	m_{Br}	kg	Add mass of holding brake to mass of motor
Holding brake inertia	J_{rot}	kg*m^2	Add holding brake inertia to rotor inertia

1) Suitable for use on a circuit capable of delivering not more than this SCCR value, 600 V AC or less. The drive series shall be used with listed AC input line fuses or listed circuit breakers specified in this documentation.

2) According to DIN EN ISO 11205; comparative value at distance 1 m, out of cabinet

3) KCU02: DC bus input L+/L-

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

5) 6)	Manufacturing tolerance ±5%

Tab. 5-1: KSM02.1B-041, KSM02.1B-061, KSM02.1B-071, KSM02.1B-076 data sheet

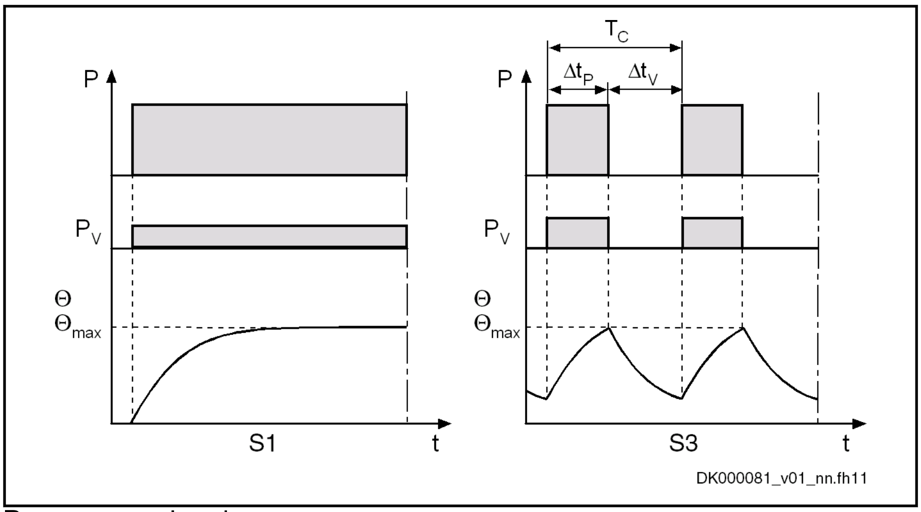
Motor data

The motor data and characteristics are determined under the following conditions:

- Ambient temperature 40 °C
- Insulated structure (aluminum flange)
- Amplifier temperature S-0-0384 = 100 °C (ΔT = 60 K); this temperature is slightly higher than the temperature of the motor housing.
- Switching frequency 4 kHz (at 8 kHz reduced continuous torque and peak torque)
- Motors with radial shaft sealing ring

Operation modes

KSM02 motor-integrated servo drives are documented according to the test criteria and measuring methods of EN 60034-1. The specified characteristics correspond to operation modes S1 or S3.



P	Load
P_V	Electric losses
Θ	Temperature
$Θ_{max}$	Highest temperature (motor housing)
t	Time
T_C	Cycle duration
$Δt_P$	Operating time with constant load
$Δt_V$	Idle time

Fig. 5-1: Operation modes according to EN 60034-1: 1998

Duty cycle

Operation mode S3 (intermittent duty) is supplemented by specification of the duty cycle ED %. The duty cycle is calculated as follows:

$$ED = \frac{\Delta t_P}{T_C} \cdot 100\%$$

ED	Relative duty cycle in %
$Δt_P$	Operating time with constant load

Fig. 5-2: Relative duty cycle

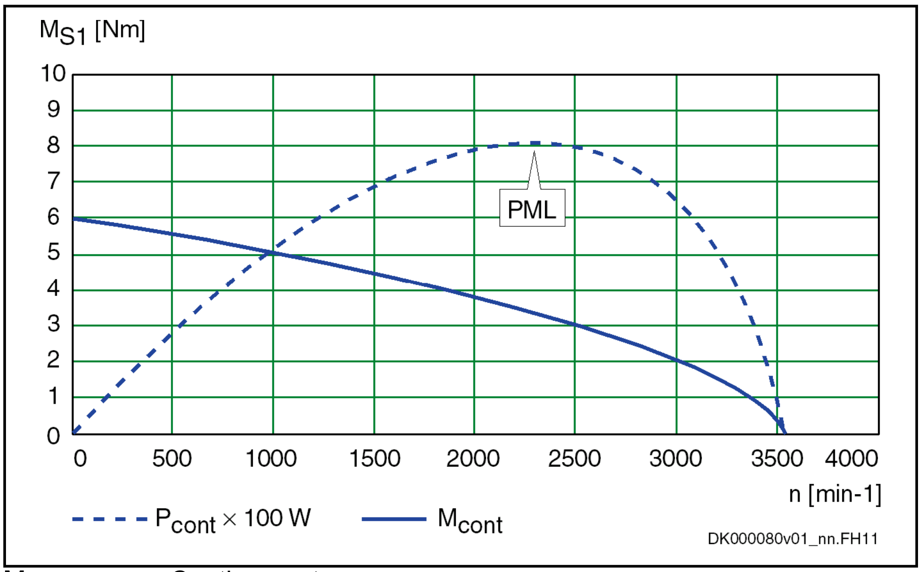
The values specified in the documentation have been determined on the basis of the following parameters:

Cycle duration: 1 min

Duty cycle ED: 25%

DC continuous power P_{DC}

Power consumption at the point of maximum power (PML); mechanical power and power dissipation



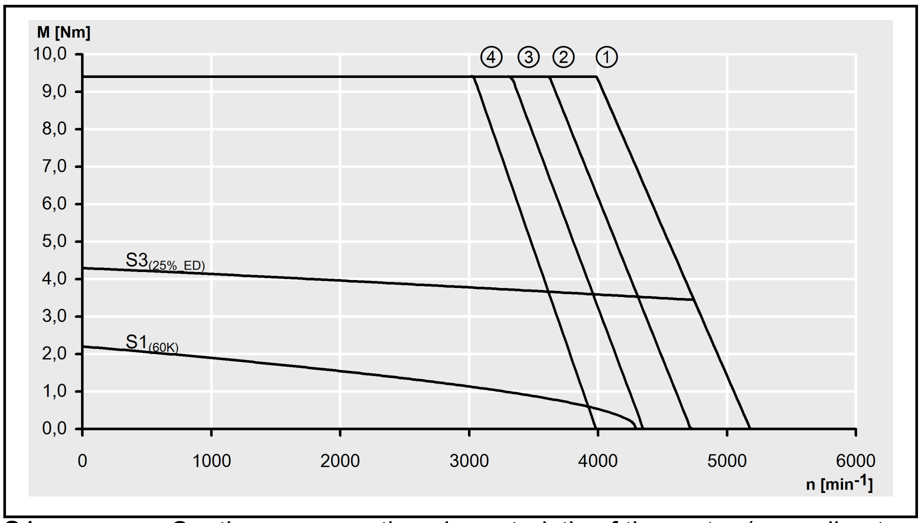
M_{cont}	Continuous torque
M_{S1}	S1 torque
n	Speed
P_{cont}	Continuous power
P_{ML}	Point of maximum power

Fig. 5-3: Power consumption

DC peak power P_{DC_max}

Electric peak power (worst-case value for dimensioning the supply unit)

Sample characteristic



S1	Continuous operation characteristic of the motor (according to EN 60034-1; 1998), natural convection
S3	Intermittent duty characteristic with 25% ED of the motor (according to EN 60034-1; 1998) and max. cycle duration 1 min.
(1)	M_{max}, controlled supply DC 750 V
(2)(3)(4)	M_{max}, uncontrolled supply 3 × AC 400 V; the voltage drop on the supply line has not been taken into account.

Fig. 5-4: Sample characteristic

5.2 KSM02 motor-integrated servo drive

5.2.1 KSM02 without motor holding brake, data sheet

KSM without motor holding brake, data sheet

Description	Symbol	Unit	KSM02.1 B-041C-42N-__-__0	KSM02.1 B-061C-35N-__-__0	KSM02.1 B-061C-61N-__-__0	KSM02.1 B-071C-24N-__-__0	KSM02.1 B-071C-35N-__-__0	KSM02.1 B-076C-35N-__-__0
Listing in accordance with UL standard		-	UL 508C					
Listing in accordance with CSA standard		-	C22.2 No. 14-10					
UL files			E134201					
Short circuit current rating	SCCR	A, KCU supplied	42000					
Maximum bypass current		A	25.0					
Ambient temperature range for operation with nominal data	T_{a_work}	°C	0...40					
Degree of protection according to IEC 60529	IP		IP65					
Ambient conditions according to UL50/50E			Type 4X Indoor use only					
Mass	m_{mot}	kg	5.6	9.6		14.1		14.6
Average sound pressure level (accuracy class 2) at P_{DC_cont} 1)	L_P	dB (A)	Less than 75					
Control voltage data								
Rated control voltage input 2)	U_{N3}	V	30...42					
Rated power consumption control voltage input at U_{N3} 3)	P_{N3}	W	17.5					
Power section data								
Rated power (t > 10 min)	P_{LN_nenn}	W	470	895	765	1320	1285	1200
Power dissipation at continuous current and continuous DC bus power respectively 4)	P_{Diss_cont}	W	70	140		175		165
Rated input voltage, power 5)	U_{LN_nenn}	V	540...750					
Capacitance in DC bus	C_{DC}	mF	0.012	0.024				
Capacitance against housing	C_Y							
Allowed switching frequencies 6)	f_s	kHz	4; 8					
Motor stage data								

Last modification: 2013-12-16

Technical data of the components

Description	Symbol	Unit	KSM02.1 B-041C-42N-__-__0	KSM02.1 B-061C-35N-__-__0	KSM02.1 B-061C-61N-__-__0	KSM02.1 B-071C-24N-__-__0	KSM02.1 B-071C-35N-__-__0	KSM02.1 B-076C-35N-__-__0
Continuous torque at standstill 60 K	M_{0_60}	Nm	2.2	6.0	5.5	10.5	10.0	8.7
Maximum torque	M_{max}	Nm	9.4	25.0	18.0	35.0	28.0	29.0
Maximum current	$I_{max(rms)}$	A	6.8	14.9	17.7			
Torque constant at 20 °C	K_{M_N}	Nm/A	1.60	2.03	1.16	2.52	1.85	
Voltage constant at 20 °C[7)]	K_{EMK_1000}	V/1000 min-1	98.2	125.0	71.5	155.0	114.0	113.8
Rotor inertia	J_{rot}	kg*m²	0.00017	0.00087		0.00173		0.00430
Thermal time constant	T_{th}	min	13	18		15		25
Maximum speed (electrical)	$n_{max\ el}$	min⁻¹	5500	4300	6000	3400	4700	
Thermal class (EN 60034-1)	T.CL.		155					
Last modification: 2013-12-16								

1) According to DIN EN ISO 11205; comparative value at distance 1 m, out of cabinet; HCS types with order code -L***: load-dependent
2) Observe supply voltage for motor holding brakes
3) See information on "Rated power consumption control voltage input at U_{N3}"
4) Plus dissipation of braking resistor and control section
5) Mains input L1, L2, L3 (for HMV and HCS only); For use on a solidly grounded wye source only.
6) Also depending on firmware and control section; see parameter description "P-0-0001, Switching frequency of power output stage"; see "P-0-4058, Amplifier type data"
7) Manufacturing tolerance ±5%

Tab. 5-2: KSM without motor holding brake - Technical data

Rated power consumption control voltage input at U_{N3}

Plus power consumption of externally connected inputs/outputs, plus safety option

5.2.2 KSM02 with motor holding brake, data sheet

The data of KSM02 ***with*** *motor holding brake differ from the data of KSM02* ***without*** *motor holding brake in the following aspects:*

- Rated power consumption control voltage input at U_{N3}
- Mass
- Rotor inertia
- Motor holding brake

KSM with motor holding brake, data sheet

Description	Symbol	Unit	KSM02.1 B-041C-42N-__-__2	KSM02.1 B-061C-35N-__-__2	KSM02.1 B-061C-61N-__-__2	KSM02.1 B-071C-24N-__-__2	KSM02.1 B-071C-35N-__-__2	KSM02.1 B-076C-35N-__-__2
Listing in accordance with UL standard		-	UL 508C					
Listing in accordance with CSA standard		-	C22.2 No. 14-10					
UL files			E134201					
Short circuit current rating	SCCR	A, KCU sup-plied	42000					
Maximum bypass current		A	25.0					
Ambient temperature range for operation with nominal data	T_{a_work}	°C	0...40					
Degree of protection according to IEC 60529	IP		IP65					
Ambient conditions according to UL50/50E			Type 4X Indoor use only					
Mass	m_{mot}	kg	5.9	10.1		15.2		15.7
Average sound pressure level (accuracy class 2) at P_{DC_cont} 1)	L_P	dB (A)	Less than 75					
Control voltage data								
Rated control voltage input 2)	U_{N3}	V	30...42					
Rated power consumption control voltage input at U_{N3} 3)	P_{N3}	W	29.5	35.5		41.5		
Power section data								
Rated power (t > 10 min)	P_{LN_nenn}	W	470	895	765	1320	1285	1200
Power dissipation at continuous current and continuous DC bus power respectively 4)	P_{Diss_cont}	W	70	140		175		165
Rated input voltage, power 5)	U_{LN_nenn}	V	540...750					
Capacitance in DC bus	C_{DC}	mF	0.012	0.024				
Last modification: 2013-12-16								

Technical data of the components

<table>
<tr><th>Description</th><th>Symbol</th><th>Unit</th><th>KSM02.1 B-041C-42N-__-__2</th><th>KSM02.1 B-061C-35N-__-__2</th><th>KSM02.1 B-061C-61N-__-__2</th><th>KSM02.1 B-071C-24N-__-__2</th><th>KSM02.1 B-071C-35N-__-__2</th><th>KSM02.1 B-076C-35N-__-__2</th></tr>
<tr><td>Capacitance against housing</td><td>C_Y</td><td></td><td colspan="6"></td></tr>
<tr><td>Allowed switching frequencies[6)]</td><td>f_s</td><td>kHz</td><td colspan="6">4; 8</td></tr>
<tr><td>Motor stage data</td><td></td><td></td><td colspan="6"></td></tr>
<tr><td>Continuous torque at standstill 60 K</td><td>M_{0_60}</td><td>Nm</td><td>2.2</td><td>6.0</td><td>5.5</td><td>10.5</td><td>10.0</td><td>8.7</td></tr>
<tr><td>Maximum torque</td><td>M_{max}</td><td>Nm</td><td>9.4</td><td>25.0</td><td>18.0</td><td>35.0</td><td>28.0</td><td>29.0</td></tr>
<tr><td>Maximum current</td><td>$I_{max(rms)}$</td><td>A</td><td>6.8</td><td>14.9</td><td colspan="4">17.7</td></tr>
<tr><td>Torque constant at 20 °C</td><td>K_{M_N}</td><td>Nm/A</td><td>1.60</td><td>2.03</td><td>1.16</td><td>2.52</td><td colspan="2">1.85</td></tr>
<tr><td>Voltage constant at 20 °C[7)]</td><td>K_{EMK_1000}</td><td>V/1000 min-1</td><td>98.2</td><td>125.0</td><td>71.5</td><td>155.0</td><td>114.0</td><td>113.8</td></tr>
<tr><td>Rotor inertia</td><td>J_{rot}</td><td>kg*m^2</td><td>0.00019</td><td colspan="2">0.00093</td><td colspan="2">0.00189</td><td>0.00446</td></tr>
<tr><td>Thermal time constant</td><td>T_{th}</td><td>min</td><td>13</td><td colspan="2">18</td><td colspan="2">15</td><td>25</td></tr>
<tr><td>Maximum speed (electrical)</td><td>$n_{max\ el}$</td><td>min^{-1}</td><td>5500</td><td>4300</td><td>6000</td><td>3400</td><td colspan="2">4700</td></tr>
<tr><td>Thermal class (EN 60034-1)</td><td>T.CL.</td><td></td><td colspan="6">155</td></tr>
<tr><td>Holding brake data</td><td></td><td></td><td colspan="6"></td></tr>
<tr><td>Holding torque</td><td>M_4</td><td>Nm</td><td>4.00</td><td colspan="2">10.00</td><td colspan="3">16.00</td></tr>
<tr><td>Maximum clamping delay</td><td>t_1</td><td>ms</td><td colspan="3">25</td><td colspan="3">30</td></tr>
<tr><td>Maximum release delay</td><td>t_2</td><td>ms</td><td>35</td><td colspan="2">40</td><td colspan="3">50</td></tr>
<tr><td>Brake mass</td><td>m_{Br}</td><td>kg</td><td colspan="6">-</td></tr>
<tr><td>Holding brake inertia</td><td>J_{br}</td><td>kg*m^2</td><td>0.0000230</td><td colspan="2">0.0000590</td><td colspan="3">0.0001610</td></tr>
<tr><td colspan="9" align="right">Last modification: 2013-12-16</td></tr>
</table>

1) According to DIN EN ISO 11205; comparative value at distance 1 m, out of cabinet; HCS types with order code -L***: load-dependent
2) Observe supply voltage for motor holding brakes
3) See information on "Rated power consumption control voltage input at U_{N3}"
4) Plus dissipation of braking resistor and control section
5) Mains input L1, L2, L3 (for HMV and HCS only); For use on a solidly grounded wye source only.
6) Also depending on firmware and control section; see parameter description "P-0-0001, Switching frequency of power output stage"; see "P-0-4058, Amplifier type data"
7) Manufacturing tolerance ±5%

Tab. 5-3: KSM with motor holding brake - Technical data

☞ **Rated power consumption control voltage input at U_{N3}**

Including motor holding brake, plus power consumption of externally connected inputs/outputs, plus safety option

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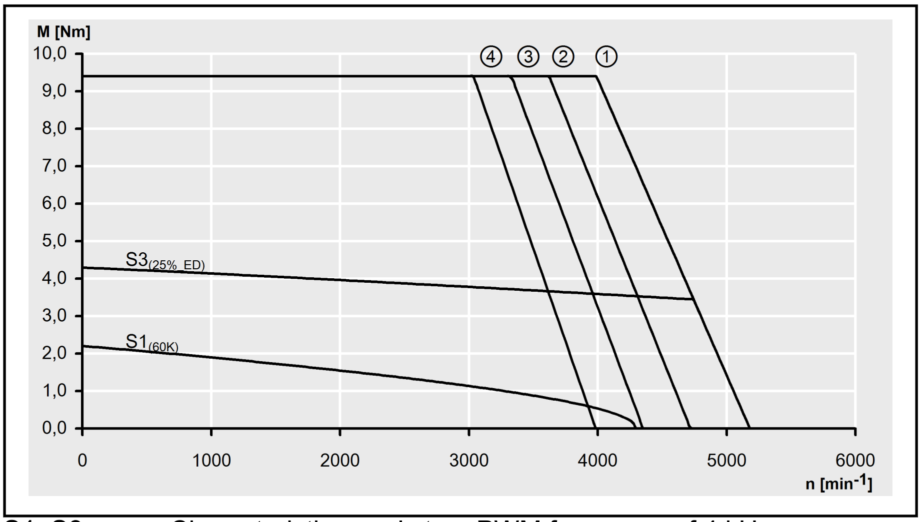
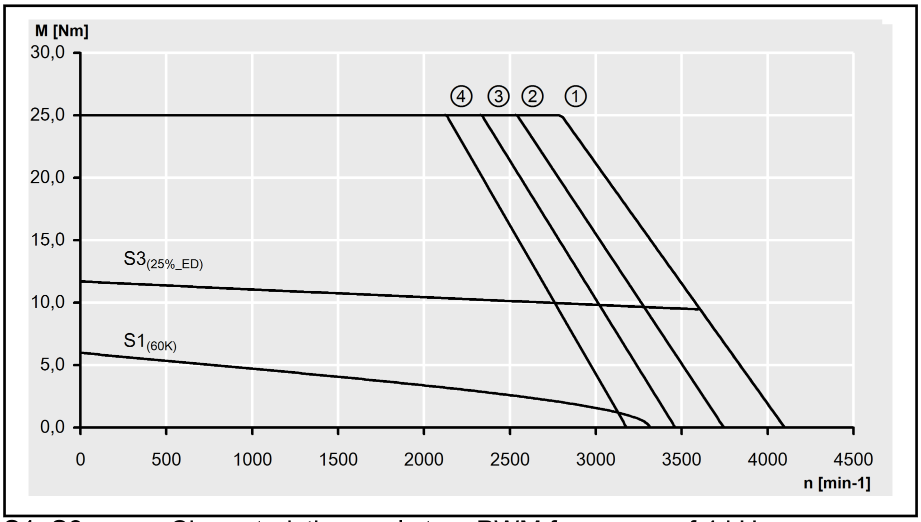
5.2.3 KSM02 characteristics



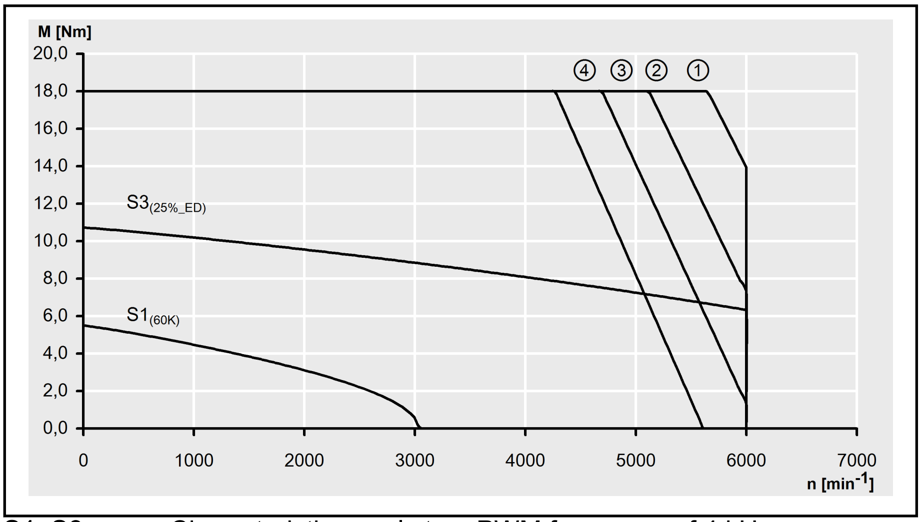
S1, S3	Characteristics apply to a PWM frequency of 4 kHz
(1)	M_{max}, controlled supply (1) 3 × AC 400 V
(2)(3)(4)	M_{max}, uncontrolled supply (2) 3 × AC 480 V, (3) 3 × AC 440 V, (4) 3 × AC 400 V

Fig. 5-5: KSM02.1B-041C-42 characteristics



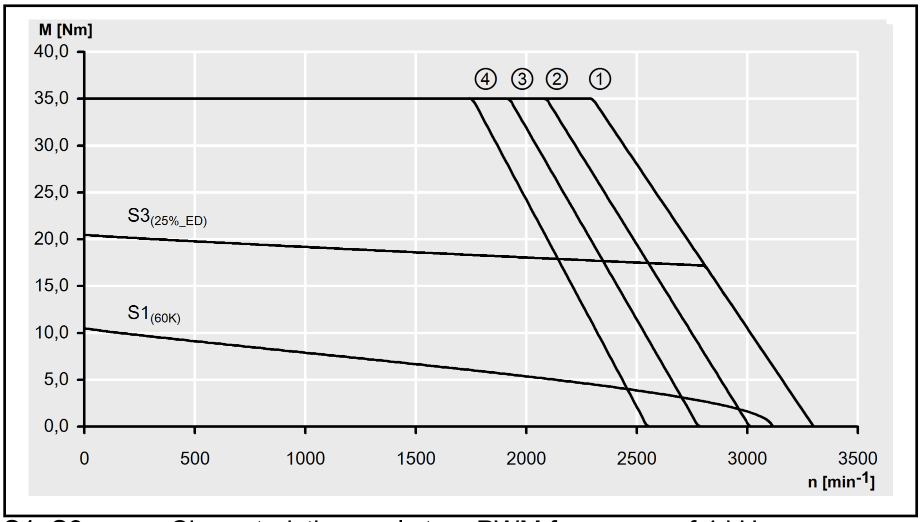
S1, S3	Characteristics apply to a PWM frequency of 4 kHz
(1)	M_{max}, controlled supply (1) 3 × AC 400 V
(2)(3)(4)	M_{max}, uncontrolled supply (2) 3 × AC 480 V, (3) 3 × AC 440 V, (4) 3 × AC 400 V

Fig. 5-6: KSM02.1B-061C-35 characteristics



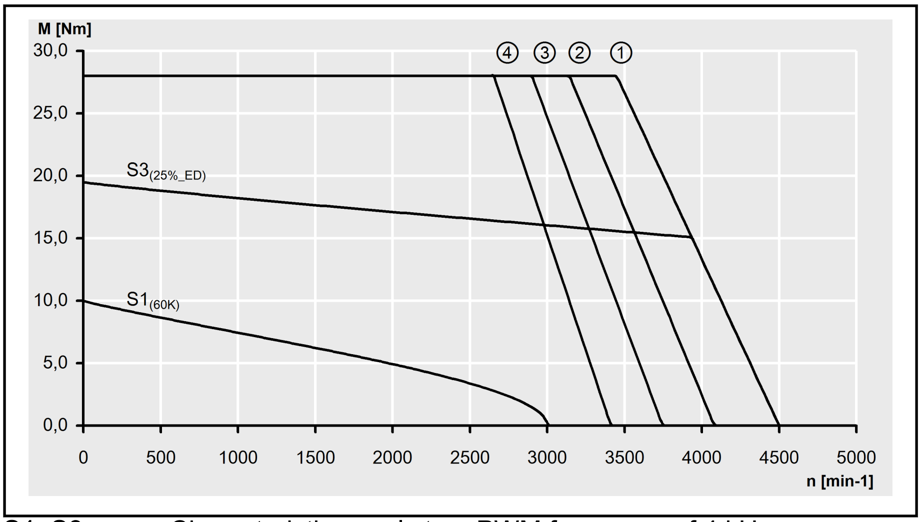
S1, S3	Characteristics apply to a PWM frequency of 4 kHz
(1)	M_{max}, controlled supply (1) 3 × AC 400 V
(2)(3)(4)	M_{max}, uncontrolled supply (2) 3 × AC 480 V, (3) 3 × AC 440 V, (4) 3 × AC 400 V

Fig. 5-7: KSM02.1B-061C-61 characteristics



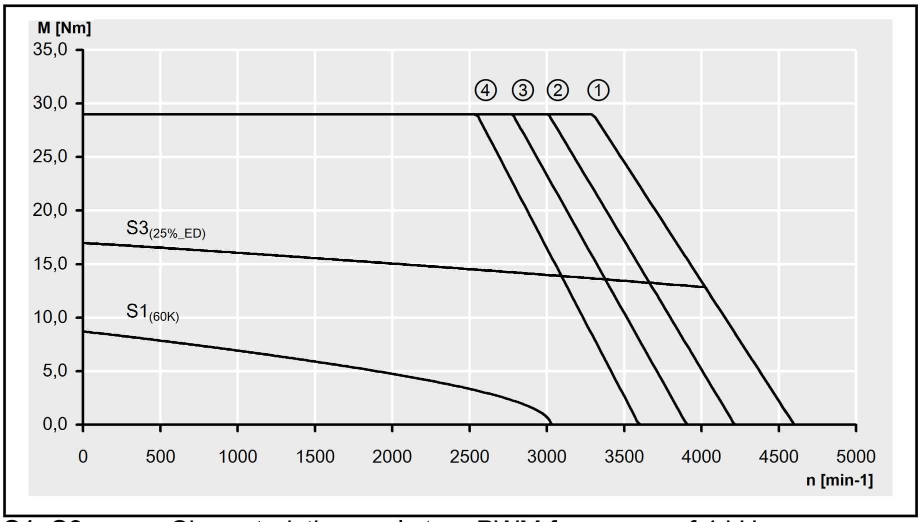
S1, S3	Characteristics apply to a PWM frequency of 4 kHz
(1)	M_{max}, controlled supply (1) 3 × AC 400 V
(2)(3)(4)	M_{max}, uncontrolled supply (2) 3 × AC 480 V, (3) 3 × AC 440 V, (4) 3 × AC 400 V

Fig. 5-8: KSM02.1B-071C-24 characteristics



S1, S3 Characteristics apply to a PWM frequency of 4 kHz
(1) M_{max}, controlled supply (1) 3 × AC 400 V
(2)(3)(4) M_{max}, uncontrolled supply (2) 3 × AC 480 V, (3) 3 × AC 440 V, (4) 3 × AC 400 V

Fig. 5-9: KSM02.1B-071C-35 characteristics



S1, S3 Characteristics apply to a PWM frequency of 4 kHz
(1) M_{max}, controlled supply (1) 3 × AC 400 V
(2)(3)(4) M_{max}, uncontrolled supply (2) 3 × AC 480 V, (3) 3 × AC 440 V, (4) 3 × AC 400 V

Fig. 5-10: KSM02.1B-076C-35 characteristics

5.2.4 Dimensions and technical design

Dimensions

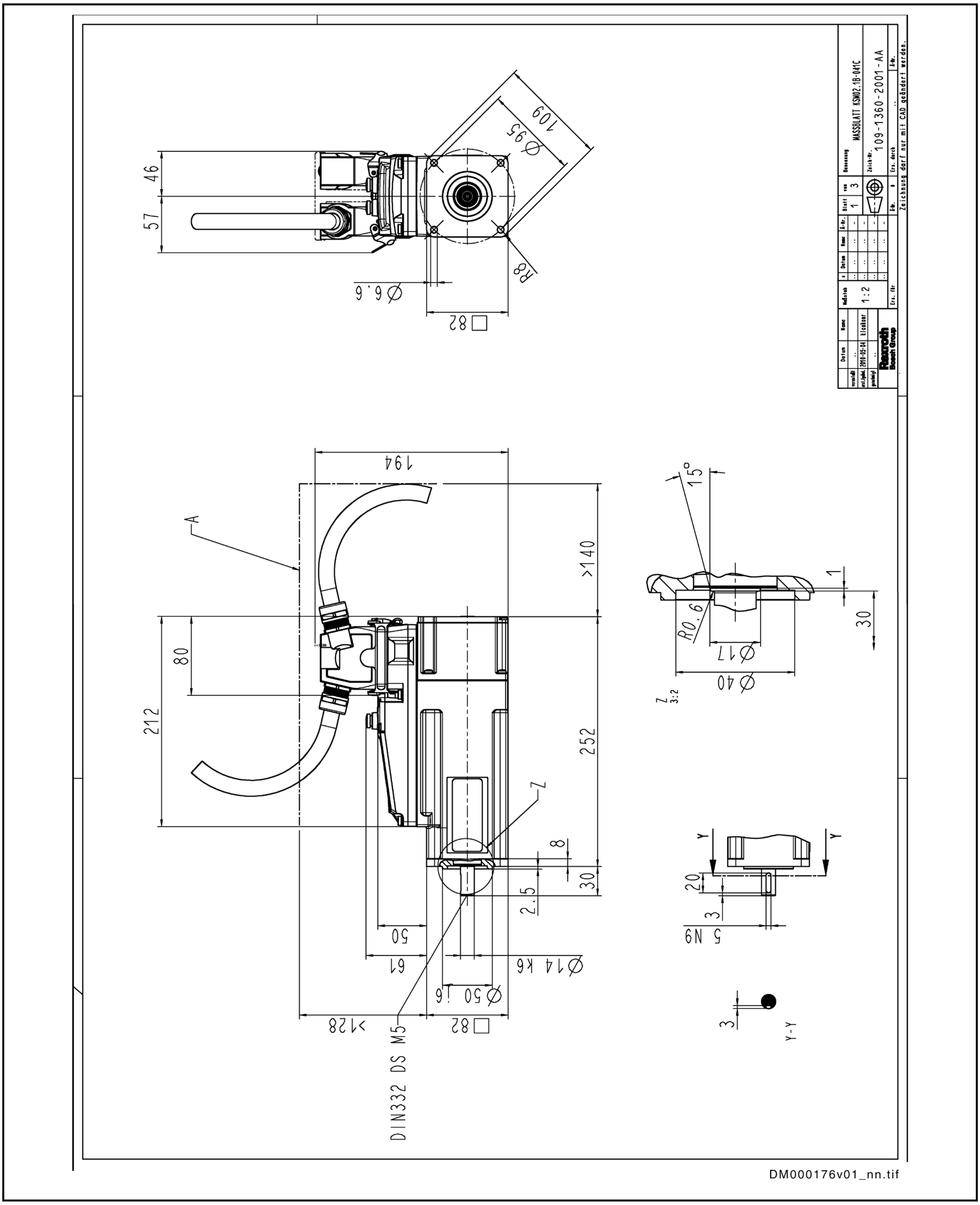


Fig. 5-11: KSM02.1B-041C dimensions

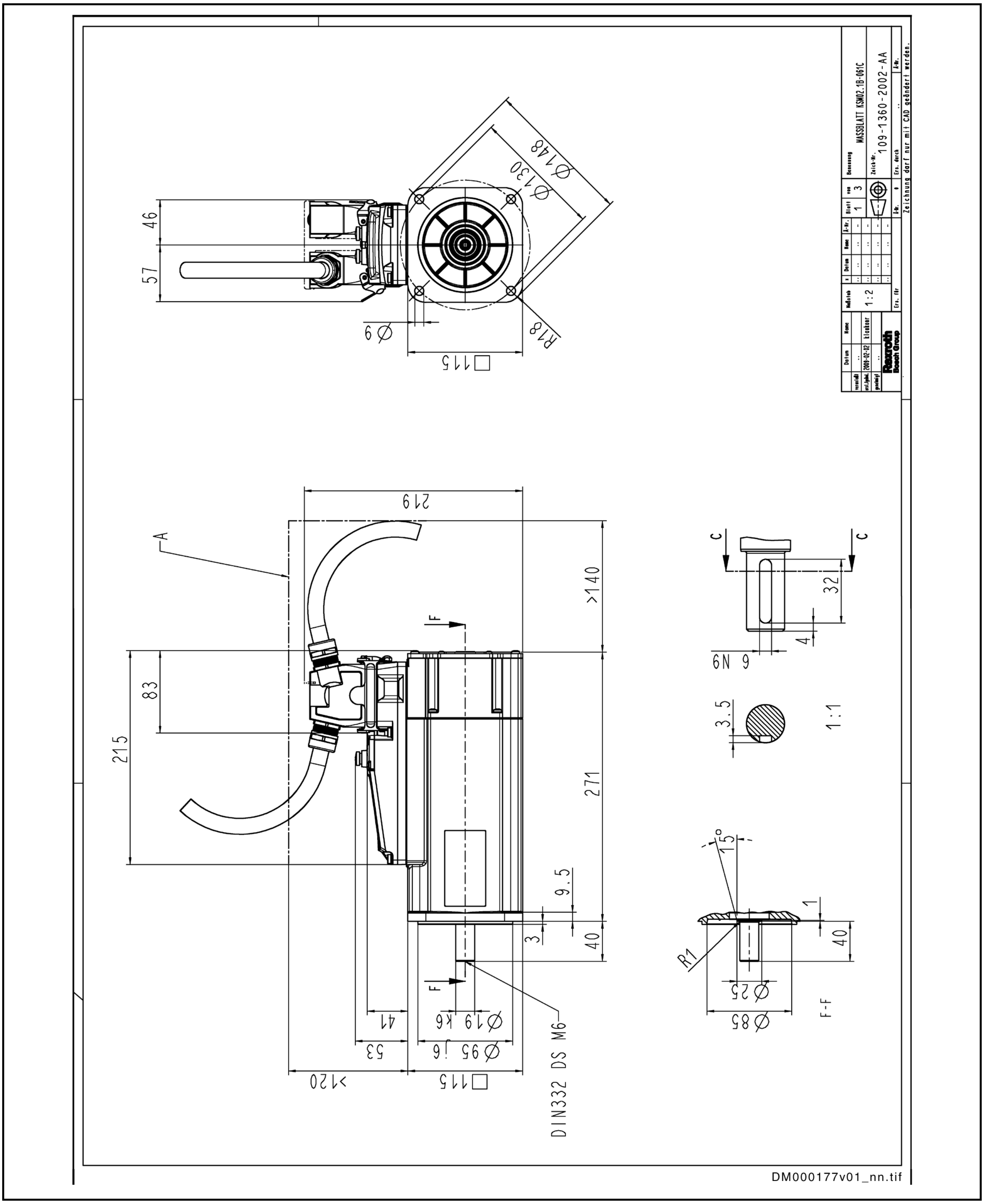
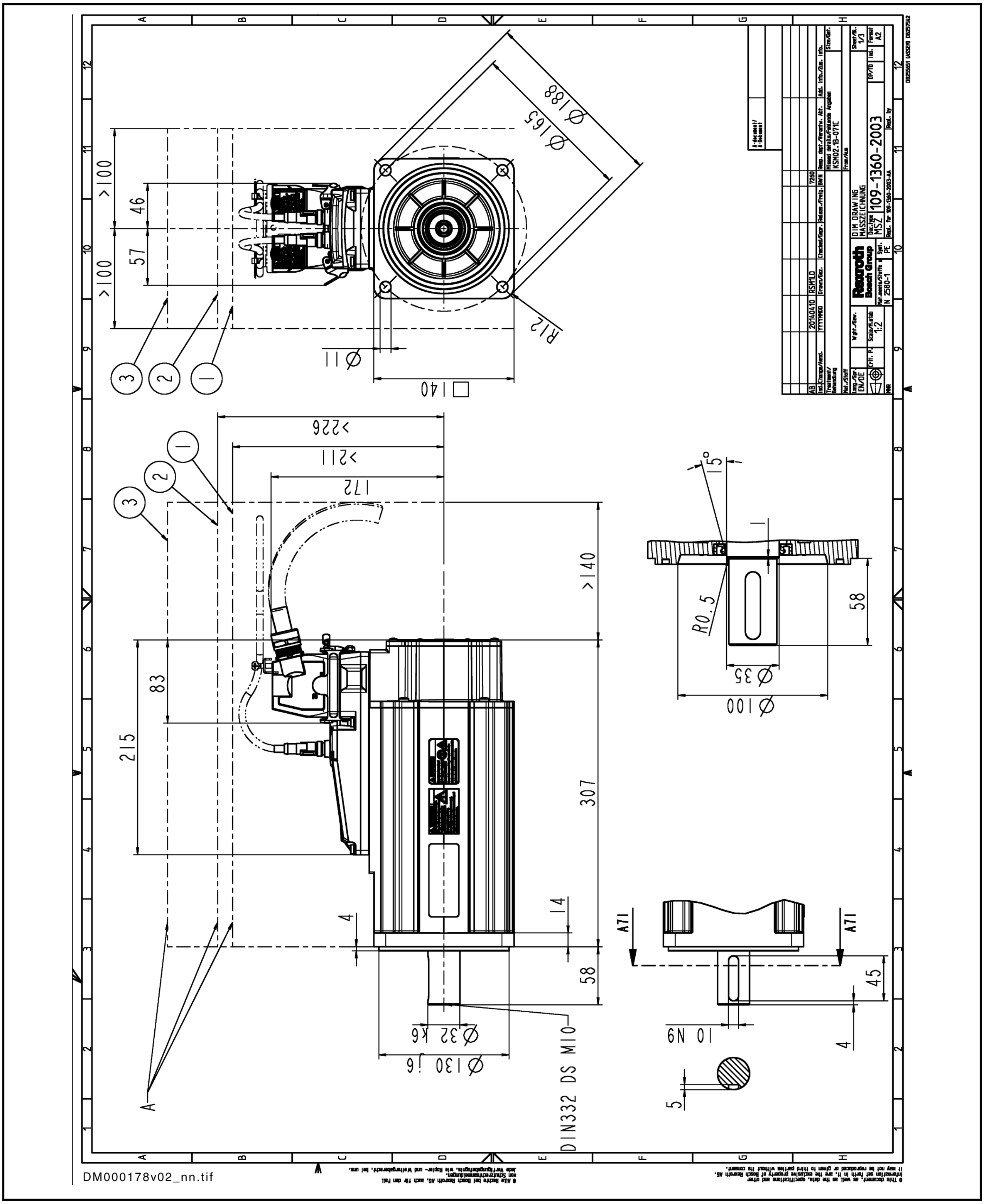


Fig. 5-12: KSM02.1B-061C dimensions

Technical data of the components



1	Mounting clearance (standard)
2	Mounting clearance with optional master communication output coupling

3 More mounting clearance with HAS10 accessory (fixing clip for hybrid cable connectors). More mounting clearance is required to install the HAS10 accessory with a screwdriver. The exact dimension of the mounting clearance is not specified, since the required mounting clearance depends on the length of the screwdriver used.

Fig. 5-13: KSM02.1B-071C dimensions

Technical data of the components

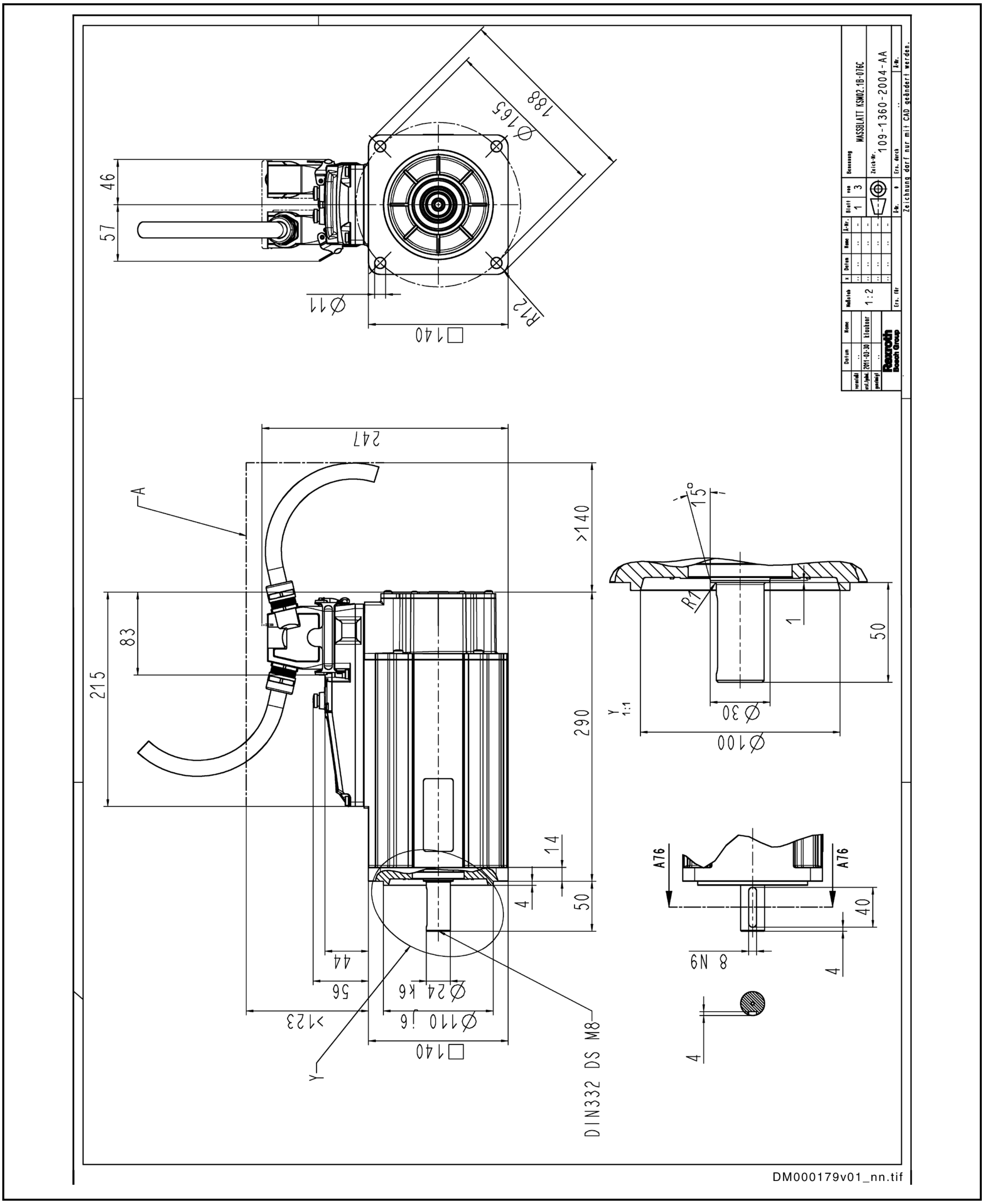


Fig. 5-14: KSM02.1B-076C dimensions

Technical design

Type of construction of motor
Type of construction of motor B5 according to EN 60034-7

Housing varnish
Black, RAL 9005

Balance value level (Balance quality)
A, according to EN 60034-14: 2004

Concentricity, run-out and alignment
According to DIN 42955, ed. 12.81 (IEC 60072-1)

Encoder	Concentricity tolerance		Run-out and alignment tolerance	
S1, S3, M1, M3	N	---	N	---

Tab. 5-4: Tolerance for concentricity, run-out and alignment, depending on encoder option

Flange
According to DIN 42948, ed. 11.65

Output shaft, shaft wnd and centering hole
Motors with keyway have been balanced with the complete key. The machine element to be driven has to be balanced without a key.

Shaft end cylindrical, acc. to DIN 748 Teil 3, ed. 07.75 (IEC 60072-1)

Centering hole, according to DIN 332 Teil 2, ed. 05.83

Type	Corresponding key, according to DIN 6885-A (is not part of the scope of supply of the motors)	Centering hole, according to DIN 332 part 2, ed. 05.83
KSM02.1B-041	5 × 5 × 20	DS M5
KSM02.1B-061	6 × 6 × 32	DS M6
KSM02.1B-071	10 × 8 × 45	DS M10
KSM02.1B-076	8 × 7 × 40	DS M8

Tab. 5-5: Key and centering hole

5.2.5 Bearing load and shaft load

See chapter 7.3 "Notes on mechanical project planning" on page 225 for further information on

- Allowed radial and axial forces
- Shaft load
- Bearings

Radial force F_{radial}

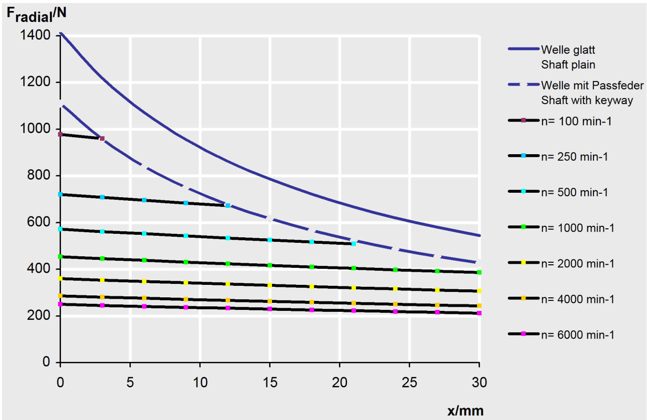


Fig. 5-15: KSM02.1B-041: Allowed radial force (shaft and bearing load)

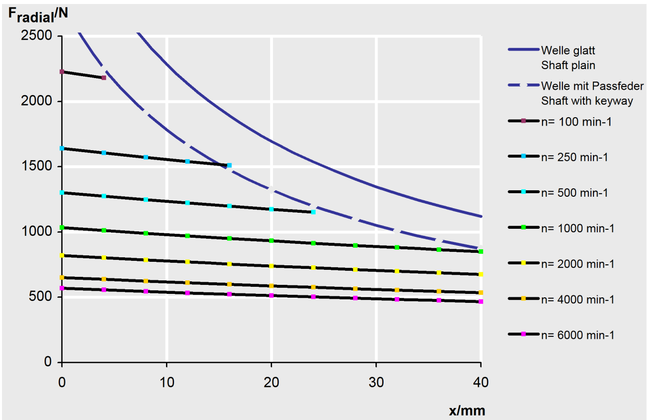


Fig. 5-16: KSM02.1B-061: Allowed radial force (shaft and bearing load)

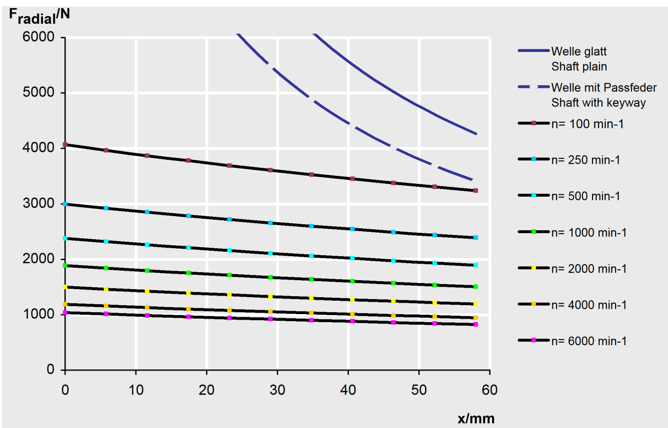


Fig. 5-17: KSM02.1B-071: Allowed radial force (shaft and bearing load)

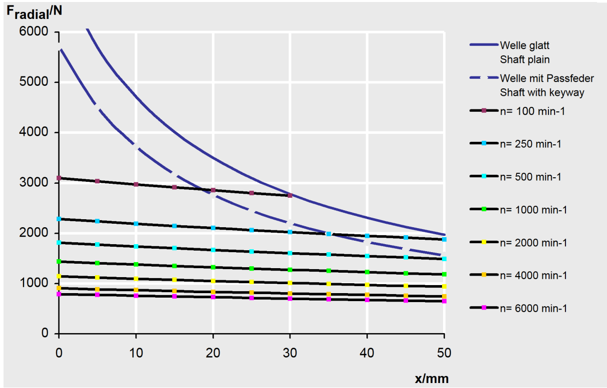


Fig. 5-18: KSM02.1B-076: Allowed radial force (shaft and bearing load)

Axial force F_{axial}

Type	Maximum allowed axial force in [N]
KSM02.1B-041	20
KSM02.1B-061	20
KSM02.1B-071	40
KSM02.1B-076	40

Tab. 5-6: Allowed axial force

5.3 KMS02 near motor servo drive

5.3.1 KMS02 data sheet

KMS data sheet

Description	Symbol	Unit	KMS02.1B-A018-P-D7-ET-NNN-NN-NN
Listing in accordance with UL standard			UL 508 C
Listing in accordance with CSA standard			C22.2 No. 14-10
UL files			E 134201
Ambient temperature range for operation with nominal data	T_{a_work}	°C	0...40
Degree of protection according to IEC60529			IP65
Ambient conditions according to UL50/50E			4X Indoor Use Only
Mass	m	kg	2.50
Control voltage data			
Control voltage input[1)]	U_{N3}	V	DC 30...42
Power consumption control voltage input at U_{N3}[2)]	P_{N3}	W	17.5
Power section data			
Short circuit current rating	SCCR	A rms	42000
Rated input voltage, power[3)]	U_{LN_nenn}	V	DC 540...750
Capacitance in DC bus	C_{DC}	mF	0.02
Capacitance against housing	C_Y	nF	118+100
Rated input current	I_{LN}	A	7.3
Allowed switching frequencies[4)]	f_s	kHz	4, 8
Maximum bypass current		A	25.0
Power dissipation at continuous current and continuous DC bus power respectively[5)]	P_{Diss_cont}	W	50.00
Power section data - output			
Output voltage, fundamental wave for V/Hz (U/f) control	V_{out_eff}	V	UDC * 0.71
Output voltage, fundamental wave for closed-loop operation	V_{out_eff}	V	-
Rise of voltage at output with U_{LN_nenn} and 7.5 m motor cable length phase-phase (10-90%)[6)]	dv/dt	kV/µs	5.00
Last modification: 2016-01-11			

Description	Symbol	Unit	KMS02.1B-A018-P-D7-ET-NNN-NN-NN
Rise of voltage at output with U_{LN_nenn} and 7.5 m motor cable length phase-ground (10-90%)[7]	dv/dt	kV/µs	5.00
Output frequency range when f_s = 4 kHz	f_{out_4k}	Hz	0...400
Output frequency range when f_s = 8 kHz	f_{out_8k}	Hz	0...800
Output frequency threshold to detect motor standstill[8]	f_{out_still}	Hz	0...4
Maximum output current when f_s = 4 kHz	I_{out_max4}	A	17.7
Maximum output current when f_s = 8 kHz	I_{out_max8}	A	13.3
Continuous output current when f_s = 4 kHz	I_{out_cont4}	A	5.8
Continuous output current when f_s = 8 kHz	I_{out_cont8}	A	2.6
Continuous output current when f_s = 4 kHz, output frequency $f_{out} < f_{out\_still}$	$I_{out\_cont0Hz\_4}$	A	5.6
Continuous output current when f_s = 8 kHz, output frequency $f_{out} < f_{out\_still}$	$I_{out\_cont0Hz\_8}$	A	2.4
Last modification: 2016-01-11			

1) Observe supply voltage for motor holding brakes
2) See information on "Rated power consumption control voltage input at U_{N3}"
3) Mains input L1, L2, L3 (for HMV and HCS only); For use on a solidly grounded wye source only.
4) Also depending on firmware and control section; see parameter description "P-0-0001, Switching frequency of power output stage"; see "P-0-4058, Amplifier type data"
5) Plus dissipation of braking resistor and control section
6) 7) Guide value, see following note
8) See following note regarding output current reduction

Tab. 5-7: KMS - Technical data

☞ **Rated power consumption control voltage input at U_{N3}**

Plus motor holding brake, plus power consumption of externally connected inputs/outputs, plus safety option

☞ **Guide value "Rise of voltage at output"**

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

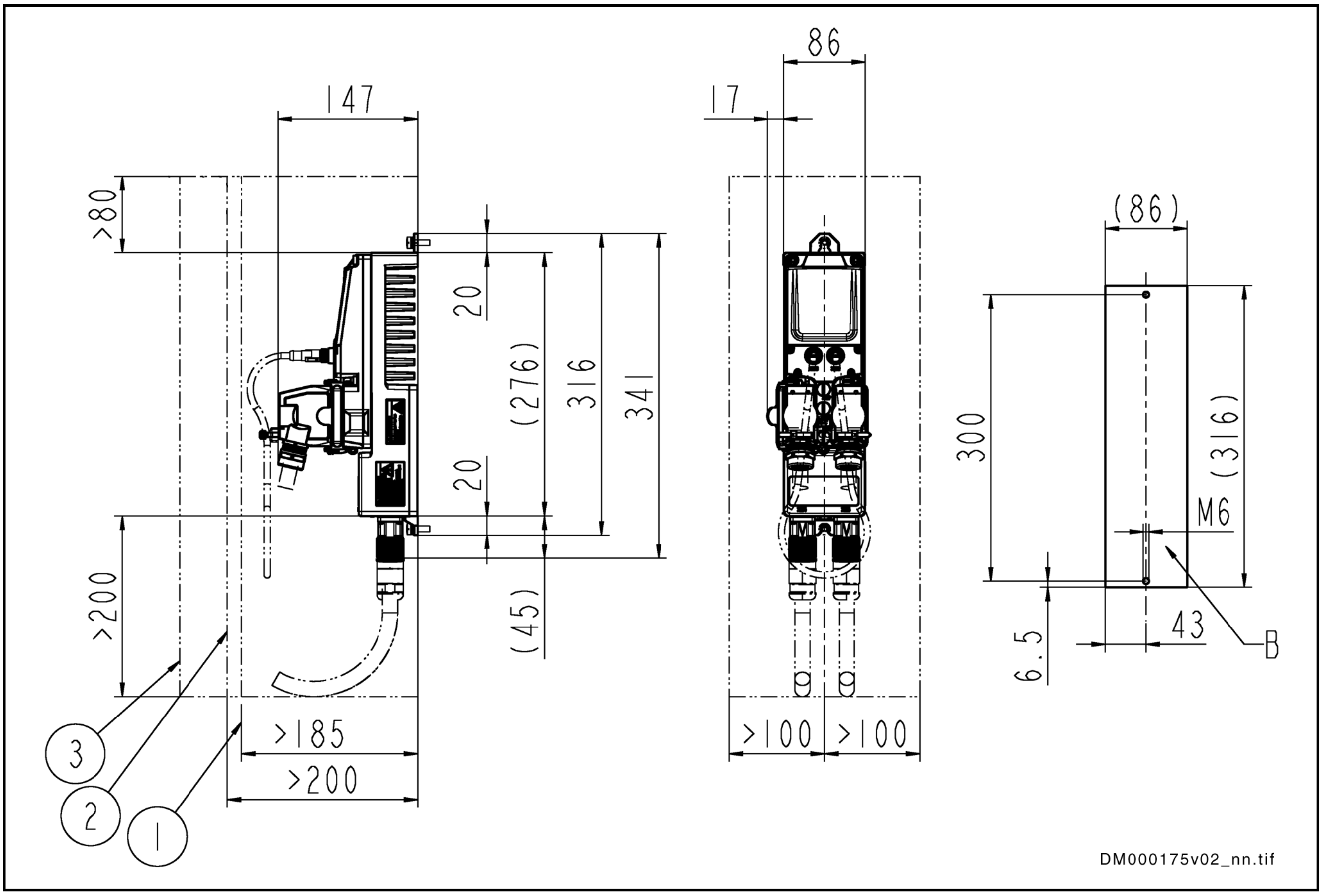
Especially when using **standard motors**, make sure that they comply with the occurring voltage load.

☞ **Reduced output current at motor standstill**

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

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

5.3.2 KMS02 dimensional drawing



1	Mounting clearance (standard)
2	Mounting clearance with optional master communication output coupling
3	More mounting clearance with HAS10 accessory (fixing clip for hybrid cable connectors). More mounting clearance is required to install the HAS10 accessory with a screwdriver. The exact dimension of the mounting clearance is not specified, since the required mounting clearance depends on the length of the screwdriver used.
B	Boring dimensions

Fig. 5-19: Dimensions

5.4 KCU02 drive connection box

5.4.1 Brief description and use

Drive Connection Box KCU02

The drive connection box KCU02

- supplies the motor-integrated servo drives KSM and the near motor servo drives KMS
  - with power (from the DC bus connection to an HMV supply unit or HCS converter)
  - with 42V control voltage
- with integrated fuses protects the hybrid cable RKH against electric overload
- allows communication between the higher-level control unit and the motor-integrated servo drives KSM and near motor servo drives KMS

5.4.2 KCU02 data sheet

KCU data sheet - Currents, voltages, power

Description	Symbol	Unit	KCU02.2N-ET-ET*-025-NN-N-NN-NW
Listing in accordance with UL standard			UL 508C
Listing in accordance with CSA standard			C22.2 No. 14-10
UL files			E134201
Mass	m	kg	3.80
Degree of protection according to IEC60529			IP20
Minimum distance on the top of the device1)	d_{top}	mm	80
Minimum distance on the bottom of the device2)	d_{bot}	mm	110
Horizontal spacing on the device3)	d_{hor}	mm	0
Temperature increase with minimum distances d_{bot}; d_{top}; P_{BD}	ΔT	K	Less than 60
Cooling type			Forced
Volumetric capacity of forced cooling	V	m^3/h	approx. 0.3
Power dissipation at continuous current and continuous DC bus power respectively4)	P_{Diss_cont}	W	90
Insulation resistance at 500 V DC	R_{is}	Mohm	>50
Average sound pressure level (accuracy class 2) at P_{DC_cont}5)	L_P	dB (A)	Less than 70
Control voltage data - input			
Control voltage input6)	U_{N3}	V	24 ± 20%
Rated power consumption control voltage input at U_{N3}7)	P_{N3}	W	675
Max. inrush current at 24 V supply	I_{IN3_max}	A	10.00
Pulse width of I_{EIN3}	$t_{EIN3Lade}$	ms	Less than 1000
Input capacitance	C_{N3}	mF	11.00
Maximum allowed voltage for 1 ms	U_{N3_max}	V	33.00
Control voltage data - output			
Nominal voltage	V_{out}	V	42.0
Nominal power	P_{out}	W	588.0
			Last modification: 2015-10-07

Description	Symbol	Unit	KCU02.2N-ET-ET*-025-NN-N-NN-NW
Power section data - input			
Rated input voltage, power[8)]	U_{LN_nenn}	V	DC 540...750
Rated input current	I_{LN}	A	25.0
Capacitance in DC bus	C_{DC}	mF	Less than 0.001
Capacitance against housing	C_Y	nF	2 x 100
Short circuit current rating	SCCR	A rms	42000
Power section data - output			
Output voltage	V_{out}	V	DC 540...750
Output current	I_{out}	A	25.0
Derating of P_{DC_cont}; P_{BD}; I_{out_cont} when $T_{a\_work} < T_a < T_{a\_work\_red}$	f_{Ta}	%/K	-
Rated power (t > 10 min) at f_s = 4 kHz; U_{LN_nenn}; control factor $a_0 > 0.8$; without mains choke	P_{DC_cont}	kW	14.0...18.8
Maximum allowed DC bus power at U_{LN_nenn}; without mains choke	P_{DC_max}	kW	42.0...53.3
Last modification: 2015-10-07			

1) 2) 3) See fig. "Air intake and air outlet at device"
4) Plus dissipation of braking resistor and control section
5) According to DIN EN ISO 11205; comparative value at distance 1 m, out of cabinet; HCS types with order code -L***: load-dependent
6) Observe supply voltage for motor holding brakes
7) See information on "Rated power consumption control voltage input at U_{N3}"
8) Mains input L1, L2, L3 (for HMV and HCS only); For use on a solidly grounded wye source only.

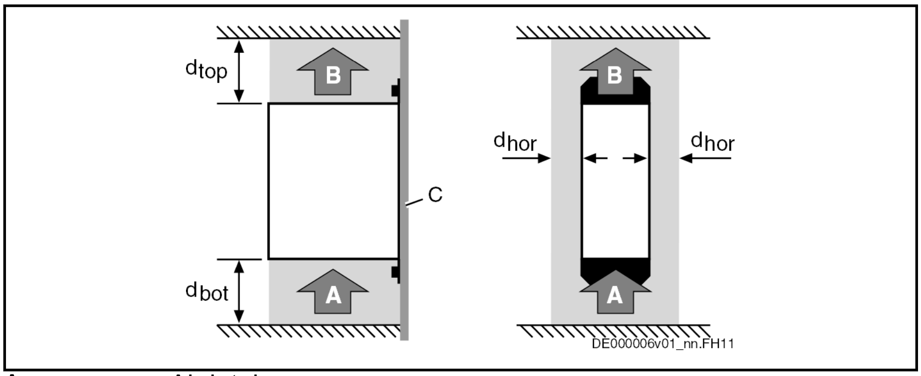
Tab. 5-8: KCU - Technical data

Rated power consumption control voltage input at U_{N3}

Maximum power consumption from 24V supply

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

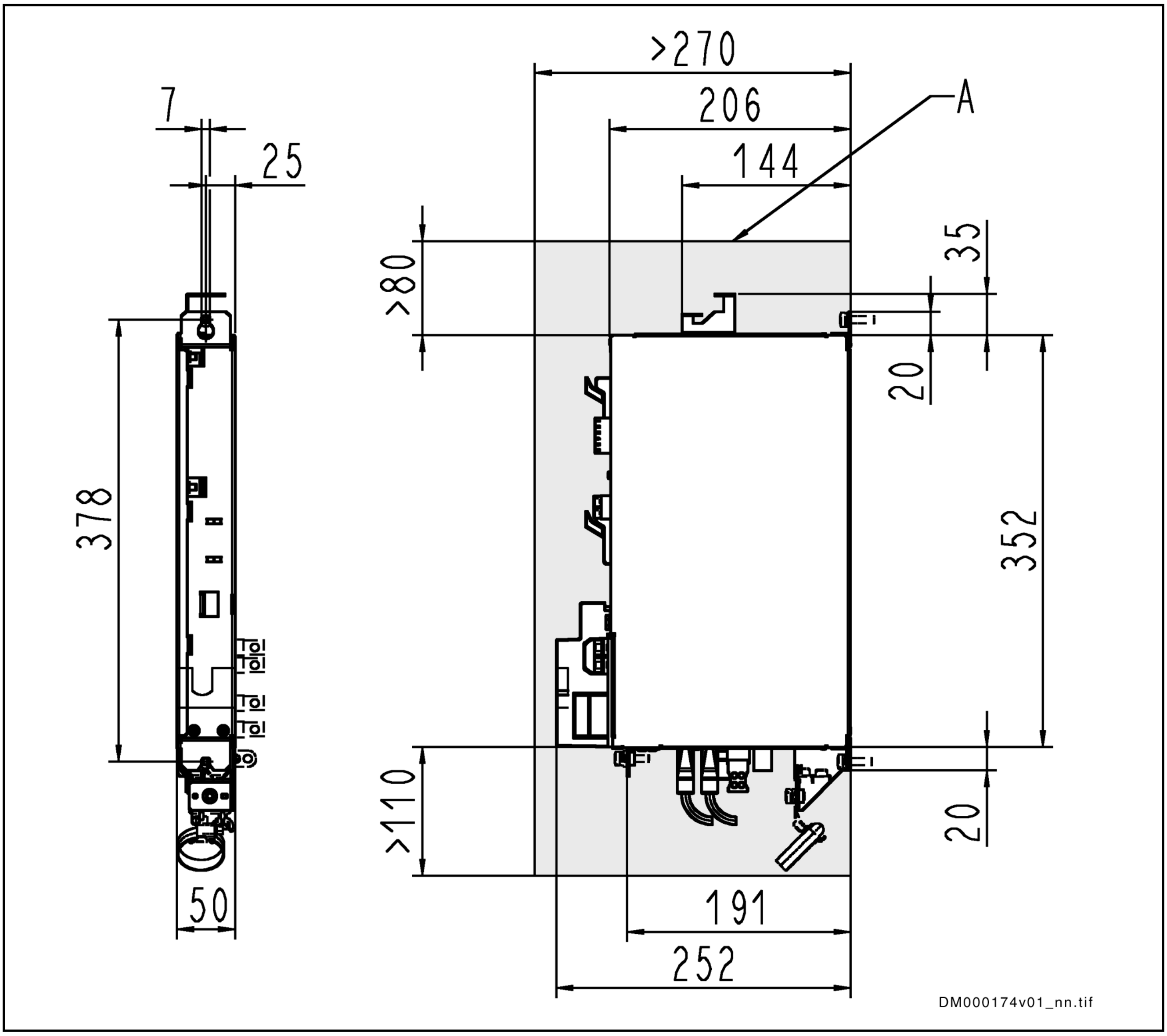
Comply with indicated minimum distances!



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. 5-20: Air intake and air outlet at device

5.4.3 KCU02 dimensional drawing



A Minimum mounting clearance

Fig. 5-21: Dimensions

5.5 KMV03 supply unit

5.5.1 Ambient and operating conditions

Ambient and operating conditions - UL ratings

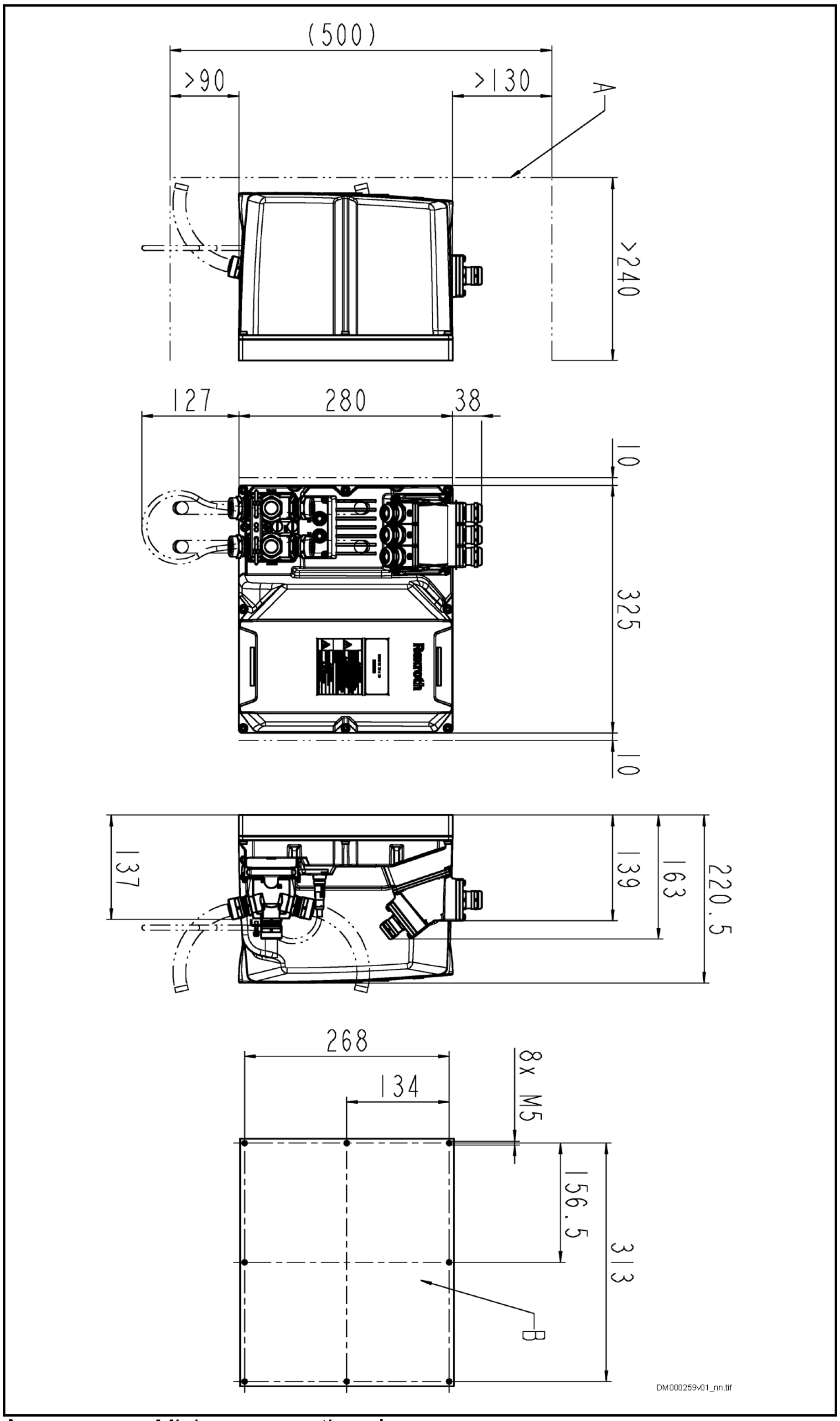
Description	Symbol	Unit	KMV03.1R-B0007-P-D7-ET-NNNN
Short circuit current rating	SCCR	A rms	42000
Rated input voltage, power[1)]	U_{LN_nenn}	V	3 x AC 380…500
Rated input current	I_{LN}	A	12
Output voltage	V_{out}	V	DC 750
Output power	P_{out}	kW	7.5
Last modification: 2016-03-08			

1) For use on a solidly grounded wye source only.

Tab. 5-9: KMV - Ambient and operating conditions - UL ratings

5.5.2 Mechanics and mounting

KMV03 dimensions



A Minimum mounting clearance
B Boring dimensions

Fig. 5-22: KMV03, dimensions

Dimensions, mass, insulation, sound pressure level

Data for mass, dimensions, sound pressure level, insulation

Description	Symbol	Unit	KMV03.1R-B0007-P-D7-ET-NNNN
Mass	m	kg	15.70
Device height[1)]	H	mm	280
Device depth[2)]	T	mm	230
Device width[3)]	B	mm	325
Insulation resistance at 500 V DC	R_{is}	Mohm	tbd
Capacitance against housing	C_Y	nF	100.00
Average sound pressure level (accuracy class 2) at P_{DC_cont}[4)]	L_P	dB (A)	tbd
			Last modification: 2016-03-08

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

Tab. 5-10: KMV - Data for mass, dimensions, sound pressure level, insulation

Power dissipation, mounting position, cooling, distances

Cooling and power dissipation data

Description	Symbol	Unit	KMV03.1R-B0007-P-D7-ET-NNNN
Ambient temperature range for operation with nominal data	T_{a_work}	°C	0…40
Allowed mounting position			G1, G2, G3, G4
Cooling type			Thermal interface
Power dissipation at continuous current and continuous DC bus power respectively[1)]	P_{Diss_cont}	W	500.00
Power consumption control voltage input at U_{N3}[2)]	P_{N3}	W	18
Temperature increase with minimum distances d_{bot}; d_{top}; P_{BD}	ΔT	K	-
			Last modification: 2016-02-11

1) Plus dissipation of braking resistor and control section
2) See information on "Rated power consumption control voltage input at U_{N3}"

Tab. 5-11: KMV - Cooling and power dissipation data

Rated power consumption control voltage input at U_{N3}

Plus power consumption of externally connected inputs/outputs, plus safety option

5.5.3 Basic data

Control voltage

Control voltage supply data

Description	Symbol	Unit	KMV03.1R-B0007-P-D7-ET-NNNN
Control voltage input[1)]	U_{N3}	V	DC 24 V ±20 %
Control voltage when using motor holding brake with motor cable length > 50 m[3)]	U_{N3}	V	DC 24 V ±20 %
Max. inrush current at 24 V supply	I_{IN3_max}	A	10.00
Pulse width of I_{EIN3}	$t_{EIN3Lade}$	ms	Less than 1000
Input capacitance	C_{N3}	mF	11.00
Rated power consumption control voltage input at U_{N3}[4)]	P_{N3}	W	18
Last modification: 2016-02-11			

1) 2) 3) Observe supply voltage for motor holding brakes
4) See information on "Rated power consumption control voltage input at U_{N3}"

Tab. 5-12: KMV - Control voltage supply data

☞ **Rated power consumption control voltage input at U_{N3}**

Plus power consumption of externally connected inputs/outputs, plus safety option

Mains voltage

Mains voltage supply data

Description	Symbol	Unit	KMV03.1R-B0007-P-D7-ET-NNNN
Mains frequency	f_{LN}	Hz	50...60
Mains frequency tolerance		Hz	±2
Maximum allowed mains frequency change	$\Delta f_{LN}/\Delta t$	Hz/s	1
Rotary field condition			None
Short circuit current rating	SCCR	A rms	42000
Nominal mains voltage	U_{LN_nenn}	V	3 AC 400
Three-phase mains voltage at TN-S, TN-C, TT mains	U_{LN}	V	3 AC 380…500
Three-phase mains voltage at IT mains[1)]	U_{LN}	V	tbd
Three-phase mains voltage at Corner-grounded-Delta mains[2)]	U_{LN}	V	tbd
Tolerance rated input voltage U_{LN}		%	±10
Minimum inductance of mains supply (mains phase inductance)[3)]	L_{min}	µH	50
Assigned mains filter with integrated mains choke			KNK03.1A-NR-B0012-P-U226-A4-NNNN
Minimum short circuit power of the mains for failure-free operation	S_{k_min}	MVA	tbd
Inrush current	$I_{L\_trans\_max\_on}$	A	tbd
Maximum allowed ON-OFF cycles per minute[4)]			1
Power factor TPF (λ_L) at P_{DC_cont} with mains choke; U_{LN_nenn}	TPF		tbd
Power factor of fundam. component DPF at P_{DC_cont} with mains choke	$\cos\varphi^{h1}$		tbd
Mains connection power at P_{DC_cont}; U_{LN_nenn} with mains choke	S_{LN}	kVA	15.00
Rated input current	I_{LN}	A	12
Last modification: 2016-03-08			

Technical data of the components

Description	Symbol	Unit	KMV03.1R-B0007-P-D7-ET-NNNN
Mains fuse according to EN 60204-1		A	tbd
Required wire size in accordance with NFPA 79 and UL 508 A (internal wiring);[5)]	A_{LN}	AWG	tbd
			Last modification: 2016-03-08

1) 2) Mains voltage > U_{LN}: Use a transformer with grounded neutral point, do not use autotransformers!
3) Otherwise use HNL mains choke
4) Observe allowed number of switch-on processes; without external capacitors at the DC bus
5) Copper wire; PVC-insulation (conductor temperature 90 °C; $T_a \leq 40$ °C) in accordance with NFPA 79 chapter 12 and UL 508A chapter 28

Tab. 5-13: KMV - Mains voltage supply data

DC bus

Supply unit data - DC bus

Description	Symbol	Unit	KMV03.1R-B0007-P-D7-ET-NNNN
Nominal value of regulated DC bus voltage[1)]	U_{DC_nenn}	V	750
Capacitance in DC bus	C_{DC}	mF	2.35
DC resistance in DC bus (L+ to L-)	R_{DC}	kOhm	23.00
Rated power (t > 10 min) at f_s = 4 kHz; U_{LN_nenn}; control factor a_0 > 0.8; with mains choke	P_{DC_cont}	kW	7.50
P_{DC_cont} and P_{DC_max} vs. mains input voltage; $U_{LN} \leq U_{LN\_nenn}$		%/V	$P_{DC\_cont(ULN)} = P_{DC\_cont}$ x (1 - (400 - U_{LN}) x 0.0025)
P_{DC_cont} and P_{DC_max} vs. mains input voltage; $U_{LN} > U_{LN\_nenn}$		%/V	P_{DC_cont}
Maximum allowed DC bus power at U_{LN_nenn}; with mains choke	P_{DC_max}	kW	15.00
Monitoring value maximum DC bus voltage, switch-off threshold	$U_{DC\_limit\_max}$	V	900
Monitoring value minimum DC bus voltage, undervoltage threshold	$U_{DC\_limit\_min}$	V	500
Allowed external DC bus capacitance (nom.) at U_{LN_nenn}[2)]	C_{DCext}	mF	2.00
Charging time at maximum allowed C_{DCext} external DC bus capacitance at U_{LN_nenn}	$t_{lade\_DC\_Cext}$	s	0.70
Last modification: 2016-02-11			

1) Only devices with regulated DC bus voltage
2) Use assigned mains choke

Tab. 5-14: KMV - Supply unit data - DC bus

Technical data of the components

Braking resistor

Integrated braking resistor data

Description	Symbol	Unit	KMV03.1R-B0007-P-D7-ET-NNNN
Braking resistor continuous power	P_{BD}	kW	0.15
Braking resistor peak power	P_{BS}	kW	12.00
Nominal braking resistor	$R_{DC\_Bleeder}$	ohm	60
Braking resistor switch-on threshold – independent of mains voltage1)	$U_{R\_DC\_On\_f}$	V	820
Regenerative power to be absorbed	W_{R_max}	kWs	7.50
Cooling of integrated braking resistor			Base plate (Coldplate)
Last modification: 2016-02-11			

1) Factory setting

Tab. 5-15: KMV - Integrated braking resistor data

5.6 KNK03 mains filter

5.6.1 KNK03 data sheet

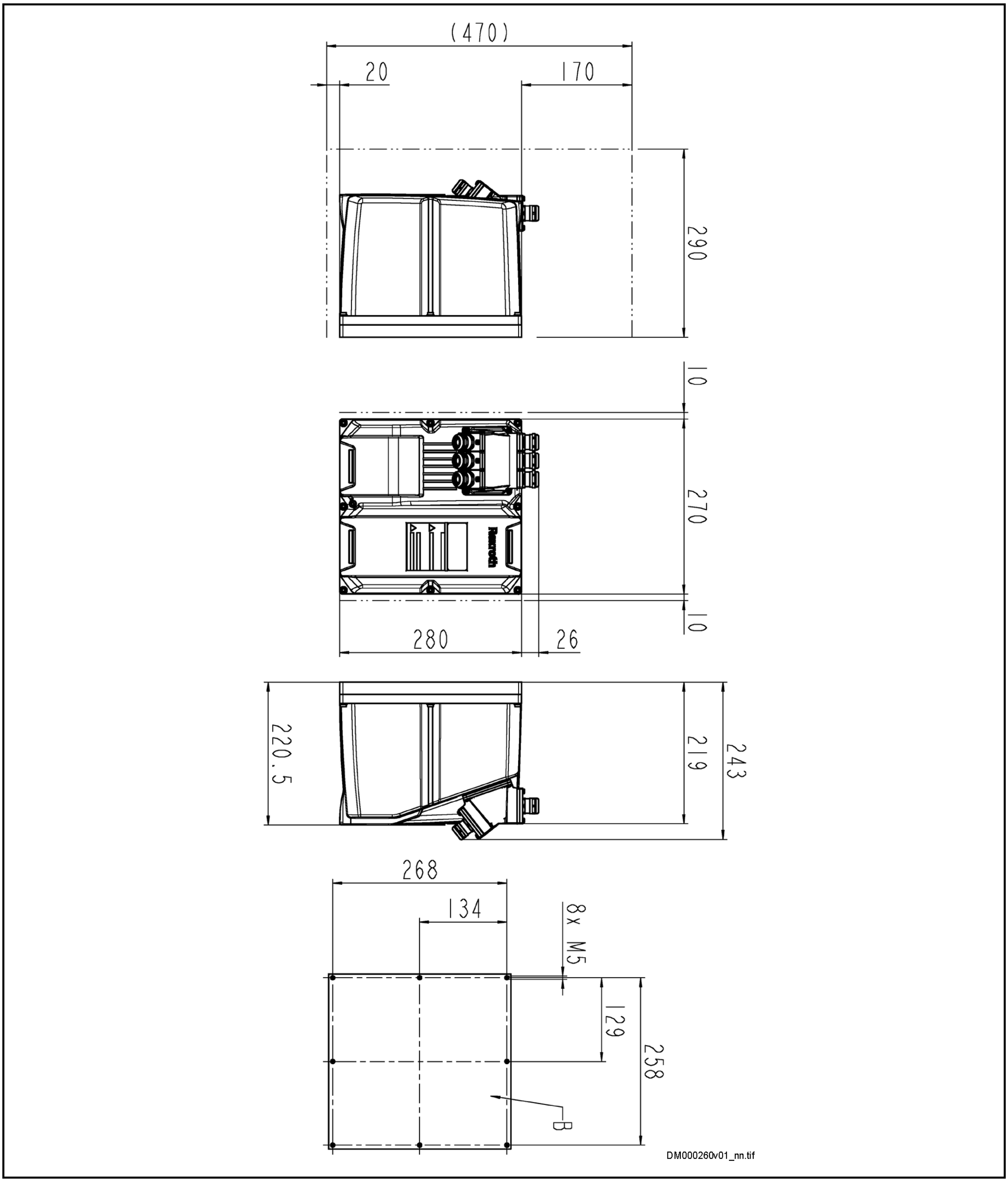
Technical data - currents, voltages, power

Description	Symbol	Unit	KNK03.1A-NR-B0012-P-U226-A4-NNNN
Degree of protection according to IEC 60529	IP		IP65
Listing in accordance with UL standard			UL 61800-5-1
Listing in accordance with CSA standard			CSA C22.2 No. 274-13
Mass	m	kg	20.00
Three-phase mains voltage at TN-S, TN-C, TT mains	U_{LN}	V	AC 380…500
Mains voltage three-phase at Corner-grounded-Delta mains[1)]	U_{LN}	V	tbd
Three-phase mains voltage at IT mains[2)]	U_{LN}	V	tbd
Tolerance rated input voltage U_{LN}		%	±10
Continuous current	I_{L_cont}		
Typical inductance per winding at I_{cont}	L_{typ}	µH	2
Power dissipation at continuous current and continuous DC bus power respectively[3)]	P_{Diss_cont}	W	160
Insulation resistance at 500 V DC	R_{is}	Mohm	tbd
Required wire size in accordance with NFPA 79 and UL 508 A (internal wiring);[4)]	A_{LN}	AWG	tbd
Last modification: 2016-01-20			

1) 2) Mains voltage > U_{LN}: Use a transformer with grounded neutral point, do not use autotransformers!
3) Plus dissipation of braking resistor and control section
4) Copper wire; PVC-insulation (conductor temperature 90 °C; T_a ≤ 40 °C) in accordance with NFPA 79 chapter 12 and UL 508A chapter 28

Tab. 5-16: KNK - Technical data - currents, voltages, power

5.6.2 KNK03 dimensional drawing



A Minimum mounting clearance
B Boring dimensions

Fig. 5-23: KNK03, dimensions

5.7 KMS03 near motor servo drive

5.7.1 KMS03 data sheet

KMS data sheet

Description	Symbol	Unit	KMS03.1B-A036-P-D7-ET-END-NN-NN-FW	KMS03.1B-B036-P-D7-ET-END-NN-NN-FW
Listing in accordance with UL standard			UL 61800-5-1	
Listing in accordance with CSA standard			CSA C22.2 No.274-13	
UL files			E134201	
Ambient temperature range for operation with nominal data	T_{a_work}	°C	0...40	
Degree of protection according to IEC60529			IP65	
Ambient conditions according to UL50/50E			Type 4X Indoor use only	
Mass	m	kg	4.00	3.40
Control voltage data				
Control voltage input[1)]	U_{N3}	V	DC 30...42	
Power consumption control voltage input at U_{N3}[2)]	P_{N3}	W	17.5	
Power section data				
Short circuit current rating	SCCR	A rms	42000	
Rated input voltage, power[3)]	U_{LN_nenn}	V	DC 540...750	
Capacitance in DC bus	C_{DC}	mF	0.05	
Capacitance against housing	C_Y	nF	100+100	
Rated input current	I_{LN}	A	10.5	19.3
Allowed switching frequencies[4)]	f_s	kHz	4, 8	
Maximum bypass current		A	Bypass max. 25 A	
Power dissipation at continuous current and continuous DC bus power respectively[5)]	P_{Diss_cont}	W	127.00	222.00
Power section data - output				
Output voltage, fundamental wave for V/Hz (U/f) control	V_{out_eff}	V	UDC * 0.71	
Output voltage, fundamental wave for closed-loop operation	V_{out_eff}	V	UDC * 0.71	
Last modification: 2016-03-08				

Technical data of the components

Description	Symbol	Unit	KMS03.1B-A036-P-D7-ET-END-NN-NN-FW	KMS03.1B-B036-P-D7-ET-END-NN-NN-FW
Rise of voltage at output with U_{LN_nenn} and 7.5 m motor cable length phase-phase (10-90%)[6)]	dv/dt	kV/µs	5.00	
Rise of voltage at output with U_{LN_nenn} and 7.5 m motor cable length phase-ground (10-90%)[7)]	dv/dt	kV/µs	5.00	
Output frequency range when f_s = 4 kHz	f_{out_4k}	Hz	0...400	
Output frequency range when f_s = 8 kHz	f_{out_8k}	Hz	0...800	
Output frequency threshold to detect motor standstill[8)]	f_{out_still}	Hz	0...4	
Maximum output current when f_s = 4 kHz	I_{out_max4}	A	36.0	
Maximum output current when f_s = 8 kHz	I_{out_max8}	A	28.2	
Continuous output current when f_s = 4 kHz	I_{out_cont4}	A	12.0	22.0
Continuous output current when f_s = 8 kHz	I_{out_cont8}	A	8.8	22.0
Continuous output current when f_s = 4 kHz; output frequency $f_{out} < f_{out\_still}$	$I_{out\_cont0Hz\_4}$	A	12.0	22.0
Continuous output current when f_s = 8 kHz; output frequency $f_{out} < f_{out\_still}$	$I_{out\_cont0Hz\_8}$	A	5.9	16.0
Last modification: 2016-03-08				

1) Observe supply voltage for motor holding brakes
2) See information on "Rated power consumption control voltage input at U_{N3}"
3) Mains input L1, L2, L3 (for HMV and HCS only); For use on a solidly grounded wye source only.
4) Also depending on firmware and control section; see parameter description "P-0-0001, Switching frequency of power output stage"; see "P-0-4058, Amplifier type data"
5) Plus dissipation of braking resistor and control section
6) 7) Guide value, see following note
8) See following note regarding output current reduction

Tab. 5-17: KMS - Technical data

☞ **Rated power consumption control voltage input at U_{N3}**

Plus motor holding brake, plus power consumption of externally connected inputs/outputs, plus safety option

☞ **Guide value "Rise of voltage at output"**

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

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

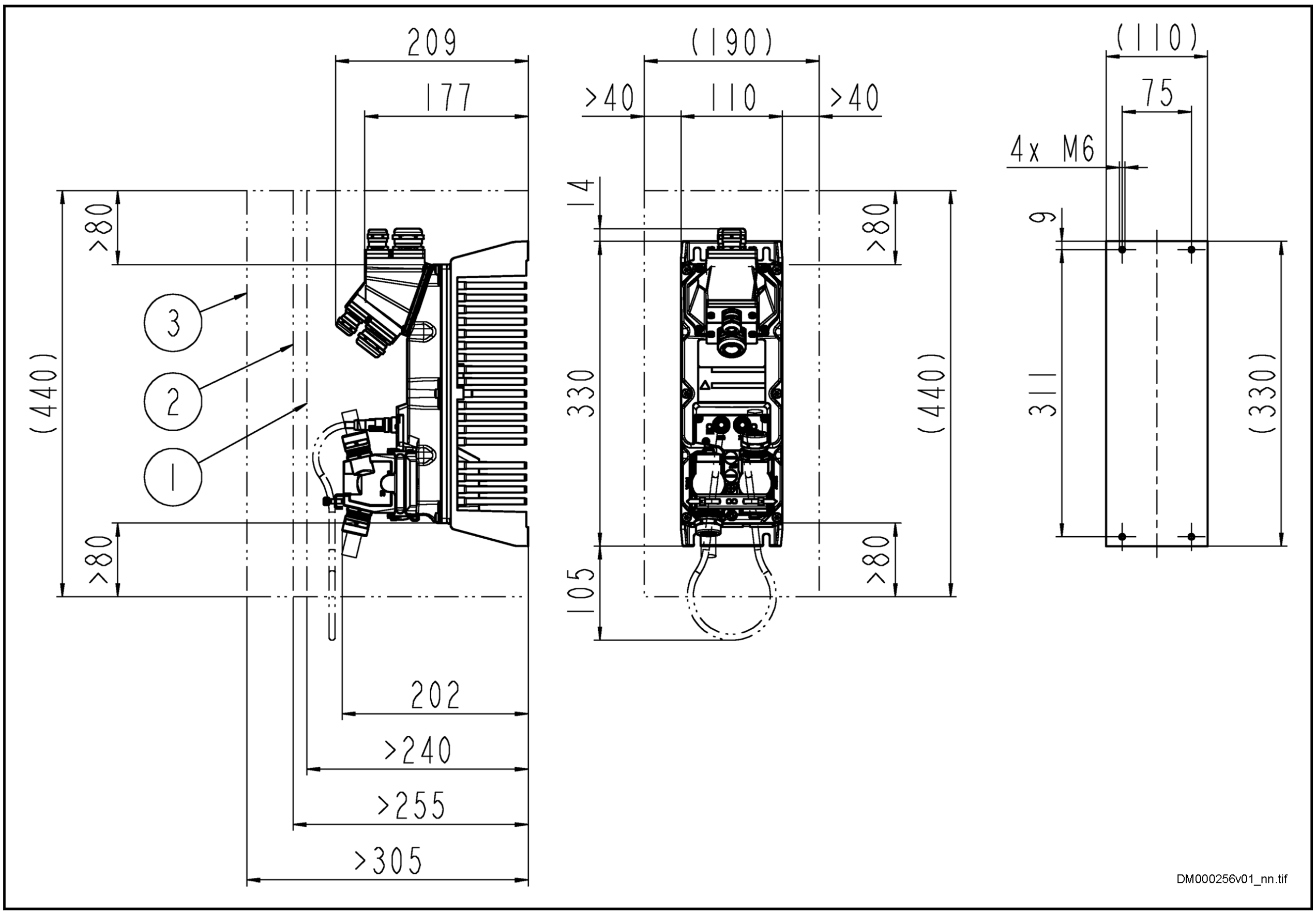
☞ **Reduced output current at motor standstill**

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

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

5.7.2 KMS03 dimensional drawing

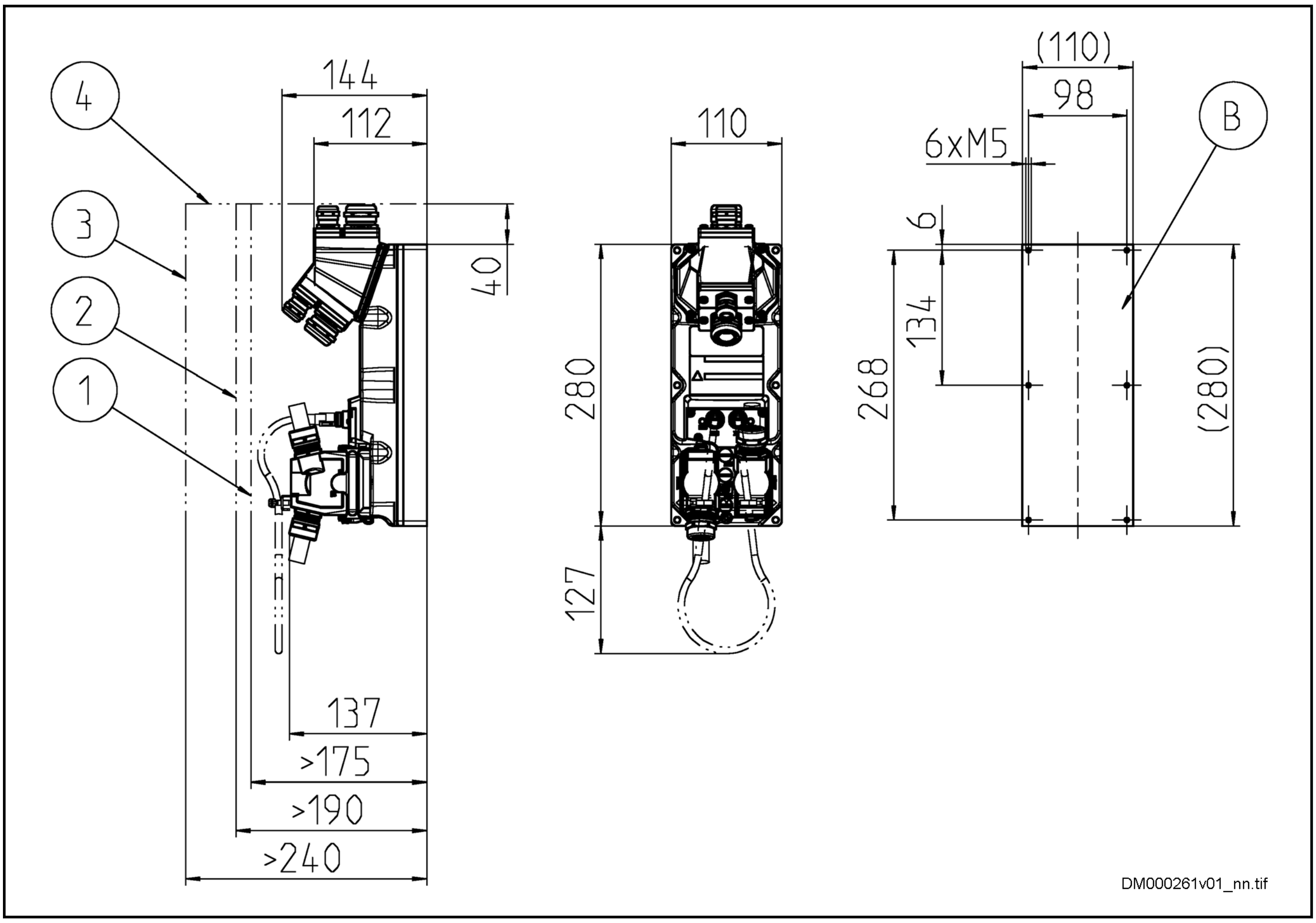
KMS03.1B-A036



1	Mounting clearance (standard)
2	Mounting clearance with optional master communication output coupling
3	More mounting clearance with HAS10 accessory (fixing clip for hybrid cable connectors). More mounting clearance is required to install the HAS10 accessory with a screwdriver.

Fig. 5-24: KMS03.1B-A, dimensions

KMS03.1B-B036



1	Mounting clearance (standard)
2	Mounting clearance with optional master communication output coupling
3	More mounting clearance with HAS10 accessory (fixing clip for hybrid cable connectors). More mounting clearance is required to install the HAS10 accessory with a screwdriver.
4	Mounting clearance with cable outlet away from housing
B	Drilling pattern

Fig. 5-25: KMS03.1B-B, dimensions

5.8 RKH hybrid cable

5.8.1 RKH hybrid cable incl. communication, technical data

Data sheet - bulk cable

Description	Symbol	Unit	REH0800
Brief description of cable			[5x2.5mm² + 5x0.34mm² + (2x2x0.34mm²)StC]C
RoHS			compliant with EU Directive 2002/95/EC
Recognized UL and CSA[1)]			cURus
AWM Style			AWM20234
Diameter	D	mm	16.2 +/- 0.5
Power core cross section		mm^2	2.5
Cable jacket material[2)]			PUR
Cable jacket color			RAL2003
Specific cable weight	m	kg/m	0.355
Temperature range for storage		°C	-30 ... +60
Ambient temperature at operation (permanent installation)		°C	-30 ... +80
Ambient temperature at operation (flexible installation)		°C	-20 ... +80
Operating temperature at conductor (flexible/permanent)		°C	80
Leakage capacitance	$C_{Y\_K\_typ}$		
Conductor resistance at 20°C (EN 60228; class 6)	R_{20}	ohm/km	8 (2.5 mm²)
Operational voltage at power cores		V	850
Operational voltage at control cores		V	100
Halogens			Halogen-free acc. to VDE 0472, Part 815
Oil resistance			EN 60811-2-1 and EN 50363-10-2
Flammability			UL 7 58, section 40, Cable Flame Test Section 1061 according to UL 1581 and CSA C22.2 No. 210-05 Sec. 8.8.2 Test according to EN 60332-1-2
Flexible cable tracks			
Suitable for application in flexible cable tracks			Yes
Bending cycles			5
Bending radius with flexible installation		mm	10 x D
			Last modification: 2013-04-15

Description	Symbol	Unit	REH0800
Bending radius with permanent installation		mm	5 x D
Max. acceleration3)	a_{max}	m/s²	4
Max. travel velocity4)	v	m/s	4
Max. horizontal travel distance5)	s	m	10
Bending and torsional stress		°	not suitable
Last modification: 2013-04-15			

1) UL file number according to cable marking
2) According to EN 50363-10-2
3) 4) 5) Flexible cable track parameters: Maximum values only apply individually

Tab. 5-18: REH - Technical data

The hybrid cable contains both power lines and control lines. Route hybrid cables in accordance with EN 61800-5-1 and EN 61800-5-2, protected against external damage. Select the types of protective measures according to the respective application.

5.8.2 Hybrid cable without communication, technical data

Data sheet - bulk cable

Description	Symbol	Unit	REH0803
Brief description of cable			(5x2.5mm² + 5x0.34mm²)StC
RoHS			RoHS compliant (according to 2011/65/EC)
Recognized UL and CSA[1)]			cURus
AWM Style			AWM21223
Diameter	D	mm	11.4 +/-0.3
Power core cross section		mm^2	2.5
Cable jacket material[2)]			PUR
Cable jacket color			RAL2003
Specific cable weight	m	kg/m	0.234
Temperature range for storage		°C	tbd
Ambient temperature at operation (permanent installation)		°C	-40 … +80
Ambient temperature at operation (flexible installation)		°C	tbd
Operating temperature at conductor (flexible/permanent)		°C	tbd
Leakage capacitance	$C_{Y\_K\_typ}$		
Conductor resistance at 20°C (EN 60228; class 6)	R_{20}	ohm/km	8 (2.5 mm²)
Operational voltage at power cores		V	850
Operational voltage at control cores		V	100
Halogens			Halogen-free acc. to VDE 0472, Part 815
Oil resistance			tbd
Flammability			IEC 60332-1-2
Flexible cable tracks			
Suitable for application in flexible cable tracks			Yes
Bending cycles			5
Bending radius with flexible installation		mm	8 x D
Bending radius with permanent installation		mm	4 x D
Max. acceleration[3)]	a_{max}	m/s²	50m/s² (5m)
Max. travel velocity[4)]	v	m/s	5
			Last modification: 2016-01-13

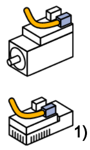
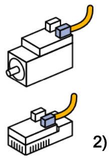
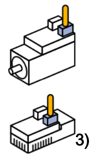
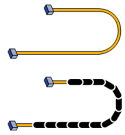
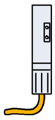
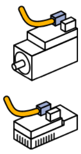
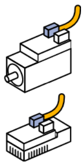
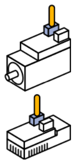
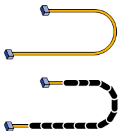
Description	Symbol	Unit	REH0803
Max. horizontal travel distance[5)]	s	m	50
Bending and torsional stress		°	not suitable
Last modification: 2016-01-13			

1) UL file number according to cable marking
2) According to EN 50363-10-2
3) 4) 5) Flexible cable track parameters: Maximum values only apply individually

Tab. 5-19: REH - Technical data

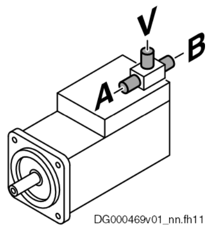
☞ The hybrid cable contains both power lines and control lines. Route hybrid cables in accordance with EN 61800-5-1 and EN 61800-5-2, protected against external damage. Select the types of protective measures according to the respective application.

5.8.3 Selecting hybrid cable incl. communication for appropriate connection

Hybrid cable RKH (with different outgoing directions from connection point X103.1 and X103.2 at KSM and KMS)		 1) X103.1	 2) X103.1	 3) X103.1	 RKH0700
	KCU02	RKH0311	RKH0411	RKH0511	RKH0511
 1)	X103.2	RKH0011	RKH0111	RKH0213	RKH0213
 2)	X103.2	RKH0110	RKH0210	RKH0215	RKH0215
 3)	X103.2	RKH0212	RKH0214	RKH0610	RKH0610
	RKH0700	RKH0212	RKH0214	RKH0610	- 4)

1) Outgoing direction "A"
2) Outgoing direction "B"
3) Outgoing direction "V"
4) If you wish to connect two cables RKH0700 to each other, use a short cable RKH0610 as intermediate piece.

Tab. 5-20: Hybrid Cables RKH



Hybrid cable outgoing direction:

- A: horizontal (towards the housing)
- B: horizontal (away from the housing)
- V: vertical

Tab. 5-21: Hybrid Cable Outgoing Directions

Selection of Hybrid Cables

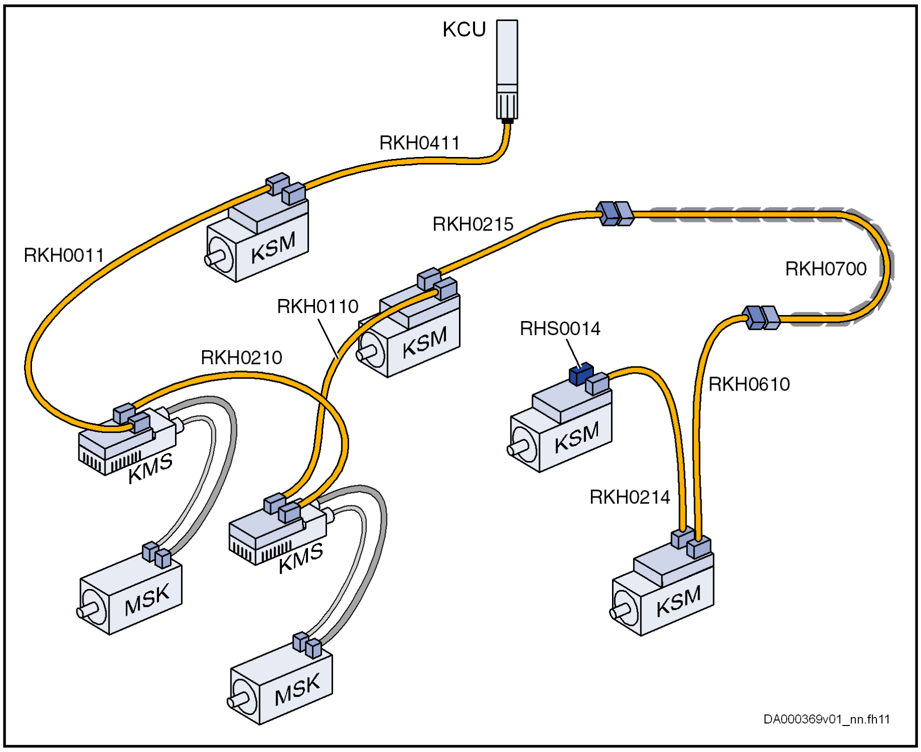


Fig. 5-26: Example of Drive System With Hybrid Cable

Each drive line must be terminated with the terminal connector RHS0014.

All hybrid cables are suited for use in flexible cable tracks. In the example, the cable RKH0700 is used in a flexible cable track. To quickly replace the flexible cable track cable for servicing, the cable in the example used in the flexible cable track has been equipped with connectors at the inputs.

Observe the maximum allowed length of the hybrid cable in the flexible cable track (see chapter "Length of hybrid cable incl. communication " on page 205).

Identifying the Hybrid Cables

Hybrid cables are labeled according to the following example:

RKH0111/030,5

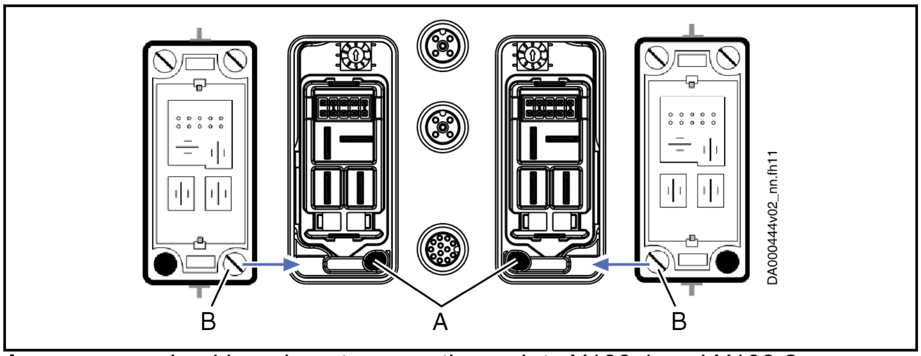
The cable designation is made up of:

Cable number ⇒ e.g. **RKH0111**

and

Cable length ⇒ e.g. **30.5 m**

Locking pins at connectors and connection points



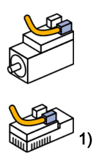
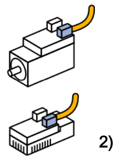
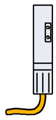
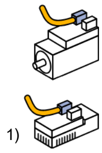
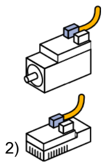
A Locking pins at connection points X103.1 and X103.2
B Locking pin at connector of hybrid cable

Fig. 5-27: Locking pins

Locking pins at connectors and connection points ensure that hybrid cables run in the right direction. It is not allowed to subsequently invert the direction of a hybrid cable by removing the locking pins. Otherwise, the signals for E-Stop and safety technology would not be valid.

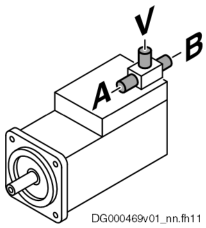
When mounting hybrid cables in cable ducts or flexible cable tracks, make sure that the direction of the hybrid cables is correct.

5.8.4 Selecting hybrid cable without communication for appropriate connection

RKH hybrid cable without communication (with different outgoing directions from connection point X103.1 or X103.2 at KSM and KMS)		 X103.1	 X103.1
	KCU02	RKH0321	RKH0421
	X103.2	RKH0021	RKH0121
	X103.2	RKH0120	RKH0220

1) Outgoing direction "A"
2) Outgoing direction "B"

Tab. 5-22: RKH hybrid cable without communication

	*Hybrid cable outgoing direction:* • A: horizontal (towards the housing) • B: horizontal (away from the housing) • V: vertical

Tab. 5-23: Hybrid Cable Outgoing Directions

Identifying the hybrid cables

Hybrid cables are marked according to the following example:

RKH0121/030,5

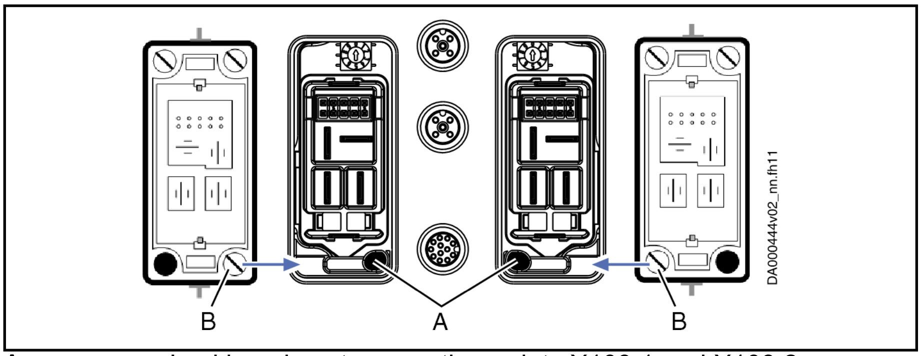
The cable designation is made up of:

Cable number ⇒ e.g., **RKH0121**

and

Cable length ⇒ e.g., **30.5 m**

Locking pins at connectors and connection points



A Locking pins at connection points X103.1 and X103.2

B Locking pin at connector of hybrid cable

Fig. 5-28: Locking pins

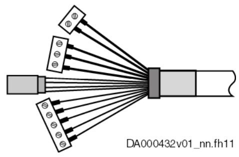
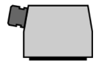
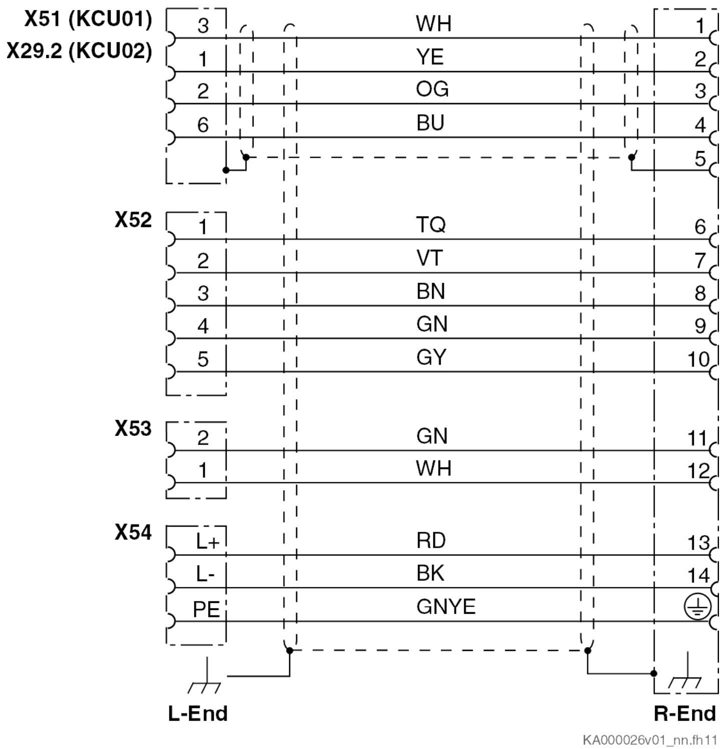
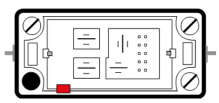
Locking pins at connectors and connection points ensure that hybrid cables run in the right direction. It is not allowed to subsequently invert the direction of a hybrid cable by removing the locking pins. Otherwise, the signals for E-Stop and safety technology would not be valid.

When mounting hybrid cables in cable ducts or flexible cable tracks, make sure that the direction of the hybrid cables is correct.

5.8.5 Interconnection diagrams for ready-made hybrid cables incl. communication

KCU - KSM/KMS

Applies to: RKH0311, RKH0411, RKH0511

KCU plug-in connector	Bulk cable	KSM/KMS plug-in connector
RHS0005/C03 	REH0800	RHS0011/C03 [1)]  RHS0016/C03 [2)] 
Interconnection diagram		
		
Coding at KSM/KMS plug-in connector [3)]		
Cable type	L-End	R-End
RKH0311 RKH0411 RKH0511	RHS0005	 ● Locking pin ▬ Coding profile [4)]

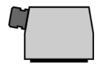
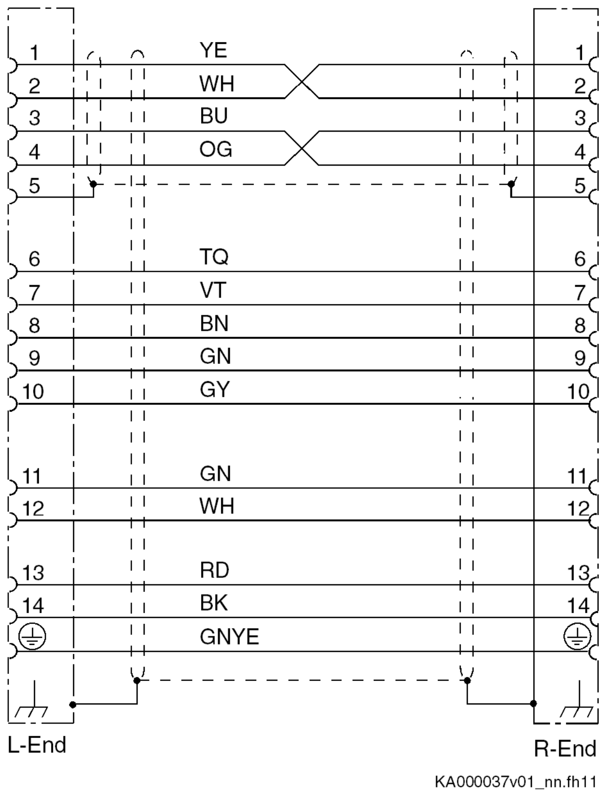
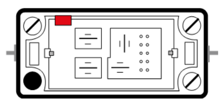
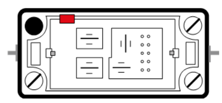
1) Plug-in connector R-End for RKH0310, RKH0401
2) Plug-in connector R-End for RKH0501
3) Picture shows coding with view to mating side

4) The coding profile ensures the downward compatibility of the hybrid cable for KSM01/KMS01

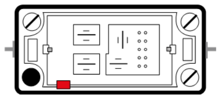
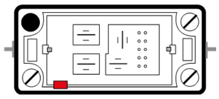
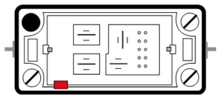
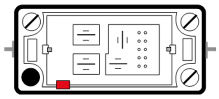
Tab. 5-24: Parts of ready-made hybrid cables from KCU to KSM/KMS

KSM/KMS - KSM/KMS

Applies to: RKH0011, RKH0012, RKH0110, RKH0210, RKH0111, RKH0211, RKH0212, RKH0213, RKH0214, RKH0215, RKH0610, RKH0611

KSM/KMS plug-in connector	Bulk cable	KSM/KMS plug-in connector
RHS0011/C03  RHS0016/C03 	REH0800	RHS0011/C03  RHS0016/C03 
Interconnection diagram		
		
Coding at KSM/KMS plug-in connector 1)		
Cable type	L-End (X103.1)	R-End (X103.2)
RKH0011 RKH0110 RKH0210 RKH0212 RKH0214 RKH0610		

Technical data of the components

RKH0012 RKH0211 RKH0611		
RKH0111 RKH0213 RKH0215		
	● Locking pin Coding profile [2)]	

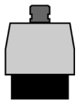
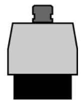
1) Picture shows coding with view to mating side

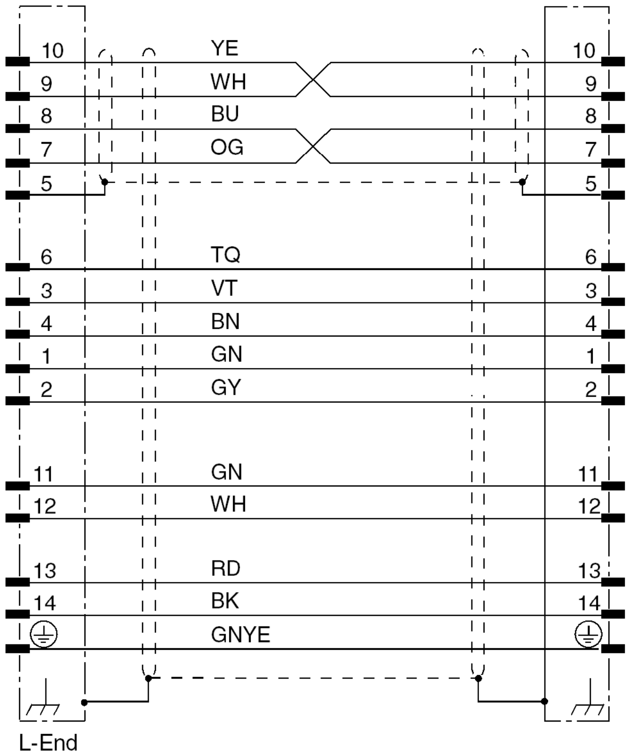
2) The coding profile ensures the downward compatibility of the hybrid cable for KSM01/KMS01

Tab. 5-25: Parts of ready-made hybrid cables from KSM/KMS to KSM/KMS

Flexible cable tracks

Applies to: RKH0700

KSM/KMS plug-in connector	Bulk cable	KSM/KMS plug-in connector
RHS0007/C03 	REH0800	RHS0007/C03 
Interconnection diagram		



KA000066v01_nn.fh11

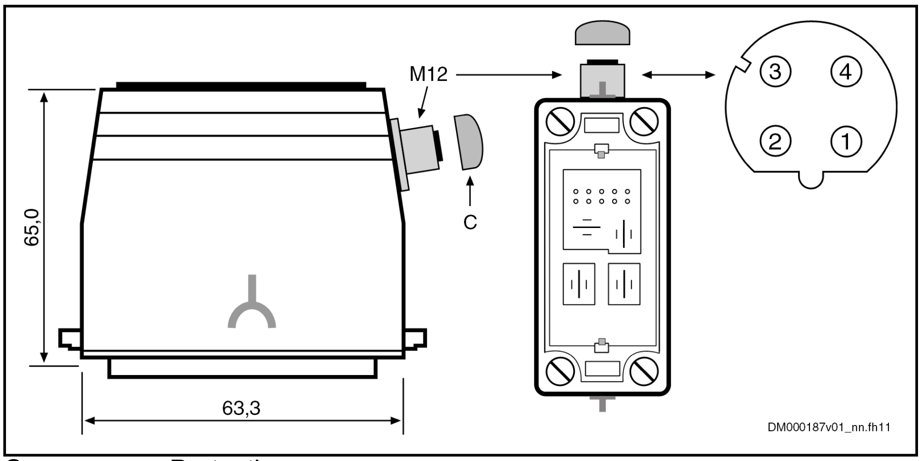
Coding at KSM/KMS plug-in connector		
Cable type	L-End	R-End
RKH0700	Not coded	Not coded

Tab. 5-26: Parts of ready-made hybrid cable for flexible cable tracks

RHS0014 terminal connector

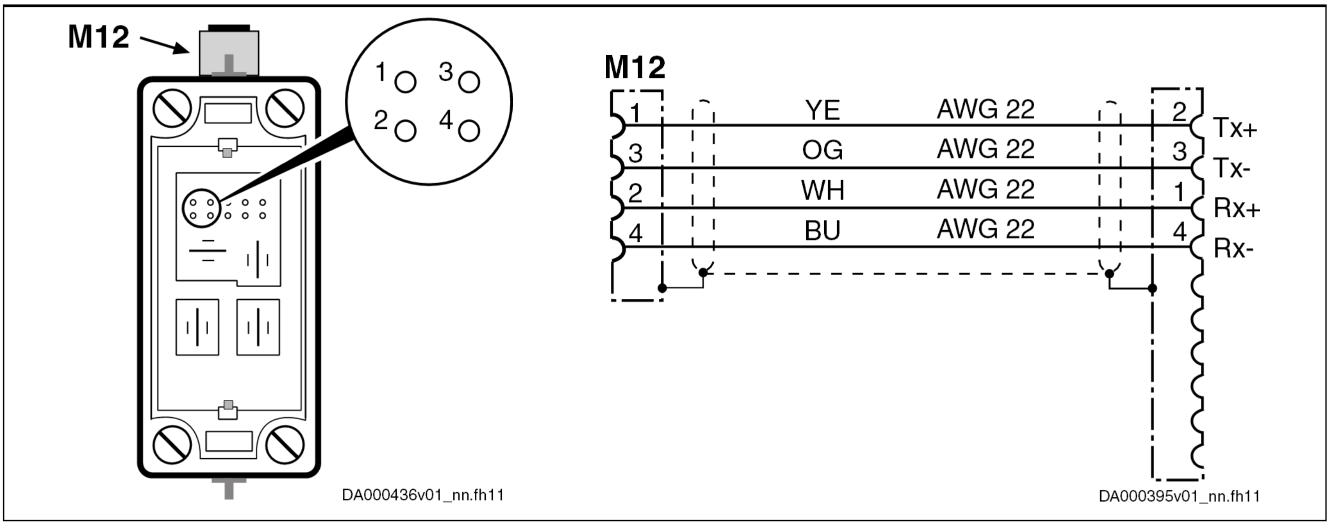
Terminal Connector RHS0014

Each line of drives must be terminated at the last connection point X103.2, using terminal connector RHS0014 (parts number: R911335793). The terminal connector is not coded.



C	Protective cap
M12	4-pin socket, D-coded; the pins are internally connected to the contacts for Multi-Ethernet communication (Tx+, Tx-, Rx+, Rx-); the connection point can be used for the drive system Engineering

Fig. 5-29: Terminal Connector RHS0014



Tab. 5-27: Internal M12 Socket Wiring

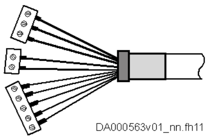
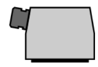
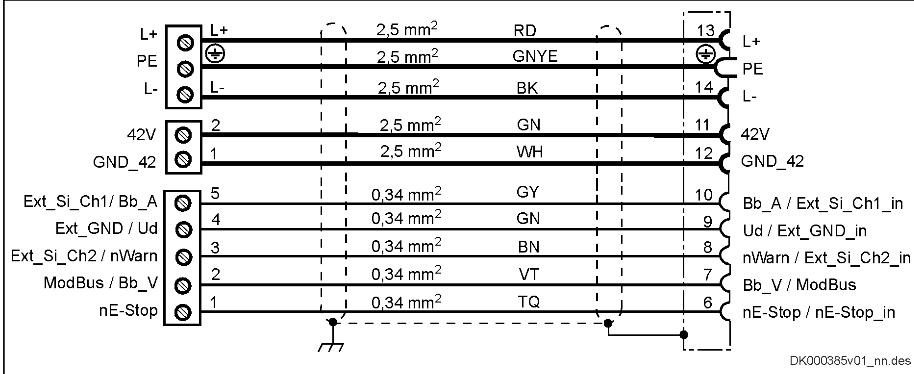
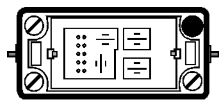
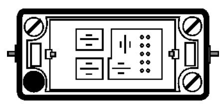
☞ If it is difficult to access the M12 socket in your drive system:

Connect a cable (e.g. RKB0043) to the M12 socket and position the end of the cable at an easily accessible point.

5.8.6 Interconnection diagrams for ready-made hybrid cables without communication

KCU - KSM/KMS

Applies to: RKH0321, RKH0421

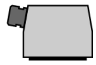
KCU plug-in connector	Bulk cable	KSM/KMS plug-in connector
RHS0005/C03 	REH0803	RHS0011/C03 
Interconnection diagram		
		
KSM/KMS plug-in connector[1)]		
Cable type	L-End	R-End
RKH0321	RHS0005	 X103.1
RKH0421	RHS0005	 X103.1

1) View to mating side

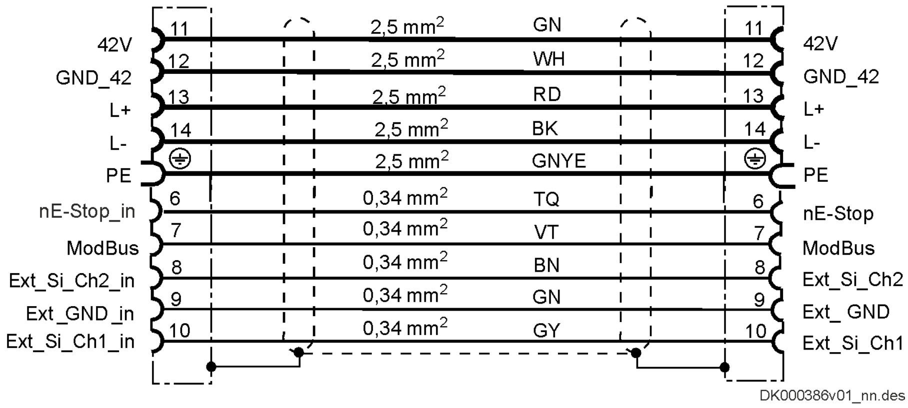
Tab. 5-28: Parts of ready-made hybrid cables without communication from KCU to KSM02/KMS

KSM/KMS - KSM/KMS

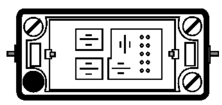
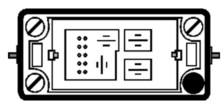
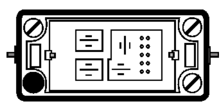
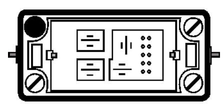
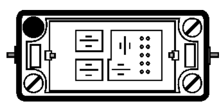
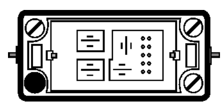
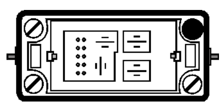
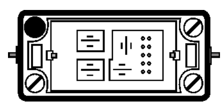
Applies to: RKH0021, RKH0120, RKH0121, RKH0220

KSM/KMS plug-in connector	Bulk cable	KSM/KMS plug-in connector
RHS0011/C03 	REH0803	RHS0011/C03 

Interconnection diagram



KSM/KMS plug-in connector[1)]

Cable type	L-End	R-End
RKH0021	 X103.1	 X103.2
RKH0120	 X103.1	 X103.2
RKH0121	 X103.2	 X103.1
RKH0220	 X103.1	 X103.2

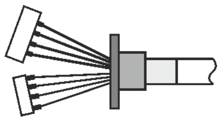
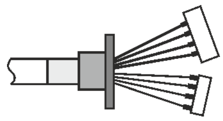
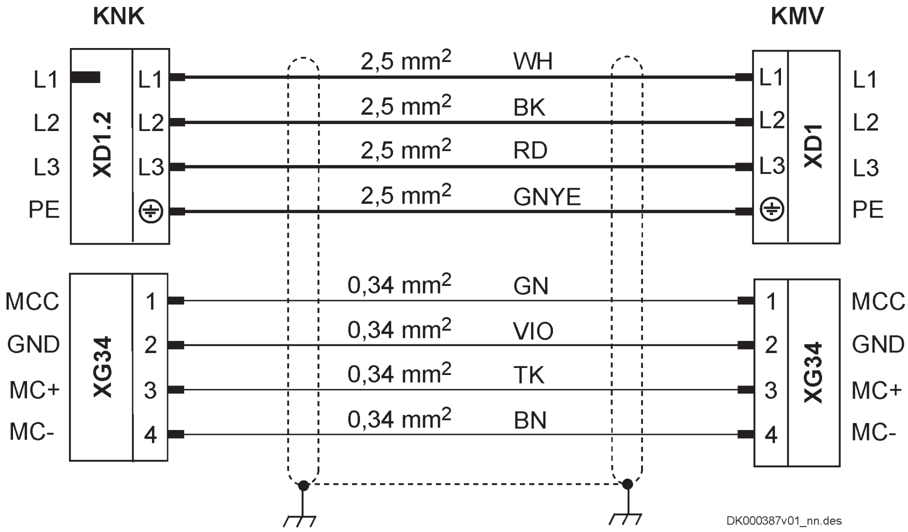
1) View to mating side

Tab. 5-29: Parts of ready-made hybrid cables without communication from KSM/KMS to KSM/KMS

5.8.7 Interconnection diagrams for ready-made hybrid cables used for mains connection

KNK03 - KMV03 (RKH0800)

Applies to: RKH0800

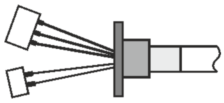
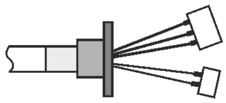
<table>
<tr><th>KNK03 plug-in connector</th><th>Bulk cable</th><th>KMV03 plug-in connector</th></tr>
<tr><td>RHS0017/K03
</td><td>REH0803</td><td>RHS0018/K03
</td></tr>
<tr><td colspan="3">Interconnection diagram</td></tr>
<tr><td colspan="3">
</td></tr>
<tr><td colspan="3">KNK03/KMV03 plug-in connector</td></tr>
<tr><td>Cable type</td><td>L-End</td><td>R-End</td></tr>
<tr><td>RKH0800</td><td>XD1 connector
XG34 connector</td><td>XD1 connector
XG34 connector</td></tr>
</table>

Tab. 5-30: Parts of ready-made hybrid cables used for mains connection

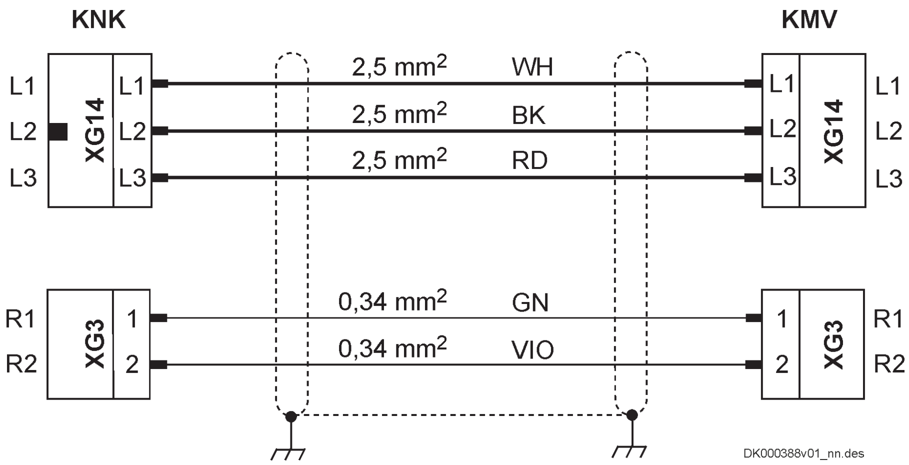
Technical data of the components

KNK03 - KMV03 (RKH0801)

Applies to: RKH0801

KNK03 plug-in connector	Bulk cable	KMV03 plug-in connector
RHS0019/K03 	REH0803	RHS0020/K03 

Interconnection diagram



KNK03/KMV03 plug-in connector		
Cable type	L-End	R-End
RKH0801	XG14 connector XG3 connector	XG14 connector XG3 connector

Tab. 5-31: Parts of ready-made hybrid cables used for mains connection

6 Connection points

6.1 System connection points

6.1.1 Connection point of equipment grounding conductor

Cabinet-bound drive systems

⚠ WARNING **Dangerous contact voltage at device housing! Lethal electric shock!**

The devices of the Rexroth IndraDrive Mi product range are devices with increased leakage current (greater than AC 3.5 mA or DC 10 mA).

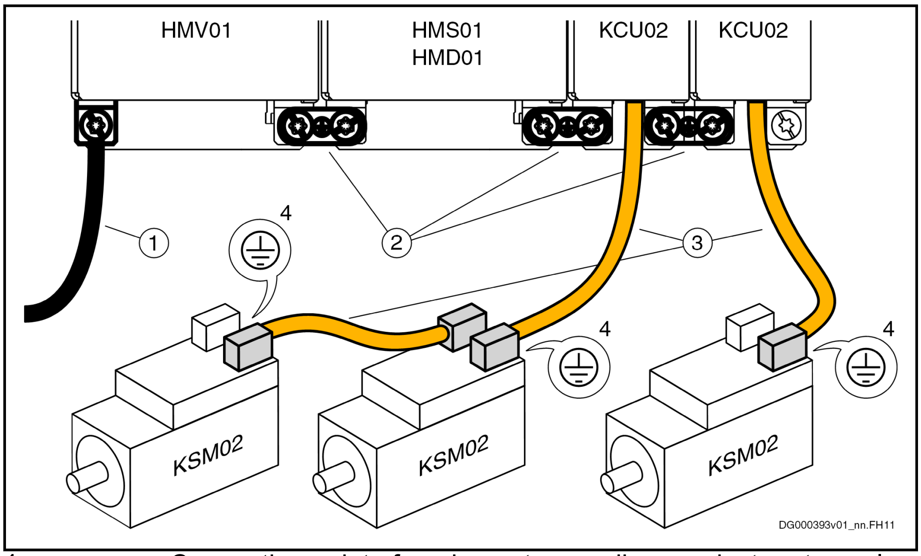
Therefore, always install a stationary connection of the equipment grounding conductor.

In a Rexroth IndraDrive Mi drive system, connect the equipment grounding conductor connections of all devices and additional components to the equipment grounding system.

NOTICE **Risk of damage to the devices by spark discharge of static charges**

In some applications (e.g., printing or packaging), high static charges can develop. Make sure that these charges can be directly discharged against ground at their point of origin. Therefore, connect the second connection point of equipment grounding conductor of the devices to the equipment grounding system of the installation.

Connection points



1	Connection point of equipment grounding conductor at supply unit with connection to equipment grounding system
2	Joint bars connect equipment grounding conductors of neighboring devices
3	Hybrid cables connect equipment grounding conductors of KSM/KMS with one another and with equipment grounding conductor of KCU
4	Second connection point of equipment grounding conductor at KSM/KMS

Fig. 6-1: Equipment grounding conductor connection point

☞ The connection point of the equipment grounding conductor shown above also applies to KMS near motor servo drives.

Cabinet free drive systems

⚠ WARNING **Dangerous contact voltage at device housing! Lethal electric shock!**

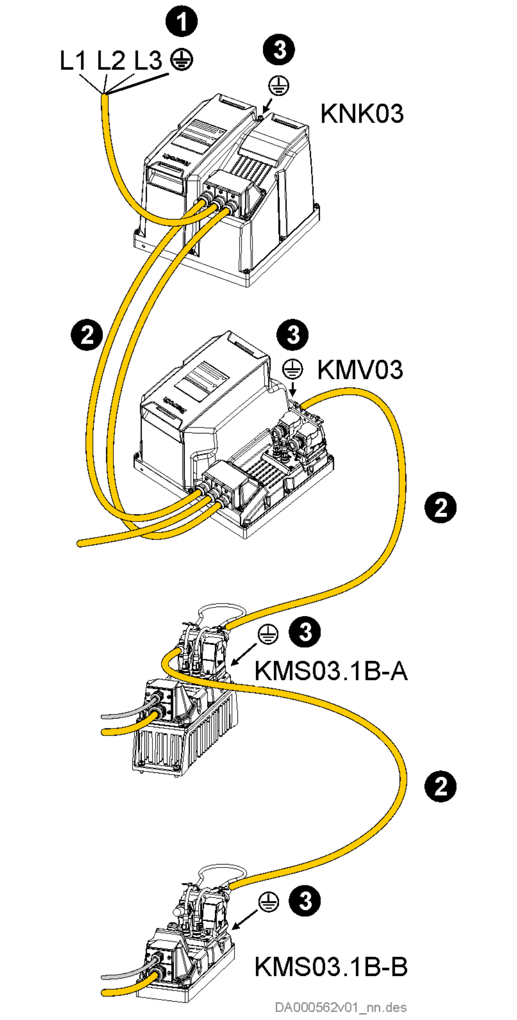
The devices of the Rexroth IndraDrive Mi product range are devices with increased leakage current (greater than AC 3.5 mA or DC 10 mA).

Therefore, always install a stationary connection of the equipment grounding conductor.

In a Rexroth IndraDrive Mi drive system, connect the equipment grounding conductor connections of all devices and additional components to the equipment grounding system.

NOTICE **Risk of damage to the devices by spark discharge of static charges**

In some applications (e.g., printing or packaging), high static charges can develop. Make sure that these charges can be directly discharged against ground at their point of origin. Therefore, connect the second connection point of equipment grounding conductor of the devices to the equipment grounding system of the installation.



1. Connection point of equipment grounding conductor at KNK03 mains filter with connection to equipment grounding system
2. Hybrid cables connect equipment grounding conductors of the devices
3. Second connection point of equipment grounding conductor

Tab. 6-1: Equipment grounding conductor connection point

6.1.2 Ground connection

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

Ground the housings of the devices:

1. Connect the bare metal back panel of the devices 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.

2 drive lines

If you connect 2 drive lines from terminal connector to terminal connector, provide equipotential bonding (ground connection) between the drive lines.

6.2 KCU02 connection points

6.2.1 Position of connection points

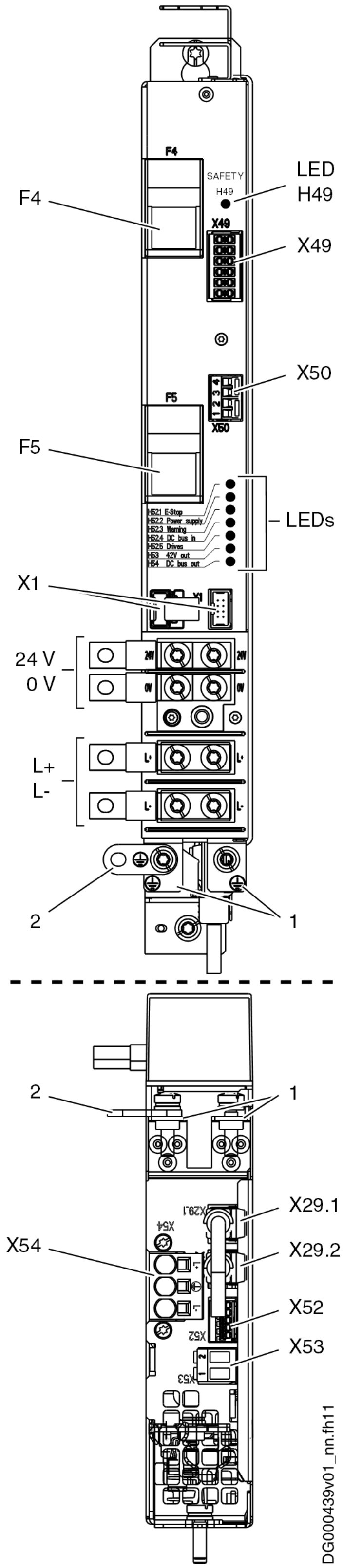


Figure	Element	Significance	Notes
	1	Equipment grounding conductor	For connection to the equipment grounding system
	2	Joint bar equipment grounding conductor	For connection to neighboring device (part of basic accessory HAS01)
	F4	Fuse output X54 (L+)	30 A
	F5	Fuse output X54 (L-)	30 A
	LEDs	H49: Safety	Diagnostic Displays
		H52.1: E-Stop	
		H52.2: Power Supply	
		H52.3: Warning	
		H52.4: DC Bus In	
		H52.5: Drives	
		H53: 42 V Out	
		H54: DC Bus Out	
	24 V, 0 V	Control voltage	For connection to supply unit via contact bars (part of basic accessory HAS01)
	L+, L-	DC bus	For connection to supply unit via contact bars (part of basic accessory HAS01)
	X1	Module bus	Keep ribbon cable in parking position, when there is no connection to neighboring device.
	X29.1 X29.2	Multi-Ethernet	Signals are looped through
	X49	Safety technology	L3 (Safe Torque Off)
	X50	E-Stop	E-Stop input
	X52	Status messages	For exchanging status messages
	X53	42 V, 0 V	42 V output; control voltage supply
	X54	DC bus, equipment grounding conductor	DC bus output; power supply

Tab. 6-2: Connection Points KCU02

☞ At a KCU02, exclusively operate KSM02 motor-integrated servo drives or KMS02/KMS03 near motor servo drives.

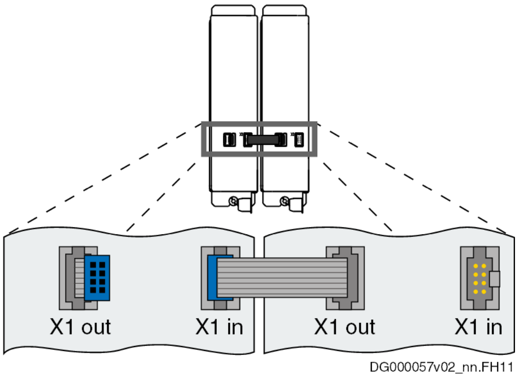
For the correct and safe function of the drive, **all** connection points must be connected.

At X29.1 or X29.2, X52, X53 and X54, use the hybrid cable RKH by Rexroth.

6.2.2 X1, Module Bus

Function, Pin Assignment

The module bus is an **internal system connection** and is used to exchange data between the devices.

View	Identification	Function
	X1 in	Receives the module bus connector
	X1 out	Passes the module bus connection to the neighboring device

Tab. 6-3: X1, Module Bus

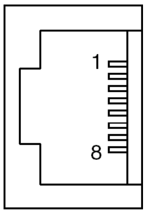
installation Instructions

- Keep the ribbon cable in the **parking position**, if the connection to the neighboring device is not established.
- If used for the module bus, **extension cables** must be **shielded.** Their total length may not exceed a **maximum of 40 m.** The module bus connection can be extended by means of accessory **RKB0001**.
- When using **DC bus capacitor units**:

  Do not establish this connection at the DC bus capacitor unit, if the DC bus capacitor unit is the last device in the drive system.

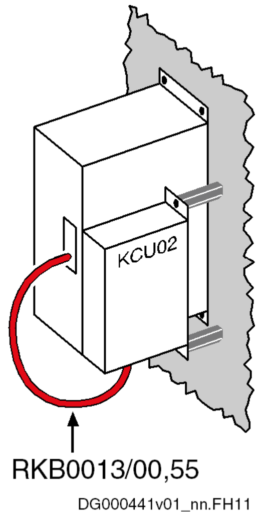
6.2.3 X29.1, X29.2, Multi-Ethernet

The signals at X29.1 are directly looped through to X29.2.

View	Connection	Signal name	Function
 DA000041v01_nn.FH	1	TD+	Transmit, differential output A
	2	TD-	Transmit, differential output B
	3	RD+	Receive, differential input A
	4	n. c.	-
	5	n. c.	-
	6	RD-	Receive, differential input B
	7	n. c.	-
	8	n. c.	-
	Housing		Shield connection
Properties			
Standard	• Ethernet • Type: RJ-45, 8-pin		
Compatibility	100Base-TX according to IEEE 802.3u		
Recommended cable type	• According to **CAT5e**; type of shield ITP (Industrial Twisted Pair) • Ready-made cables which can be ordered: – RKB0011 Long cables (100 m at maximum) to connect the drive system to the higher-level control unit or remote communication nodes. Minimum bending radius: – 48.75 mm if laid flexibly – 32.50 mm if laid permanently Order code for a 30 m long cable: RKB0011/030,0 – RKB0013 Short cables to connect devices arranged side by side in the control cabinet. 4 lengths available: 0.19 m; 0.25 m; 0.35 m; 0.55 m Order code for a 0.55 m long cable: RKB0013/00,55 Minimum bending radius: 30.75 mm		

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

RKB0013, KCU02 ↔ Drive Controller

The cable RKB0013/00,55 (length: 0.55 m) connects a KCU02 to a neighboring drive controller.	

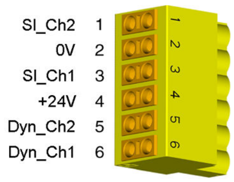
Tab. 6-5: RKB0013/00,55

netSWITCH sercos III

With sercos III and for the Engineering of the drive system, you can connect our "netSWITCH sercos III" accessory into the sercos III ring.

6.2.4 X49, L3 - Safe Torque Off

Data

View	Identification	Function	
	X49	Safe Torque Off	
Spring terminal (connector)	**Unit**	**Min.**	**Max.**
Connection cable Stranded wire	mm^2	1	1,5
	AWG	16	16
Stripped length	mm	8	
Output current per output	mA	-	350
Input current 24V supply	mA	-	700
Voltage load	V	-	60
Polarity reversal protection for power supply	-	Available	

Tab. 6-6: Data

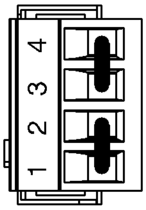
Pin Assignment, Function

Function	Signal	Connection	Technical data
Selection channel 1	SI_Ch1	3	chapter 14.1.2 "Digital inputs (safety technology L options)" on page 323
Selection channel 2	SI_Ch2	1	
Dynamization output channel 1	Dyn_Ch1	6	chapter 14.2.1 "Digital Outputs (Safety Technology L Options)" on page 325
Dynamization output channel 2	Dyn_Ch2	5	
Power supply of **isolated** inputs and outputs	+24V	4	DC 19.2 … 30 V
	0V	2	The power supply for X49 must be external (e.g. external 24 V power supply). The connection point X50 (E-Stop input) must not be used for power supply of X49!

Tab. 6-7: Pin Assignment, Function

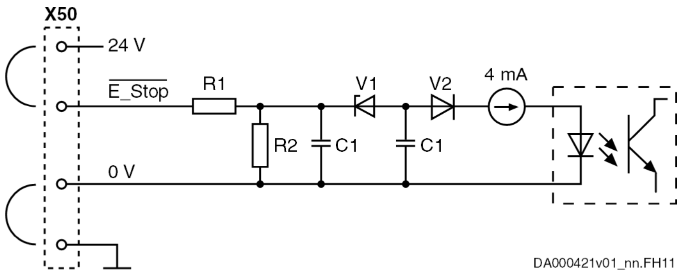
☞ When the dynamization outputs do not work, check the power supply connection. The polarity might possibly have been reversed.

6.2.5 X50, E-Stop Input

View	Connection	Signal name	Function
 DG000189v01_nn.fh11 Condition as supplied: With jumpers at 1-2 and 3-4	4	24V	24V output for E-Stop input [1]
	3	$\overline{\text{E-Stop}}$	Digital input for E-Stop (isolated; active with input voltage "L")
	2	0V	
	1	0V	0V output for E-Stop input [2]

The input complies with EN61131-2, type 1.

Input circuit (R1 = approx. 1k; R2 = approx. 7k4; C1 = approx. 10 nF; V1 = approx. 6 V; V2 = approx. 0.7 V):



DA000421v01_nn.FH11

Spring terminal (connector)	Unit	Min.	Max.
Connection cable stranded wire	mm^2	0,5	1,5
Connection cable	AWG	20	16
Allowed input voltage	V	-3	30
Input voltage "H"	V	15	30
Input current "H"	mA	2	15
Input voltage "L"	V	0	5
Input current "L"	mA	0	> 0,5
Input resistance	kΩ	2,5	

1) Exclusively use the 24 V output for the E-Stop input in conjunction with the jumper from X50.3 to X50.4. Maximum power rating: 15 mA.

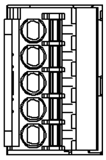
2) Exclusively use the 0 V output for the E-Stop input in conjunction with the jumper from X50.1 to X50.2. Maximum rating: 15 mA.

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

See also description of the **E-Stop function**: chapter "E-Stop function" on page 217

6.2.6 X52, Status Messages

Connection to the overall system takes place via the drive connection box KCU02.

View	Connection	Signal name	Function
1 2 3 4 5  DA000036_nn.FH11	1 (TQ*)	$\overline{\text{E-Stop}}$	Internal signals between KCU02 and KSM02/ KMS02
	2 (VT*)	$\overline{\text{Module bus}}$	
	3 (BN*)	SI_Ch2	Internal connection X49.1 ↔ X52.3
	4 (GN*)	0V_SI	Internal connection X49.2 ↔ X52.4
	5 (GY*)	SI_Ch1	Internal connection X49.3 ↔ X52.5

Spring terminal (connector at hybrid cable)	Unit	Min.	Max.
Connection cable stranded wire	mm^2	n.s.	
Connection cable	AWG		
Voltage range	V	0	24 +10%
Voltage level "H"	V	15	n.s.
Voltage level "L"	V	n.s.	5
Output current	mA	n.s.	500

* Conductor color of the ready-made cable RKH

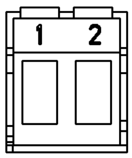
Tab. 6-9: Function, Pin Assignment, Properties

6.2.7 X53, Control Voltage Output

⚠ WARNING **High electrical voltage! Danger to life by electric shock!**

Do not remove connectors when the component has been powered. Do not plug in connectors when the component has been powered.

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

View	Connection	Signal name	Function
 DA000178v01_nn.FH11	1 (WH*)	GND	• Output of DC-DC converter (24V – 42V) in KCU02 (GND is not connected to 0V of the 24V supply) • Supplies KSM02/KMS02 with control voltage
	2 (GN*)	42 V	

Screw terminal (connector at hybrid cable)	Unit	Min.	Max.
Tightening torque	Nm	1,5	1,7
Connection cable stranded wire	mm^2	Connection via hybrid cable RKH	
Connection cable	AWG		
Output data		U_{out}, P_{out} (see technical data of KCU02)	
Short circuit protection		–	Present
Overload protection		–	Present

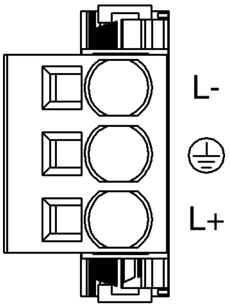
* Conductor color of the ready-made cable RKH

Tab. 6-10: Function, Pin Assignment, Properties

Control Voltage Monitoring The control voltage is constantly monitored. If the allowed voltage range is left, the control voltage for the connected KSM02/KMS02 devices is switched off and LED H53 emits red light. Thereafter, the motors are coasting down because a return movement is no longer possible.

Notes on Operation Do not remove connectors when the component has been powered. Do not plug in connectors when the component has been powered.

6.2.8 X54, DC Bus, Equipment Grounding Conductor Output KSM02/ KMS02

View	Connection	Function
 DG000185v01_nn.FH11	L- (BK*)	DC bus; negative pole
	⏚ (GNYE*)	Equipment grounding conductor
	L+ (RD*)	DC bus; positive pole
Spring terminal (connector at hybrid cable)	**Unit**	
Connection cable stranded wire		Connection via hybrid cable RKH
Connection cable		
Short circuit protection L+, L-		Fuses F4, F5
Voltage L+, L-	V	U_{out} (see technical data of KCU02)

* Conductor color of the ready-made cable RKH

Tab. 6-11: Function, Pin Assignment, Properties

6.2.9 DC Bus Connection L+, L-

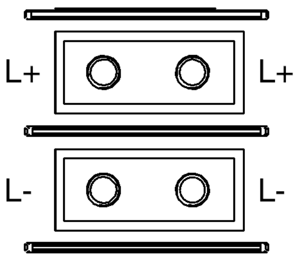
⚠ WARNING **Lethal electric shock by live parts with more than 50 V!**

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

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

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

Technical Data of the Connection Point

View	Identifica-tion	Function	
 DA000176v01_nn.FH11	L+	Connection points for connecting DC bus connections	
	L-		
Screw connection M6 thread at device (terminal block)	**Unit**	**Min.**	**Max.**
Tightening torque	Nm	5,5	6,5
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- (contact bars in scope of supply of accessory HAS01)			
With contact bars -072	A		220
Additionally with contact bars -042 and end piece	A		245

Tab. 6-12: Function, Pin Assignment, Properties

Connection points

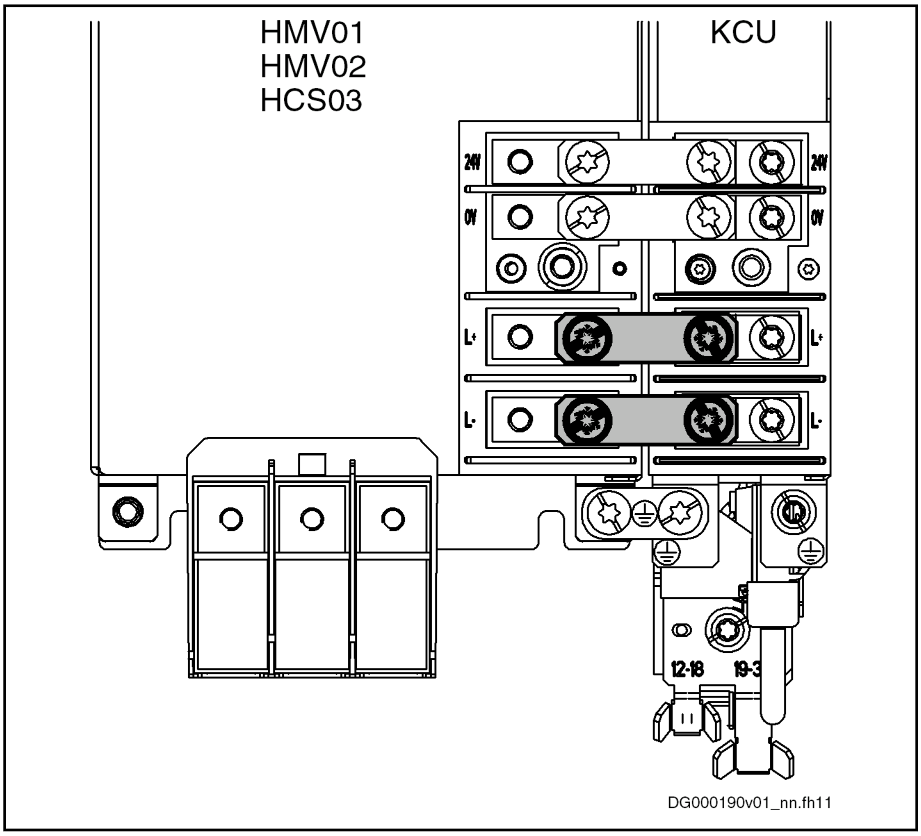


Fig. 6-2: Connection of Contact Bars

Notes on Installation

If in special cases it is not possible to use the contact bars provided to establish the connection, the connection must be established using the shortest possible **twisted** wires.

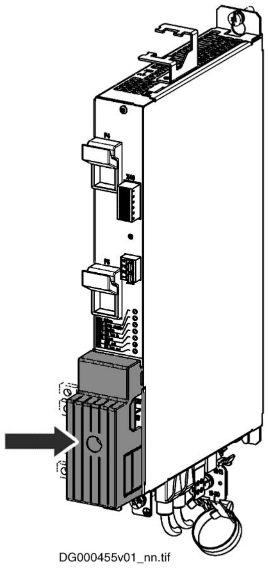
NOTICE **Risk of damage by voltage arcing!**

Insulate ring terminals and lines with a heat-shrinkable sleeve. Afterwards, only strip the insulation of the contact surface of the ring terminal.

When connecting the lines, make sure the polarity is correct.

Length of twisted wire	Max. 2 m
Line cross section	Min. 10 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)

Tab. 6-13: DC Bus Line

 DG000455v01_nn.tif	**WARNING!** Lethal electric shock by live parts with more than 50 V! The appropriate touch guard must be mounted for each device following connection work. Never operate the device without the touch guard mounted.

Tab. 6-14: Touch Guard

Adjusting Mounting Depths

HMV01 and HCS03 devices have greater mounting depths than the drive connection box KCU. For connecting the drive connection box KCU to an HMV01 or HCS03 device, you must therefore use the control cabinet adapter HAS03.1-002 which compensates the different mounting depths.

6.2.10 Control Voltage Supply +24V, 0V

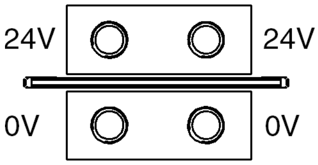
☞ **PELV[1] for 24V power supply unit**

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

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

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

Technical Data of the Connection Point

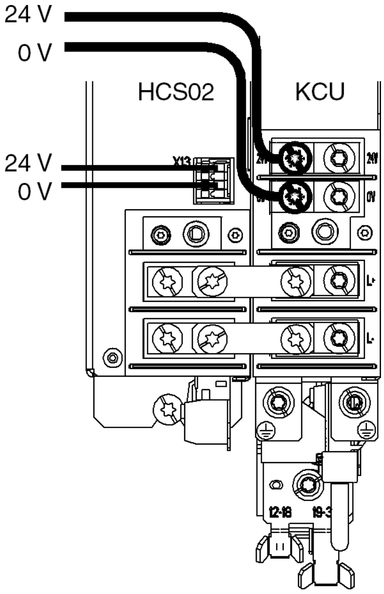
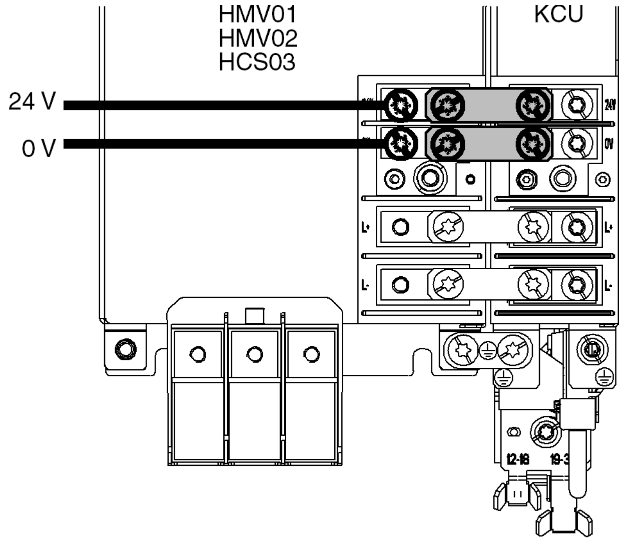
View	Identifica-tion	Function	
 DA000175v01_nn.FH11	+24V	Power supply Connection to neighboring devices with contact bars from accessory HAS01.1	
	0V	Reference potential for power supply Connection to neighboring devices with contact bars from accessory HAS01.1	
Screw connection M6 thread at device (terminal block)	Unit	Min.	Max.
Tightening torque	Nm	5,5	6,5
Power consumption	W	P_{N3} (see technical data)	
Voltage load capacity	V	U_{N3} (see technical data)	
Polarity reversal protection		Within the allowed voltage range by internal protective diode	
Current carrying capacity "looping through" from 24V to 24V, 0V to 0V (contact bars in scope of supply of accessory HAS01)			
With contact bars -072	A	220	

Tab. 6-15: Function, Pin Assignment, Properties

Control Voltage Monitoring

The control voltage is constantly monitored. If the allowed voltage range is left, the control voltage for the connected KSM02/KMS02 devices is switched off and LED H53 emits red light. Thereafter, the motors are coasting down because a return movement is no longer possible.

1) *Protective Extra Low Voltage*

HCS02	HCS03, HMV01, HMV02
 DG000221v01_nn.FH11 For HCS02 devices, the 24V supply is connected to the drive connection box KCU with **cables** (cross section: min. 6 mm² (AWG 10)).	 DG000222v01_nn.fh11 For HCS03, HMV01 and HMV02 devices, the 24V supply is connected to the drive connection box KCU with **contact bars**.

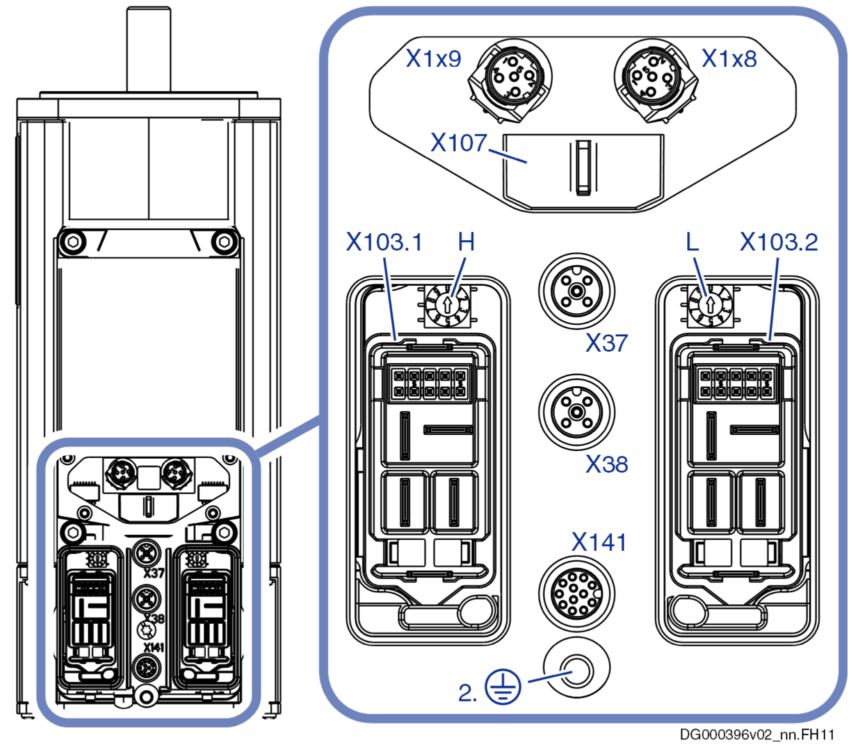
Tab. 6-16: Connecting the 24V supply

6.3 KSM02 connection points

6.3.1 Position of connection points

Use ready-made hybrid cables and terminal connectors by Rexroth for X103.1 and X103.2.

X107 (programming module) is only accessible after the cover has been removed.

Figure	Element	Significance
	H	Address selector switch (10×)
	L	Address selector switch (1×)
	X37 X38	Digital inputs/outputs
	X103.1 X103.2	Hybrid cable
	X107	Programming module
	X1x8 X1x9	Communication (optional) • X108, X109: Communication output coupling • X118, X119: External communication
	X141	Safety technology (optional)
	2nd ⏚	Second connection point of equipment grounding conductor

Tab. 6-17: KSM02 connection points

6.3.2 X37, X38, digital inputs/outputs

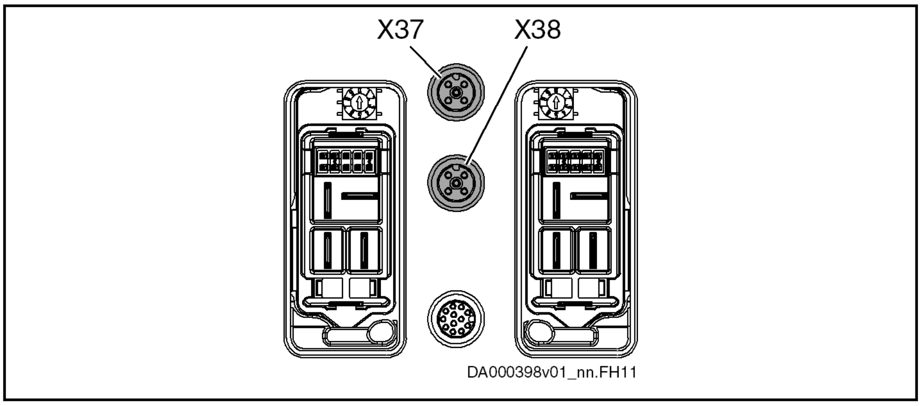
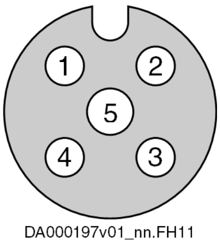
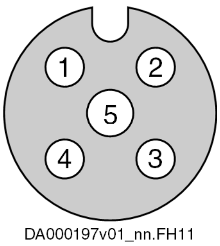


Fig. 6-3: X37 and X38

View	Connec-tion	Signal name	Function
	X37.1	U_{ext}	External supply 19 … 30 V, max. 1 A, connected to X38.1
	X37.2	I/O_3	dig. I/O, configurable
	X37.3	0 V_{ext}	Reference potential; external supply, connected to X38.3
	X37.4	I/O_1	dig. I/O, configurable, can be used as probe
	X37.5	PE	For cable shield
	X38.1	U_{ext}	External supply 19 … 30 V, max. 1 A, connected to X37.1
	X38.2	I/O_4	dig. I/O, configurable
	X38.3	0 V_{ext}	Reference potential; external supply, connected to X37.3
	X38.4	I/O_2	dig. I/O, configurable, can be used as probe
	X38.5	PE	For cable shield
M12 (5-pin, A-coded) female	Unit	min.	max.
Connection cable, stranded wire	mm^2	0.25	0.25
Cable cross section	AWG	-	-
Ready-made connection cable		RKS0010 (optional accessory)	

Tab. 6-18: Function, pin assignment, properties

The digital inputs/outputs comply with IEC 61131-2, type 1.

Properties

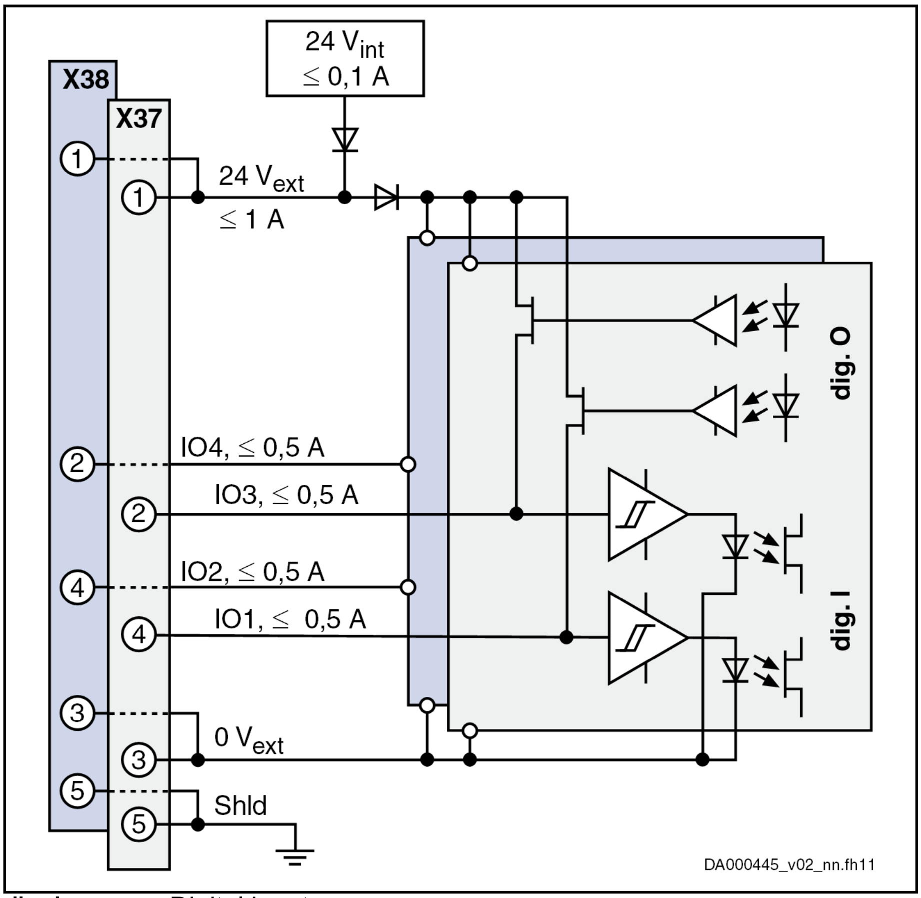
- There is a total of **4 configurable**, **isolated inputs/outputs** which are distributed over two 5-pin M12 connectors (X37 and X38).

  The configuration is carried out with the parameter "P-0-0300, Digital I/Os, assignment list".
- The inputs **I_1** (X37.4) and **I_2** (X38.4) can be used as **probe inputs.**

- The outputs and U_{ext} are internally supplied with **isolated 24 V** (±20%). This allows sensors to be directly (without any additional external 24 V supply) connected to KSM/KMS, if their total current consumption (X37 and X38) is smaller than 100 mA.

  If more current is required in total, 24 V has to be supplied externally in addition, via connections X38.1 or X37.1 (U_{ext}).
- Each of the **short-circuit proof** outputs can be loaded with 0.5 A. In total, a maximum of 1 A is possible.
- In the condition as supplied, there is an **O-ring** at the root of the thread between the female connector insert and the electronics housing which assures the tightness of the M12 female connectors. Neither the protective cap nor the connector is tight without this O-ring!

Internal design



dig. I Digital input
dig. O Digital output
24 V_{int} Voltage from internal power supply
24 V_{ext} Voltage from external power supply
Shld Shield

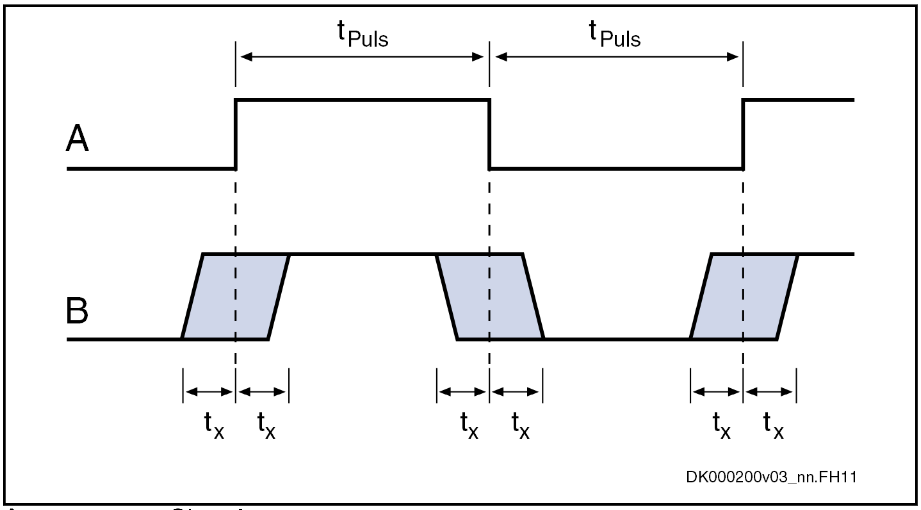
Fig. 6-4: Internal design of the digital inputs and digital outputs

Data: Inputs

Data	Unit	min.	typ.	max.
Allowed input voltage	V	-3		30
On	V	15		
Off	V			5
Input current	mA	2		15
Input resistance	kΩ	6.3		
Sampling frequency	kHz	Depending on firmware		
Delay time	µs	20		100 + 1 cycle time of position control
Pulse width t_{pulse} (probe)	µs	4		
Measuring accuracy t_x (probe)	µs			1

Tab. 6-19: Digital inputs

Probe input



A Signal
B Signal Detection at Probe Input
t_{Puls} Pulse width
t_x Measuring accuracy of the signal edges

Fig. 6-5: Signal Detection at Probe Input

☞ Probe inputs are inputs used to acquire fast digital input signals. For control use **bounce-free** switching elements (e.g., electronic switches) to avoid incorrect evaluation.

External power supply

At the pins 1 and 3 of the connectors X37 and X38, you can connect an external 24 V power supply to increase the maximum output current of the digital outputs. The external 24 V supply has to comply with a voltage tolerance of ±20%.

Data: Outputs

Data	Unit	min.	typ.	max.
Output voltage ON (**with** external supply)	V	U_{ext} - 0.5	24	U_{ext}
Output voltage ON (**without** external supply)	V	19.2	21	28.8
Output voltage OFF	V	n.s.	n.s.	2.1
Output current OFF	mA	n.s.	n.s.	0.05
Allowed output current per output (**with** external supply)	mA	n.s.	n.s.	500
Allowed output current total or per group (**with** external supply)	mA	n.s.	n.s.	1000
Allowed output current per output (**without** external supply)	mA	n.s.	n.s.	100
Allowed output current total or per group (**without** external supply)	mA	n.s.	n.s.	100
Update interval	ns	Depending on firmware		
Short circuit protection		Present		
Overload protection		Present		
Allowed energy content of connected inductive loads, e.g. relay coils; only allowed as single pulse	mJ	n.s.	n.s.	400

Tab. 6-20: Digital outputs

☞ The digital outputs have been realized with high-side switches. This means that these outputs only can actively supply current.

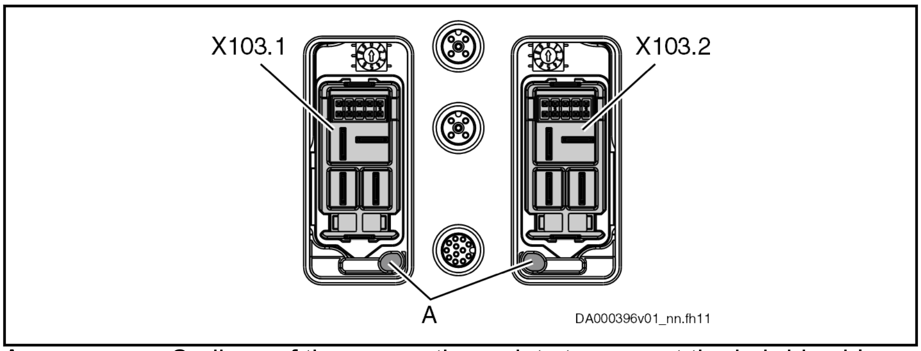
The energy absorption capacity of the outputs is used to limit voltage peaks caused when inductive loads are switched off. Limit voltage peaks by using free-wheeling diodes directly at the relay coil.

6.3.3 X103.1, X103.2, hybrid cable connection point

⚠ WARNING **High electrical voltage! Danger to life by electric shock!**

Do not remove connectors when the component has been powered. Do not plug in connectors when the component has been powered.

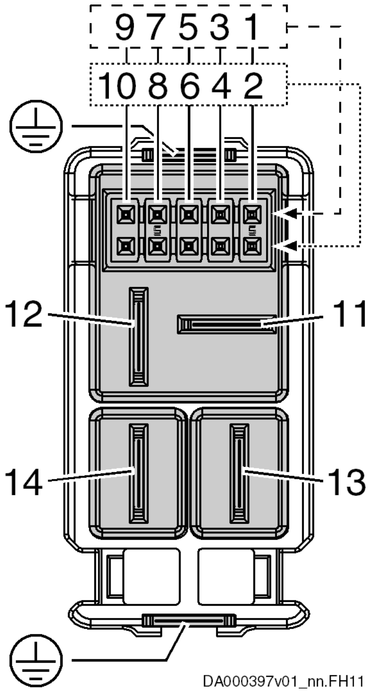
Wait at least 30 minutes after switching off the supply voltages to allow discharging.



A Codings of the connection points to prevent the hybrid cables from being incorrectly connected

Fig. 6-6: X103.1 and X103.2

Connection points

View	Connection	Signal name	Function
	⏚	PE	Equipment grounding conductor
	14	L-	Power supply, DC 750 V, 25 A
	13	L+	
	12	0V	42 V supply, max. 15 A
	11	42V	
	10	Ext_SI_Ch1_In (X103.1) Ext_SI_Ch1 (X103.2)	Control signals (24 V)
	9	Ext_GND_In (X103.1) Ext_GND (X103.2)	
	8	Ext_SI_Ch2_In (X103.1) Ext_SI_Ch2 (X103.2)	
	7	bModulbus	
	6	bE_Stop_In (X103.1) bE_Stop_Out (X103.2)	
	5	Shield	Multi-Ethernet
	4	RxD-	
	3	TxD-	
	2	TxD+	
	1	RxD+	
Contact design	Pins on device		

Tab. 6-21: Function, pin assignment, properties

Notes on installation

- Exclusively operate KSM02/KMS02/KMS03 at a KCU02 or KMV03.
- Always connect the hybrid cable of KCU02 to the connection point **X103.1** of the **first** KSM02/KMS02 of a drive line.
- Hybrid cables contain power lines and control lines. Always route hybrid cables in such a way that the hybrid cables are protected against external damage (in accordance with EN 61800-5-1 and EN 61800-5-2).

Notes on Operation

Do not remove connectors when the component has been powered. Do not plug in connectors when the component has been powered.

6.3.4 X107, programming module

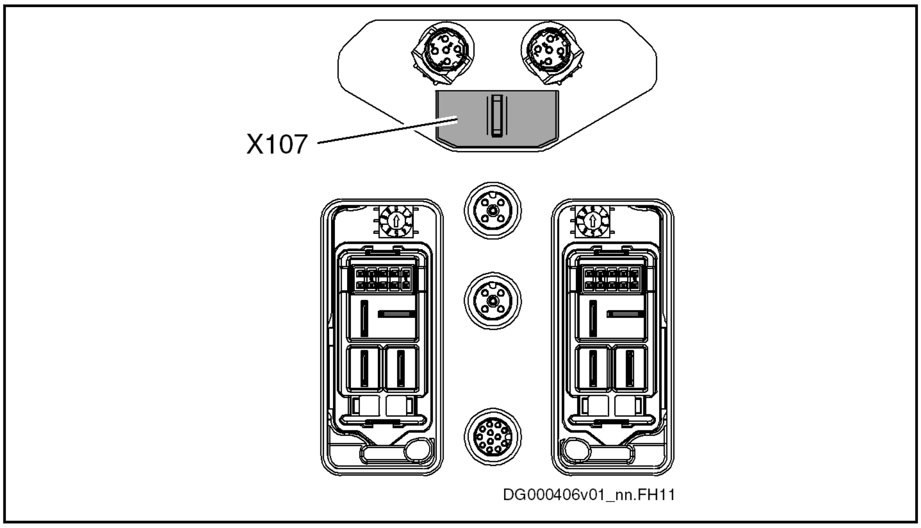


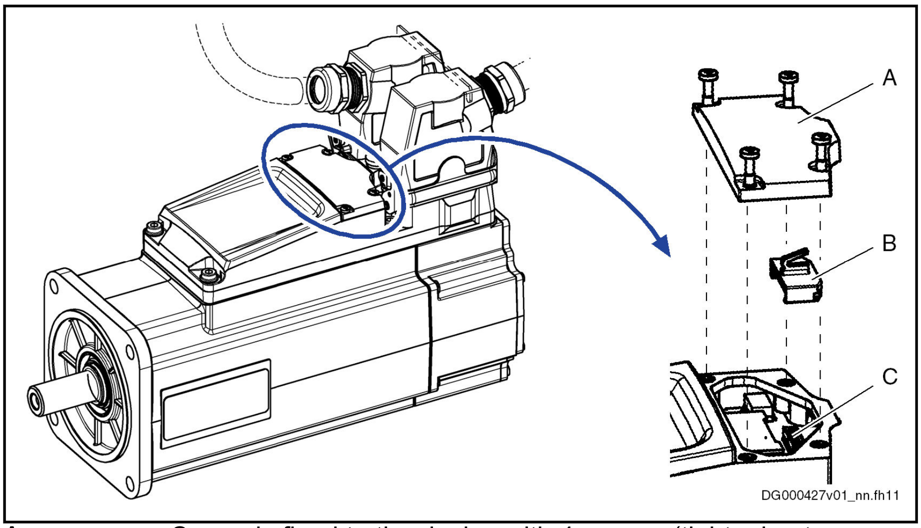
Fig. 6-7: Programming module at X107

X107 is the connection point of the PFM03.1 programming module. The programming module contains the firmware and parameter memory. It is not possible to operate the device without the programming module.

NOTICE **Risk of damage by plugging or removing the programming module!**

Neither plug nor remove the programming module when voltage has been applied.

Clean the device housing before removing the programming module cover. Make sure that neither dirt nor moisture penetrate the housing.

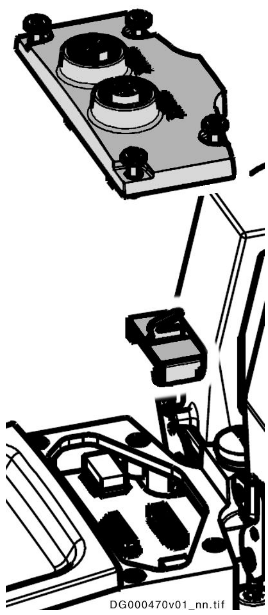


A	Cover; is fixed to the device with 4 screws (tightening torque: 1 Nm)
B	Programming module
C	X107

Fig. 6-8: Removing the programming module

Connection points

Devices with communication output coupling

<table>
<tr>
<td></td>
<td>

Information for devices with connection points for communication (e.g., X108/X109 or X118/X119)

- The cover may only be removed from the housing in vertical upward direction and placed onto the housing in vertical downward direction.

  Never rotate the cover while placing it back onto the housing and tightening the screws. Otherwise, the plug-in connections might be damaged.
- At the bottom of the cover with the connection points there is a circuit board.

  Always leave this circuit board at its place. Otherwise, the seals (O-rings) might fall out of the cover.
- Before placing the cover back onto the housing and tightening the screws:

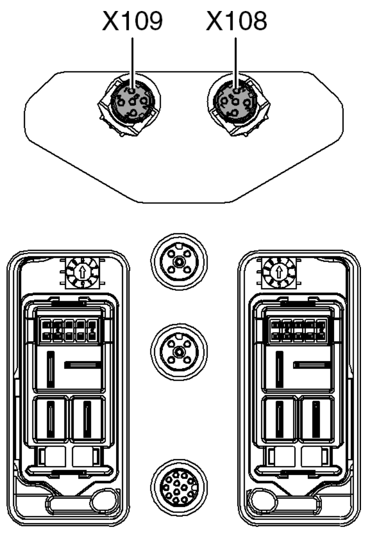
  Ensure that the circuit board with the connection points is still correctly plugged in under the cover.

</td>
</tr>
</table>

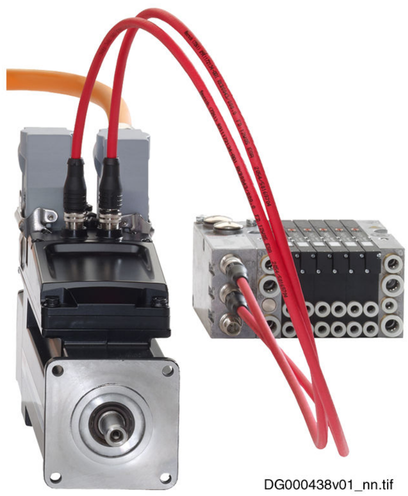
Tab. 6-22: Cover with connection points

6.3.5 X108, X109, communication output coupling

The optional connection point X108/X109 is an additional Multi-Ethernet interface used to connect components with Ethernet-based communication (sercos III, PROFINET IO, EtherNet/IP, EtherCAT) in distributed form.

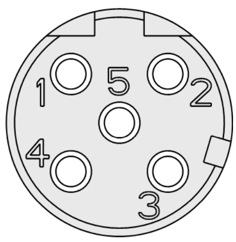


Example of connection:



Tab. 6-23: Communication output coupling

X108, X109

View	Connection	Signal name	Function
 DA000403v01_nn.FH11	1	Tx+	Transmit, Differential Output A
	2	Rx+	Receive, Differential Input A
	3	Tx-	Transmit, Differential Output B
	4	Rx-	Receive, Differential Input B
	5	Shield	Shield connection (Only use shielded cables for which the shield has been connected to ground over the largest possible surface area via the housing.)
Female connector M12 (5-pin, D-coded)			
Ready-made connection cable	• RKB0043 (M12 → M12) • RKB0044 (M12 → RJ-45)		

Tab. 6-24: X108, X109; function, pin assignment, properties

Do not use angled connectors at the connection points.

Unused output coupling

If you do not use the communication output coupling, connect X108 and X109 to the RKB0043 cable. Otherwise, the communication in the drive line is interrupted. The HAS10.1-001-002-NN accessory is used to fasten the cable to the device.

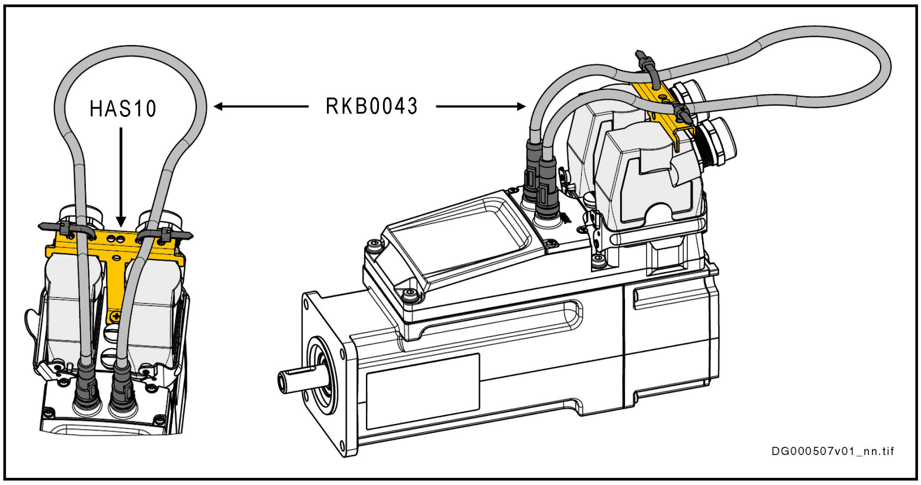
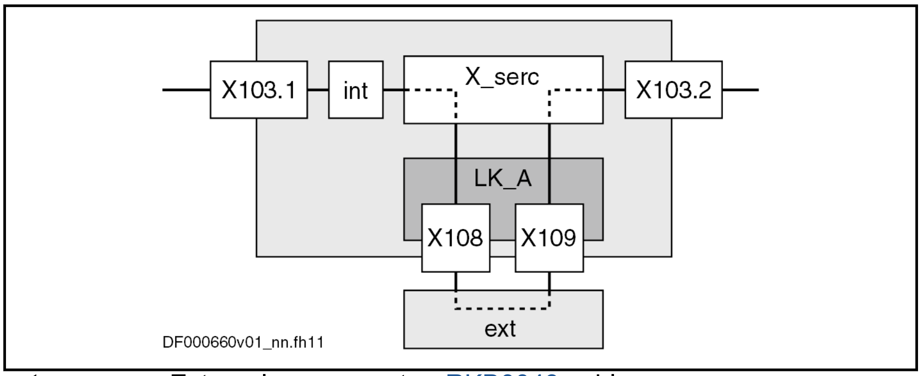


Fig. 6-9: Cable for unused output coupling

Principle of output coupling

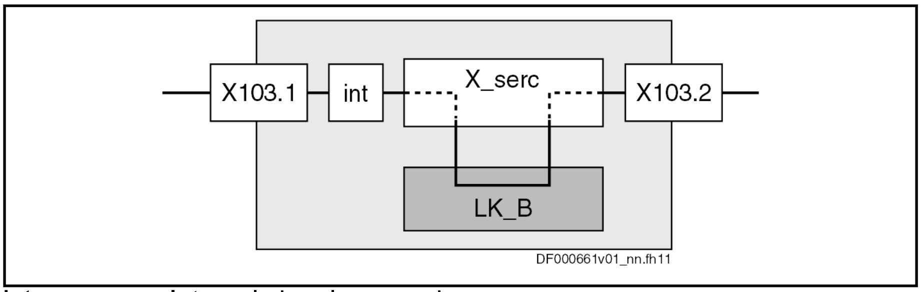
In the case of devices with communication output coupling, the communication signals are transmitted to the connection points X108 and X109 via a circuit board (see figure: LK_A). If neither a component nor the RKB0043 cable has been connected to X108 and X109, the communication in the drive line is interrupted.



ext	External component or RKB0043 cable
int	Internal signal processing
LK_A	Internal circuit board for communication output coupling
X_serc	Internal communication interface

Fig. 6-10: Devices with communication output coupling

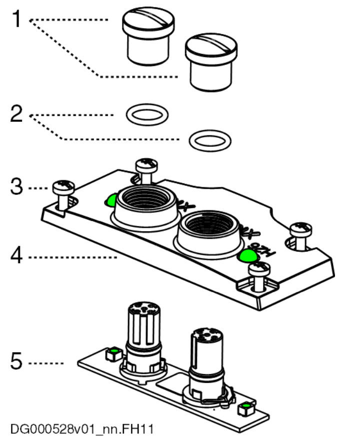
In the case of devices without communication output coupling, the communication signals are directly transmitted via a circuit board (see figure: LK_B).



int Internal signal processing
LK_B Internal circuit board for transmitting the communication signals
X_serc Internal communication interface

Fig. 6-11: Devices without communication output coupling

Parts

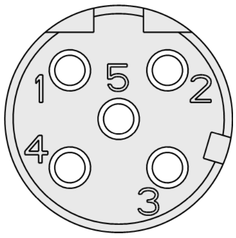
Parts	Description
	To replace the programming module (see X107), the cover with the connection points X108 and X109 has to be removed. At the bottom of the cover (4) there is a circuit board (5). **Always leave the circuit board (5) at its place.** Otherwise, the seals (2) might fall out of the cover (4). The figure shows how the parts are correctly arranged, in case you have to reassemble the parts. 1. Protective caps (2×) 2. Seals (O-rings; 2×) 3. Screws (4×; the screws are locked and cannot fall out of the cover) 4. Cover 5. Circuit board

Tab. 6-25: Parts

6.3.6 X118, X119, external communication

The optional connection point X118/X119 is a Multi-Ethernet interface used to connect components with Ethernet-based communication (sercos **III**, PROFINET IO, EtherNet/IP, EtherCAT) in distributed form.

X118, X119

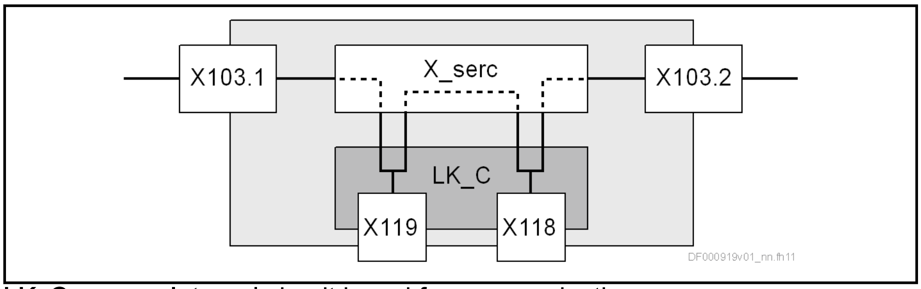
View	Connection	Signal name	Function
 DA000403v01_nn.FH11	1	Tx+	Transmit, Differential Output A
	2	Rx+	Receive, Differential Input A
	3	Tx-	Transmit, Differential Output B
	4	Rx-	Receive, Differential Input B
	5	Shield	Shield connection (Only use shielded cables for which the shield has been connected to ground over the largest possible surface area via the housing.)
Female connector M12 (5-pin, D-coded)			
Ready-made connection cable	• RKB0043 (M12 → M12) • RKB0044 (M12 → RJ-45)		

Tab. 6-26: X118, X119; function, pin assignment, properties

☞ At **KMV** supply units, the connection points **X119** (control unit) and **X103.2** (KMS; alternative: X118 - instead of X103.2 - when using hybrid cables without communication) have to be used.

Principle of external communication

In the case of devices with external communication, the communication signals are transmitted in parallel with X103.1 and X103.2 via a circuit board (see figure: LK_C) to the connection points X118 and X119.



LK_C Internal circuit board for communication
X_serc Internal communication interface

Fig. 6-12: Devices with external communication

6.3.7 X141, Safe Torque Off safety technology and "release brake" service input

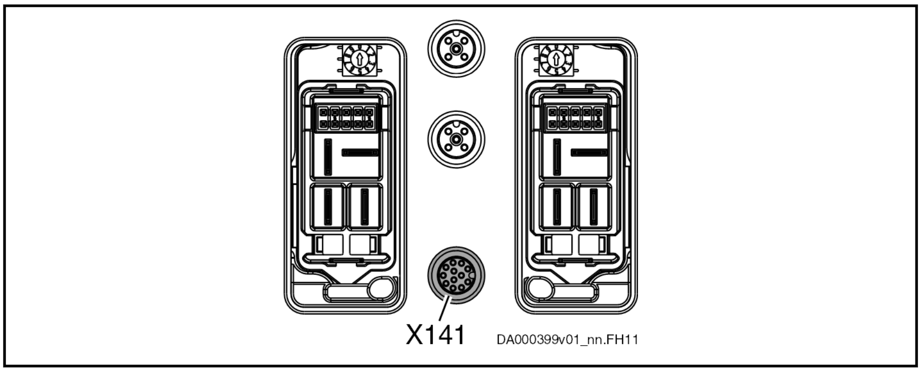
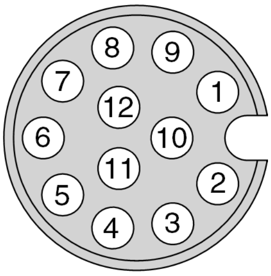


Fig. 6-13: X141

Connection points

View	Connection	Signal name Devices with safety technology	Signal name Devices without safety technology [1]	Function
 DA000400v01_nn.FH11 **Female connector M12 (12-pin, D-coded)**	1	SI_Ch1	n. c.	Input for selection of channel 1 (connected to X103.2.10)
	2	SI_Ch2	n. c.	Input for selection of channel 2 (connected to X103.2.8)
	3	Zone_Br	Zone_Br	For the desired function, X141.3 has to be accordingly controlled: • Safety zone beginner: Input not connected • Safety zone node: Short circuit to X141.11 (input voltage: 0 … 6 V) • "Release brake": Short circuit to X141.9 (input voltage: 24 V ±20%)
	4	24V	n. c.	Dynamization outputs power supply
	5	SI_Ch1_In	n. c.	Input for selection of channel 1, preceding axis (connected to X103.1.10)
	6	0V_In	0V [2]	0V selection, preceding axis (connected to X103.1.9)
	7	SI_Ch2_In	n. c.	Input for selection of channel 2, preceding axis (connected to X103.1.8)
	8	Dyn_Ch1	n. c.	Channel 1 dynamization output [3]
	9	24V_ZBr	24V_Br	Internal interface only; 24 V for "release brake" function
	10	0V	0V [2]	Inputs and outputs power supply (connected to X103.2.9)
	11	GND_Zone	GND	For "safety zone node" function
	12	Dyn_Ch2	n. c.	Channel 2 dynamization output [3]

Ready-made connection cable	RKB0033
Connector for safety zone node	RBS0023 When a KSM/KMS with optional safety technology is to be a safety zone node within a safety zone, X141 has to be equipped with the connector RBS0023. At X141, the connector RBS0023 jumpers the following connections: ● 5 ↔ 1 ● 7 ↔ 2 ● 6 ↔ 10 ● 11 ↔ 3

1) KSM/KMS without optional safety technology can be operated within a safety zone, because the signals are transmitted to the next safety zone node via X103.1 and X103.2. KSM/KMS without optional safety technology do not react to safety technology signals.
2) X141.6 connected to X141.10
3) When the two outputs are used for different functions, short circuit between the two signal wirings has to be excluded.

Tab. 6-27: Function, pin assignment, properties

Technical data

Function	Signal	Connection	Technical data
Channel 1 selection	SI_Ch1	1	chapter 14.1.2 "Digital inputs (safety technology L options)" on page 323
Channel 2 selection	SI_Ch2	2	
Channel 1 dynamization output	Dyn_Ch1	8	chapter 14.2.1 "Digital Outputs (Safety Technology L Options)" on page 325
Channel 2 dynamization output	Dyn_Ch2	12	
Power supply of **isolated** inputs and outputs	+24V	4	DC 19.2 … 30 V max. 700 mA
	0V	10	

Tab. 6-28: Technical data

6.3.8 X141, Safe Motion safety technology and "release brake" service input

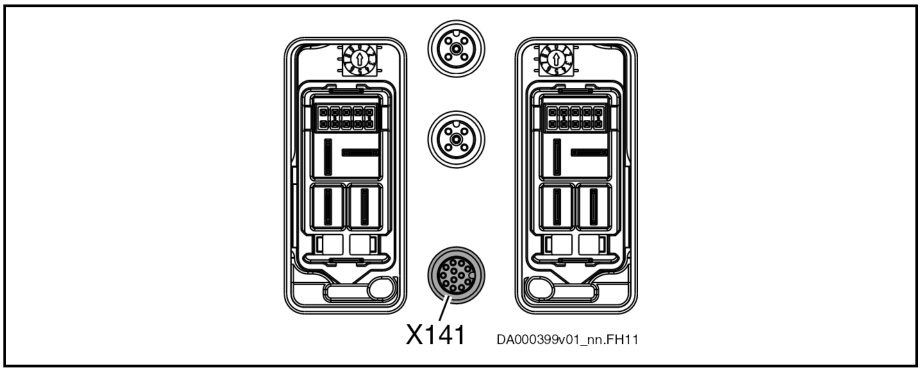
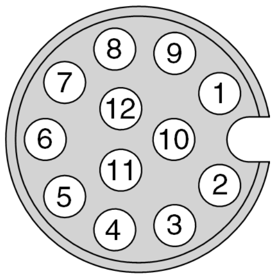


Fig. 6-14: X141

View	Connection	Signal name	Function
 Female connector M12 (12-pin, D-coded)	1	SI_In_Ch1	Input 1
	2	SI_In_Ch2	Input 2
	3	Zone_Br	X141.3 has to be accordingly controlled for the desired function: • Safety zone beginner: Input not connected • Safety zone node: Short circuit to X141.11 (input voltage: 0 … 6 V) • "Release brake": Short circuit to X141.9 (input voltage: 24 V ±20%)
	4	+24V	Power supply of the inputs and outputs
	5	SI_In_Ch1_Zone	Input 1 from preceding axis
	6	0V_Zone	0 V from preceding axis
	7	SI_In_Ch2_Zone	Input 2 from preceding axis
	8	SI_Out_Ch1	Safe output channel 1
	9	24V_Br	Internal interface only; 24 V for "release brake" function
	10	0V	Power supply of the inputs and outputs
	11	GND	GND for "zone detection" function
	12	SI_Out_Ch2	Safe output channel 2
Ready-made connection cable	RKB0033		

Tab. 6-29: Function, pin assignment, properties

☞ KSM/KMS without optional safety technology can be operated within a safety zone, because the signals are transmitted to the next safety zone node via X103.1 and X103.2. KSM/KMS without optional safety technology do not react to safety technology signals.

Technical data

chapter 14.1.3 "Digital inputs (safety technology S options)" on page 324
chapter 14.2.2 "Digital outputs (safety technology S options)" on page 326

6.3.9 Second connection point of equipment grounding conductor

Parts of the installation with attached KSM0x/KMS0x have to be connected to the equipment grounding system of the installation. The housings of KSM0x/KMS0x then are connected to the equipment grounding system of the installation via the flange. This connection is required in addition to the equipment grounding conductor in the hybrid cable, because the leakage current of a KSM0x/KMS0x servo drive is greater than 3.5 mA.

Additionally connect the KSM0x/KMS0x housing via a **second** equipment grounding conductor to the equipment grounding system of the installation, if KSM0x/KMS0x is attached to parts of the installation which

- have bad electroconductive properties

  or

- cannot be connected to the equipment grounding system of the installation.

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

Connect the **second connection point of equipment grounding conductor** at KSM0x/KMS0x to the equipment grounding system of the installation, if the electric resistance between the mechanical holder of the flange and the equipment grounding system of the installation is greater than **5 ohm.**

If you would like to measure the resistance, the following conditions previously must have been complied with:

- The installation has been switched off

  (This avoids parasitic leakage currents.)

- The hybrid cables have not been connected to the drive

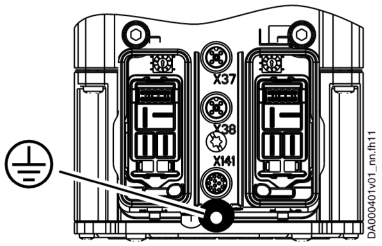
  (This disables the first equipment grounding connection via the hybrid cable.)

NOTICE **Risk of damage to the devices by spark discharge of static charges**

In some applications (e.g., printing or packaging), high static charges can develop. Make sure that these charges can be directly discharged against ground at their point of origin. Therefore, connect the second connection point of equipment grounding conductor of the devices to the equipment grounding system of the installation.

☞ The **first** equipment grounding conductor is routed via the hybrid cable from **X103.1 / X103.2 (KSM0x/KMS0x)** to the connection point **X54 (KCU02)** and connected to the equipment grounding system of the installation via KCU02.

Second connection point of equipment grounding conductor at housing

View	Connection	Signal name	Function
		Equipment grounding conductor	Second connection point of equipment grounding conductor Is used to connect KSM0x/KMS0x to a grounded part of the installation, e.g. the machine base
Thread M5 (for ring cable lug)	**Unit**	**min.**	**max.**
Tightening torque	Nm	2.6	3.1
Cable cross section stranded wire	mm^2	2.5	-
	AWG	14	-

Tab. 6-30: Second connection point of equipment grounding conductor, properties

6.4 KMS02 connection points

6.4.1 Position of connection points

Use ready-made hybrid cables and terminal connectors by Rexroth for X103.1 and X103.2.

X107 (programming module) is only accessible after the cover has been removed.

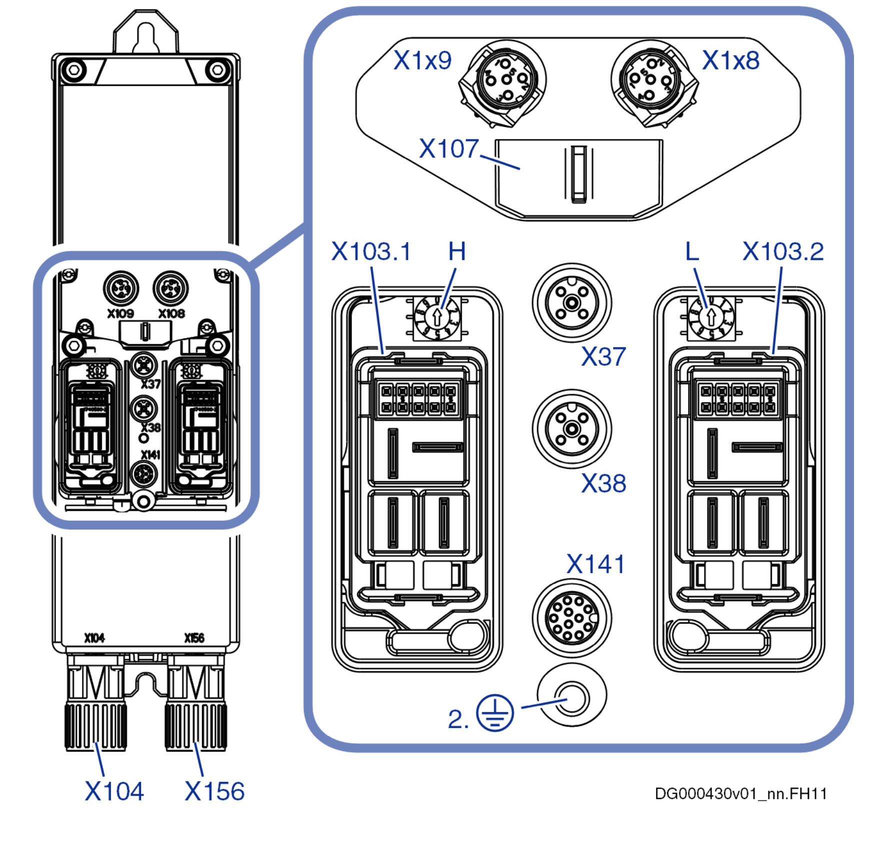


Figure	Element	Significance
	H	Address selector switch (10×)
	L	Address selector switch (1×)
	X37 X38	Digital inputs/outputs
	X103.1 X103.2	Hybrid cable
	X104	Motor encoder
	X107	Programming module
	X1x8 X1x9	Communication (optional) • X108, X109: Communication output coupling • X118, X119: External communication
	X141	Safety technology (optional)
	X156	Motor
	2nd ⏚	Second connection point of equipment grounding conductor

Tab. 6-31: KSM02 connection points

6.4.2 X37, X38, digital inputs/outputs

See description KSM02 (chapter 6.3.2 "X37, X38, digital inputs/outputs" on page 143).

6.4.3 X103.1, X103.2, hybrid cable connection point

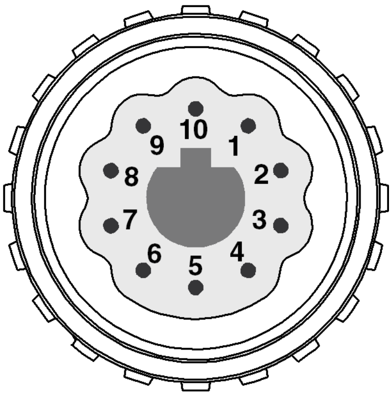
See description KSM02 (chapter 6.3.3 "X103.1, X103.2, hybrid cable connection point" on page 147).

6.4.4 X104, connection for motor encoder

Description For encoders with a supply voltage of **12 Volt (max. 60 mA)**:

Sin-cos encoder 1 V_{pp}; HIPERFACE®

The connection only exists at devices with an ENH encoder interface.

View	Connection	Signal name S1, M1 (HIPERFACE®)	Function
 DA000417v01_nn.fh11	1	VCC_Encoder	Power supply
	2	GND_Encoder	Power supply reference potential
	3	A +	Track A positive
	4	A -	Track A negative
	5	B +	Track B positive
	6	B -	Track B negative
	7	EncData+	Data transmission
	8	EncData-	Data transmission
	9	n. c.	-
	10	n. c.	-
	Overall shield via connector housing		
10-pin, female connector	**Unit**	**Min.**	**Max.**
Connection cable, stranded wire	mm^2	n.s.	n.s.
Order type of cable	RKG4201		
Allowed length	m	n.s.	7,5

Tab. 6-32: X104, motor encoder

6.4.5 X107, programming module

See chapter 6.3.4 "X107, programming module" on page 149

6.4.6 X108, X109, communication output coupling

See chapter 6.3.5 "X108, X109, communication output coupling" on page 151

6.4.7 X118, X119, external communication

See chapter 6.3.6 "X118, X119, external communication" on page 154

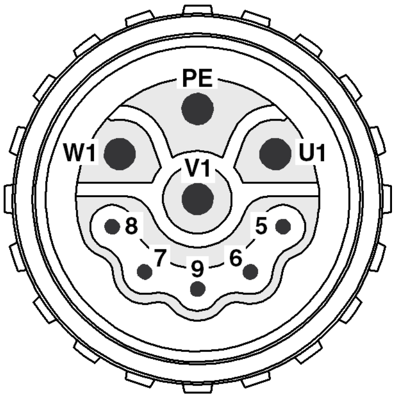
6.4.8 X141, safety technology

See chapter 6.3.7 "X141, Safe Torque Off safety technology and release brake service input" on page 155

Connection points

See chapter 6.3.8 "X141, Safe Motion safety technology and release brake service input" on page 158

6.4.9 X156, Motor Connection

View	Connection	Signal name	Function
 DA000418v01_nn.fh11	U1, V1, W1	-	Power output
	PE	-	Equipment grounding conductor
	5	MotTemp+	Temperature measurement input
	6	MotTemp-	
	7	Br+ / +24V	Output for controlling the motor holding brake of the "applied without current" type
	8	Br- / 0V	
	9	GND_shld	Shield
9-pin, female connector	**Unit**	**Min.**	**Max.**
Output for controlling the motor holding brake (X156.7/8)			
Output current (A)	A	0,15 1)	1
Continuous power overvoltage protection (B)	W	n.s.	1,5
Energy absorption (B)	Ws	n.s.	3
Cable	RKL4305		
Allowed length	m	n.s.	7,5

1) With deactivated brake current monitoring: 0 A

Tab. 6-33: X156, Motor

6.4.10 Second connection point of equipment grounding conductor

See chapter 6.3.9 "Second connection point of equipment grounding conductor" on page 160

6.5 KMS03 connection points

6.5.1 Position of connection points

Use ready-made hybrid cables and terminal connectors by Rexroth for X103.1 and X103.2.

X107 (programming module) is only accessible after the cover has been removed.

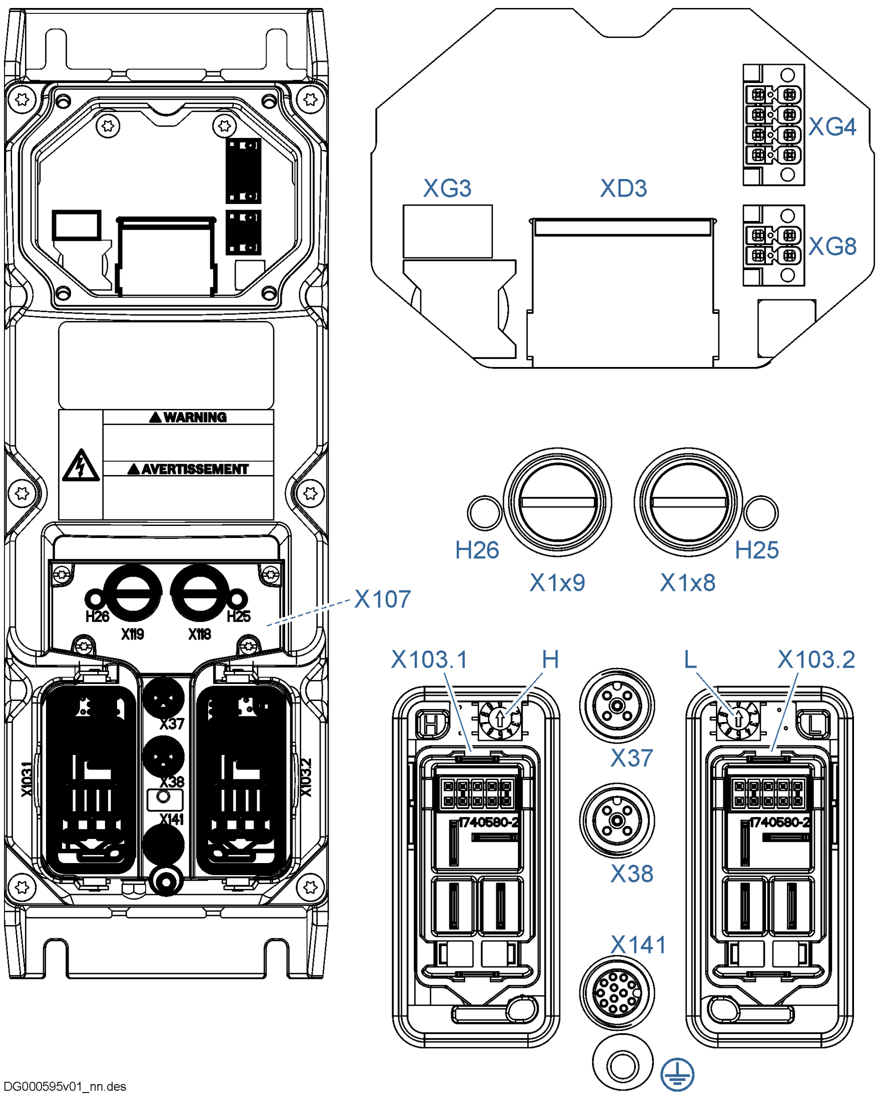
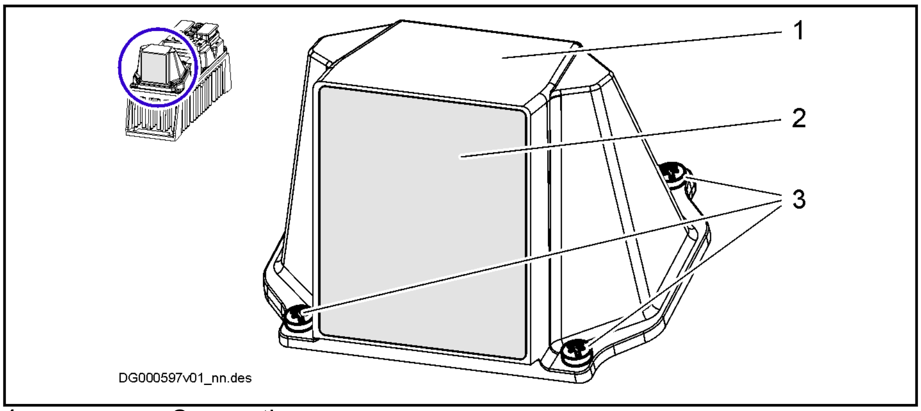


Figure	Element	Significance
	H	Address selector switch (10×)
	L	Address selector switch (1×)
	X37 X38	Digital inputs/outputs
	X103.1 X103.2	Hybrid cable
	X107	Programming module (underneath the cover)
	X1x8 X1x9	Communication (optional) • X108, X109: Communication output coupling • X118, X119: External communication
	X141	Safety technology (optional)
	XD3	Motor
	XG3	Brake/temperature
	XG4	Motor encoder, digital
	XG8	Motor encoder, analog
	⏚	Second connection point of equipment grounding conductor

Tab. 6-34: KMS03 connection points

6.5.2 Motor cable and encoder cable connection

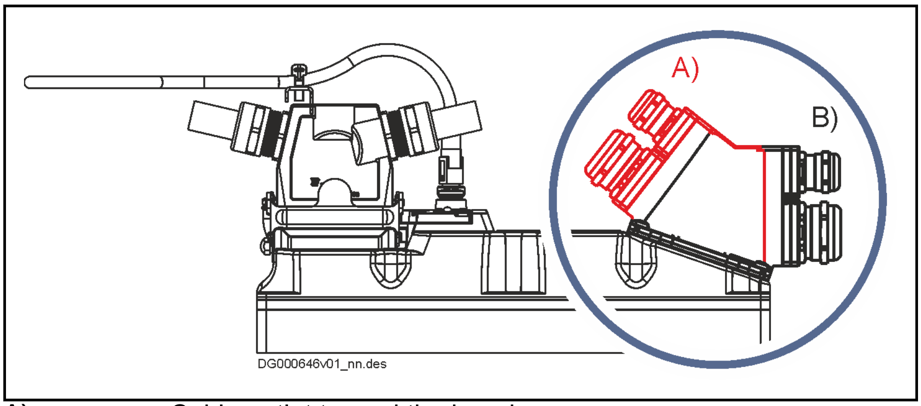
Condition as supplied



1 Connection cover
2 Protective covering
3 Screws (M4, 2.5 Nm)

Fig. 6-15: Connection cover with protective covering

Connection cover: Mounting options



A) Cable outlet toward the housing
B) Cable outlet away from the housing

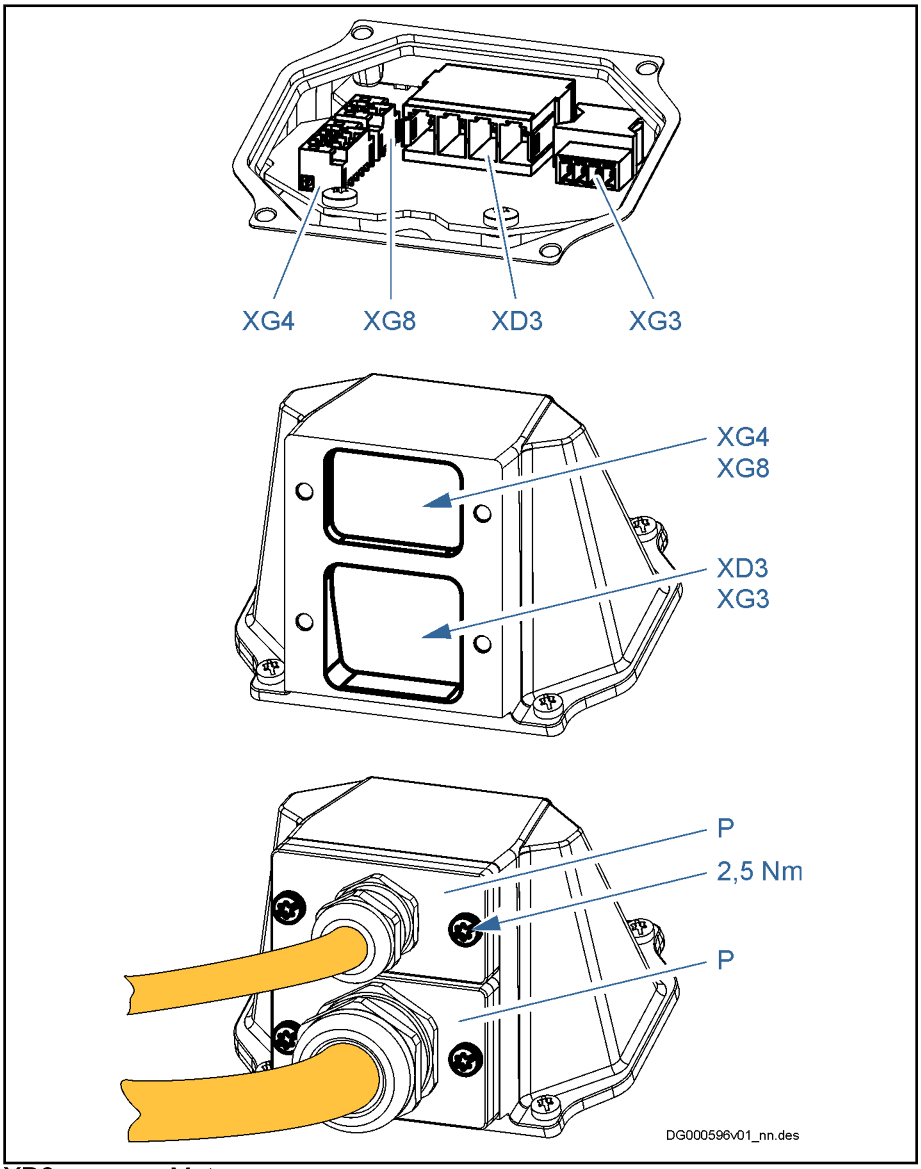
Fig. 6-16: Connection cover: Mounting options

Connecting the cables

1. Take off connection cover and remove protective covering
2. Put motor power cable connector (RLS0725) through big opening and plug connector (XD3, XG3) into device.

   (RHS0725 additionally contains the connector for digital motor encoders (XG4). With RHS0725 it is not required to connect the separate encoder cable and the HAS05.1-018 dummy cover is put on the connection cover.)
3. Screw on cable plate at connection cover with 2.5 Nm.
4. Put encoder cable connector (RGS0725) through small opening and plug connector (XG4, XG8) into device.
5. Screw on cable plate at connection cover with 2.5 Nm.
6. Screw on connection cover with 2.5 Nm.

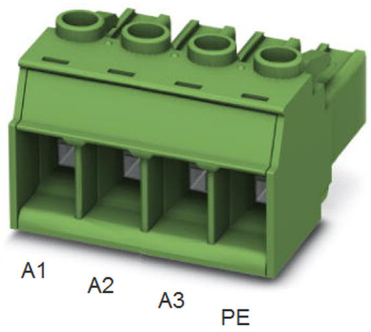
Connection points



XD3	Motor
XG3	Brake/temperature
XG4	Motor encoder, digital
XG8	Motor encoder, analog
P	Cable plate

Fig. 6-17: Motor cable and encoder cable

6.5.3 XD3, motor connection

View	Connection	Function
 DG000594v01_nn.tif	A1	For power connection U1 at motor
	A2	For power connection V1 at motor
	A3	For power connection W1 at motor
	PE	For equipment grounding conductor of motor

Tab. 6-35: Pin assignment

Mechanical data

Screw terminal (connector)	Unit	min.	max.
Connection cable Stranded wire	mm^2	0.2	6
	AWG	24	10
Stripped length	mm	10	
Tightening torque	Nm	0.5	0.8

Tab. 6-36: Mechanical data

Electrical data

Spring terminal (connector)	Unit	min.	max.
Rated voltage	V	1000	
Nominal current	A	41	

Tab. 6-37: Electrical data

6.5.4 XG3, 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

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

The motor temperature evaluation input is **not** electrically isolated from the housing. If excessive voltage is applied to the input (e.g., from motor winding voltage flashover), this voltage can travel to the housing. Make sure the temperature sensor of the connected motor is **double** insulated from the motor winding.

NOTICE **Risk of damage to device from excess voltage at motor temperature evaluation input!**

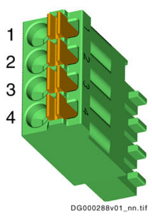
Only the allowed control voltage for the device is allowed at the motor temperature evaluation input. Excess voltage at the input can damage the device.

Function

Connection point XG3 contains the connections for

- Monitoring motor temperature
- Controlling motor holding brake

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

View	Connection	Signal name	Function
	1	MotTemp+	Motor temperature evaluation input
	2	MotTemp-	
	3	+24 VBr	Output for controlling motor holding brake
	4	0 VBr	

Tab. 6-38: Pin assignment

Mechanical data

Spring terminal (connector)	Unit	min.	max.
Connection cable Stranded wire	mm^2	0.25	1.5
	AWG	24	16
Stripped length	mm	10	

Tab. 6-39: Mechanical data

Electrical data (output for controlling motor holding brake [XG3.3/4])

Spring terminal (connector)	Unit	min.	max.
Output current	A	0.15 1)	1.29
Overvoltage protection continuous power	W	n.s.	1.5
Energy absorption	Ws	n.s.	3

1) With deactivated brake current monitoring: 0 A

Tab. 6-40: Electrical data (output for controlling motor holding brake [XG3.3/4])

Motor holding brake: Selection

Maximum current rating of XG3 outputs: 1.29 A

⇒ $R_{br\ (min)} = U_{br\ (max)}$ / 1.29 A

$R_{br\ (min)}$: minimum allowed resistance of motor holding brake

$U_{br\ (max)}$: maximum supply voltage of motor holding brake

If $U_{br\ (max)}$ = 24 V +5% = 25.2 V, then:

$R_{br\ (min)}$ = 19.53 Ω (applies to all operating and ambient conditions)

Motor holding brake: Notes on installation

Make sure there is enough **power supply** to the motor for the motor holding brake. Note that voltage drops on the supply line. Use connection lines with the largest possible cross section of single strands.

Use an **external contact element in accordance with the required safety category** if you want to supply motor holding brakes with higher currents than the current load allowed at XG3. Make sure to comply with the required minimum current consumption of 100 mA when using an external contact element. Otherwise the brake current monitor will signal an error.

Connection points

Connection diagram

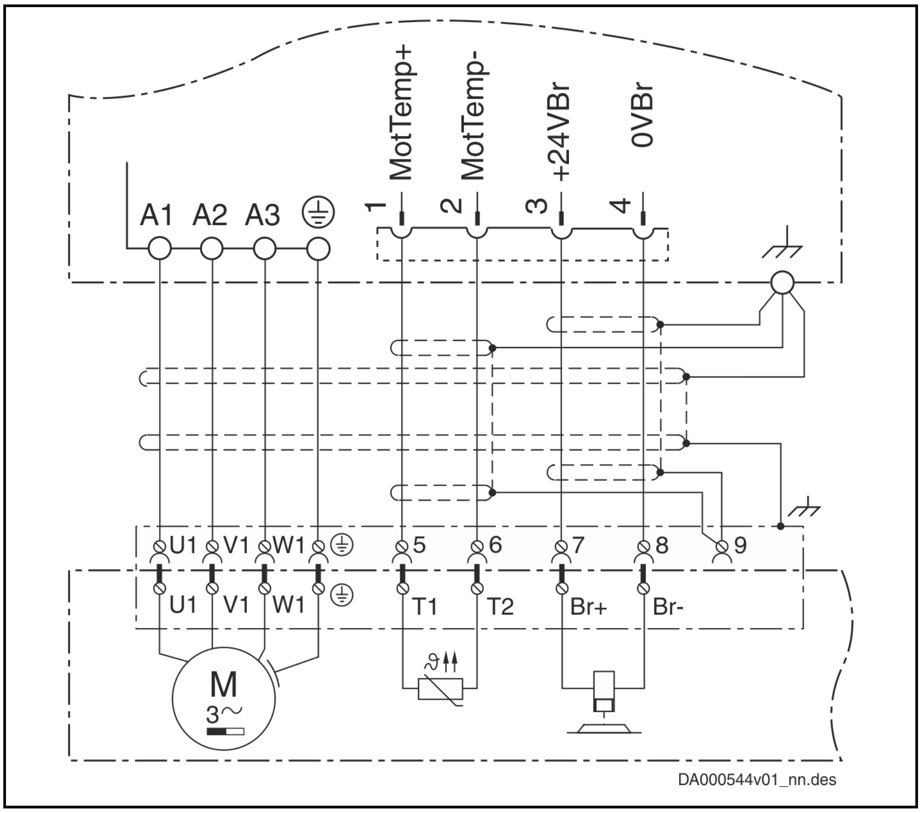


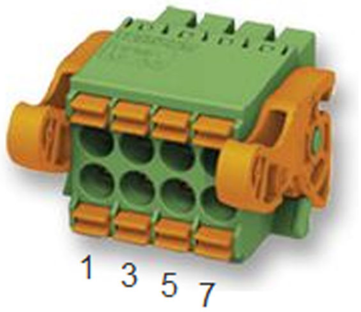
Fig. 6-18: Connection of motor temperature monitoring and motor holding brake

6.5.5 XG4, digital motor encoder connection

Description

For encoders with a supply voltage of **5 Volt (max. 300 mA)** and **12 Volt (max. 60 mA)**:

HIPERFACE®, EnDat2.1, EnDat2.2, SSI, Panasonic, 1Vpp without reference track, digital asynchronous (e.g., Hengstler AS35 of MS2N motors)

View	Connection	Signal name S1, M1 (HIPERFACE®)	Function
 DG000592v01_nn.tif	1	EncData+	RS485 data transmission positive
	2	EncData-	RS485 data transmission negative
	3	EncCLK+	RS485 clock positive
	4	EncCLK-	RS485 clock negative
	5	+5V	Encoder supply 5 V
	6	+12V	Encoder supply 12 V
	7	GND_Encoder	0V reference potential for power sup-plies
	8	GND_shld	Signal shields connection (inner shield)

Tab. 6-41: Pin assignment

Mechanical data

Spring terminal (connector)	Unit	min.	max.
Connection cable Stranded wire	mm^2	0.2	1.5
	AWG	24	16
Stripped length	mm	10	

Tab. 6-42: Mechanical data

6.5.6 XG8, analog motor encoder connection

Description

For encoders with a supply voltage of **5 Volt (max. 300 mA)** and **12 Volt (max. 60 mA)**:

HIPERFACE®, EnDat2.1, 1Vpp without reference track

View	Connection	Signal name	Function
 DG000593v01_nn.tif	1	A+	max. 1.65 V_{pp} track A analog positive
	2	B+	max. 1.65 V_{pp} track B analog positive
	3	A-	max. 1.65 V_{ss} track A analog negative
	4	B-	max. 1.65 V_{ss} track B analog negative

Tab. 6-43: Pin assignment

Mechanical data

Spring terminal (connector)	Unit	min.	max.
Connection cable Stranded wire	mm^2	0.2	1.5
	AWG	24	16
Stripped length	mm	10	

Tab. 6-44: Mechanical data

6.5.7 X37, X38, digital inputs/outputs

See description KSM02 (chapter 6.3.2 "X37, X38, digital inputs/outputs" on page 143).

6.5.8 X103.1, X103.2, hybrid cable connection point

See description KSM02 (chapter 6.3.3 "X103.1, X103.2, hybrid cable connection point" on page 147).

6.5.9 X107, programming module

See chapter 6.3.4 "X107, programming module" on page 149.

6.5.10 X108, X109, communication output coupling

See chapter 6.3.5 "X108, X109, communication output coupling" on page 151.

6.5.11 X118, X119, external communication

See chapter 6.3.6 "X118, X119, external communication" on page 154.

6.5.12 X141, safety technology

See chapter 6.3.7 "X141, Safe Torque Off safety technology and release brake service input" on page 155.

See chapter 6.3.8 "X141, Safe Motion safety technology and release brake service input" on page 158.

6.5.13 Second connection point of equipment grounding conductor

See chapter 6.3.9 "Second connection point of equipment grounding conductor" on page 160.

6.6 KMV03 connection points

6.6.1 Position of connection points

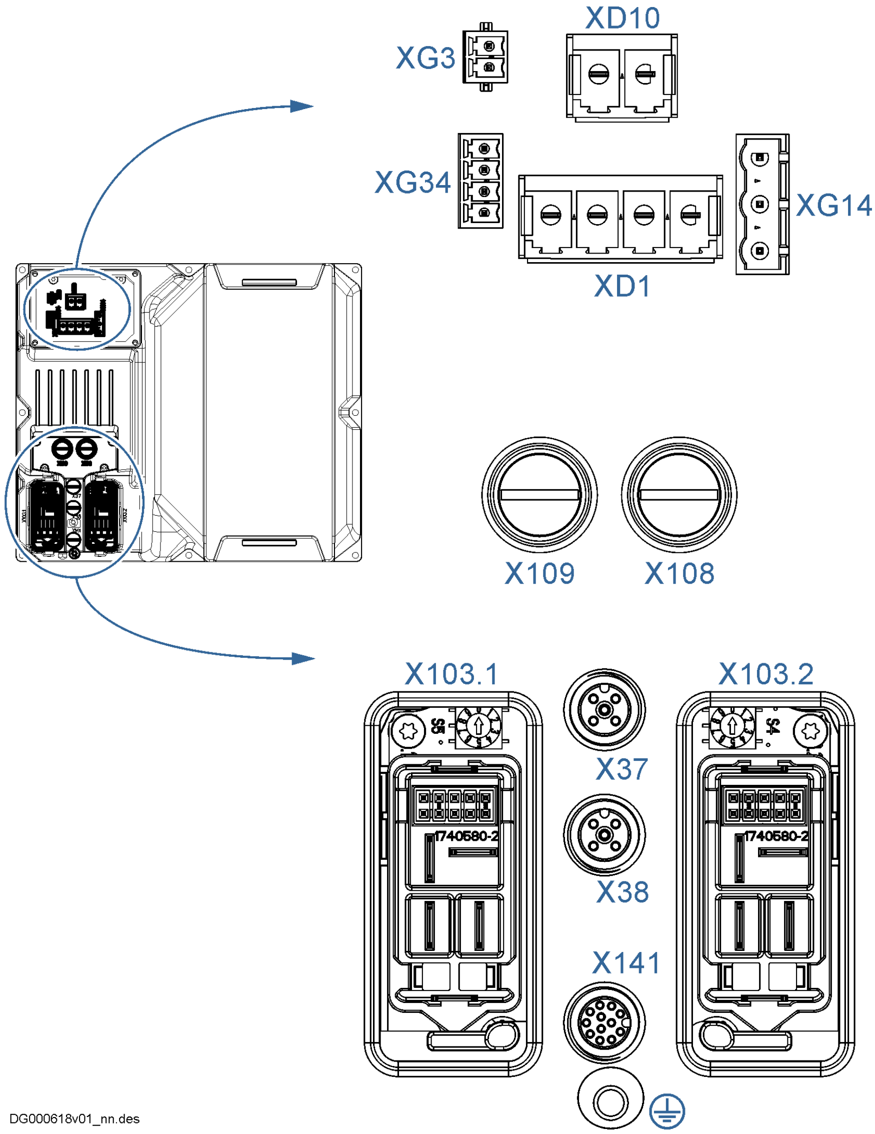


Figure	Element	Significance
	X37 X38	Digital inputs/outputs
	X103.1 X103.2	Hybrid cable
	X108 X109	Communication
	X141	Safety technology (optional)
	XD1 1)	Mains voltage
	XD10	Control voltage
	XG3 2)	Mains choke temperature contact
	XG14 2)	Mains voltage synchronization
	XG34 1)	Mains contactor control and feedback contacts (KNK03)
	⏚	Second connection point of equipment grounding conductor

1) RKH0800 cable connects KMV to KNK
2) RKH0801 cable connects KMV to KNK

Tab. 6-45: KMV03 connection points

6.6.2 X37, X38, digital inputs/outputs

See description KSM02 (chapter 6.3.2 "X37, X38, digital inputs/outputs" on page 143).

6.6.3 X103.1, X103.2, hybrid cable connection point

See description KSM02 (chapter 6.3.3 "X103.1, X103.2, hybrid cable connection point" on page 147).

6.6.4 X108, X109, communication

See chapter 6.3.5 "X108, X109, communication output coupling" on page 151

6.6.5 X118, X119, external communication

See chapter 6.3.6 "X118, X119, external communication" on page 154

6.6.6 X141, safety technology

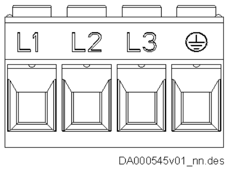
See chapter 6.3.7 "X141, Safe Torque Off safety technology and release brake service input" on page 155

See chapter 6.3.8 "X141, Safe Motion safety technology and release brake service input" on page 158

6.6.7 Second connection point of equipment grounding conductor

See chapter 6.3.9 "Second connection point of equipment grounding conductor" on page 160

6.6.8 XD1, mains voltage

View	Connection	Function
	L1	Connection to mains filter (XD1.2.L1)
	L2	Connection to mains filter (XD1.2.L2)
	L3	Connection to mains filter (XD1.2.L3)
	⏚	Equipment grounding conductor

Tab. 6-46: Pin assignment

Mechanical data

Screw terminal (connector)	Unit	max.
Connection cable Stranded wire	mm^2	6
	AWG	8
Stripped length	mm	10
Tightening torque	Nm	0.8

Tab. 6-47: Mechanical data

Electrical data

Screw terminal (connector)	Unit	Value
Occurring current load and minimum required connection cross section	A	See technical data (I_{L_cont}, I_{L_max} and A_{LN})
Occurring voltage load	V	See technical data (U_{LN})

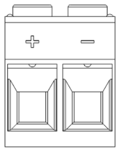
Tab. 6-48: Electrical data

Cables

Description	Value
Order type	RKH0800
Maximum allowed length	1 m

Tab. 6-49: Cables

6.6.9 XD10, control voltage

View	Connection	Function
 DA000547v01_nn.des	+	Control voltage positive pole
	-	Control voltage negative pole

Tab. 6-50: Pin assignment

Mechanical data

Screw terminal (connector)	Unit	max.
Connection cable Stranded wire	mm^2	6
	AWG	8
Stripped length	mm	10
Tightening torque	Nm	0.8

Tab. 6-51: Mechanical data

Electrical data

Screw terminal (connector)	Unit	Value
Nominal current	A	41
Nominal voltage	V	600

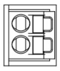
Tab. 6-52: Electrical data

Cables

Description	Value
Order type	Cable cannot be ordered. Customer assembles the cable (HAS05.1-020 accessories required).

Tab. 6-53: Cables

6.6.10 XG3, mains choke temperature contact

View	Connection	Function
	1	Connection to mains filter (mains choke temperature contact XG3.1/2)
	2	

Tab. 6-54: Pin assignment

Mechanical data

Spring terminal (connector)	Unit	max.
Connection cable Stranded wire	mm^2	1.5
	AWG	16
Stripped length	mm	10

Tab. 6-55: Mechanical data

Electrical data

Spring terminal (connector)	Unit	Value
Nominal current	A	8
Rated voltage	V	160

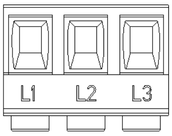
Tab. 6-56: Electrical data

Cables

Description	Value
Order type	RKH0801
Maximum allowed length	1 m

Tab. 6-57: Cables

6.6.11 XG14, mains voltage synchronization

View	Connection	Function
 DA000546v01_nn.des	L1	Connection to mains filter(XG14.L1)
	L2	Connection to mains filter (XG14.L2)
	L3	Connection to mains filter (XG14.L3)

Tab. 6-58: Pin assignment

Mechanical data

Screw terminal (connector)	Unit	max.
Connection cable Stranded wire	mm^2	6
	AWG	8
Stripped length	mm	10
Tightening torque	Nm	0.8

Tab. 6-59: Mechanical data

Electrical data

Screw terminal (connector)	Unit	Value
Nominal current	A	41
Rated voltage	V	1000

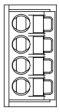
Tab. 6-60: Electrical data

Cables

Description	Value
Order type	RKH0801
Maximum allowed length	1 m

Tab. 6-61: Cables

6.6.12 XG34, mains contactor control and feedback contacts (KNK03)

View	Connection	Function
	1	Mains contactor control Connection to mains filter (XG34.1/2)
	2	
	3	Mains contactor feedback (N/O contact) Connection to mains filter (XG34.3/4)
	4	

Tab. 6-62: Pin assignment

Mechanical data

Spring terminal (connector)	Unit	max.
Connection cable Stranded wire	mm^2	1.5
	AWG	16
Stripped length	mm	10

Tab. 6-63: Mechanical data

Electrical data

Screw terminal (connector)	Unit	Value
Nominal current	A	8
Rated voltage	V	160

Tab. 6-64: Electrical data

Cables

Description	Value
Order type	RKH0800
Maximum allowed length	1 m

Tab. 6-65: Cables

6.6.13 Connection cover: Mounting options

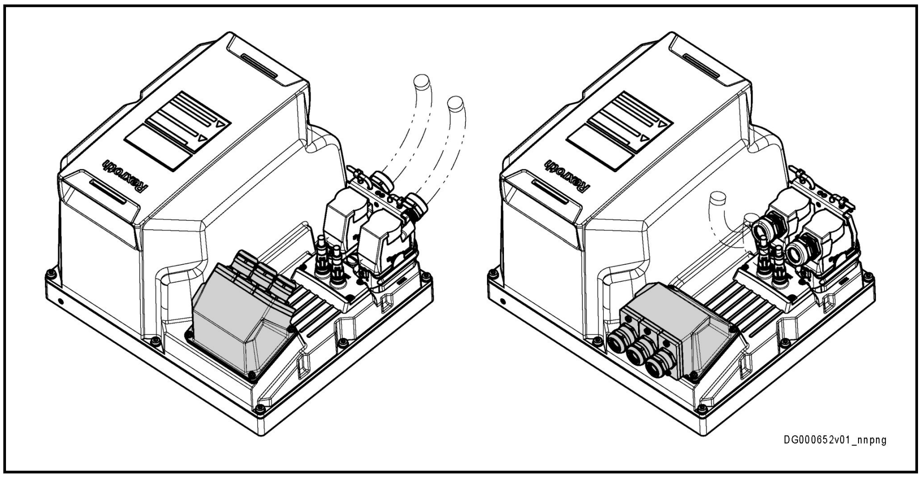
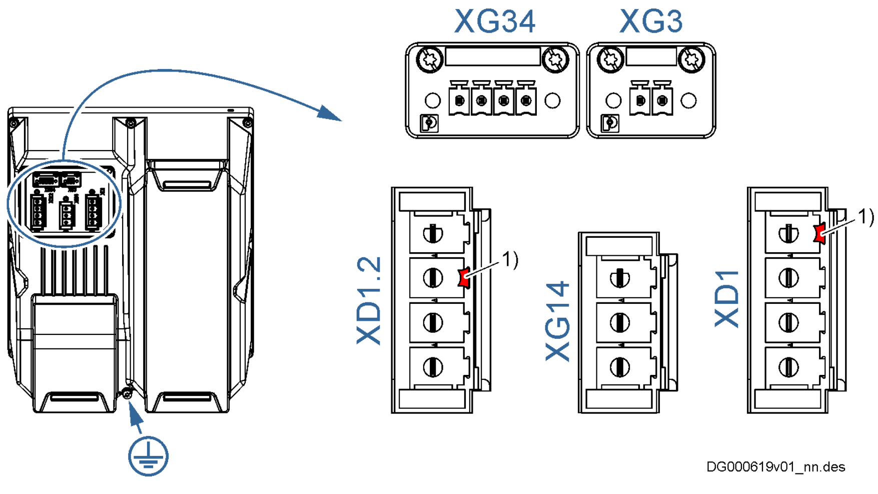


Fig. 6-19: Connection cover: Mounting options

☞ **Tightening torque** of the mounting screws: **2.5 Nm**

6.7 KNK03 connection points

6.7.1 Position of connection points

Figure	Element	Significance
	XD1	Mains voltage supply input 1)
	XD1.2 2)	Output to load KMV03 (XD1, mains voltage) 1)
	XG14 3)	Output to load KMV03 (XG14, mains voltage synchronization)
	XG3 3)	Mains choke temperature contact
	XG34 2)	Mains contactor control and feedback contacts
	⏚	Second connection point of equipment grounding conductor

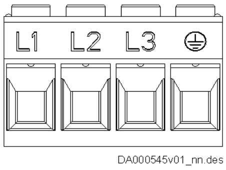
1) Coding pins prevent the connectors XD1 and XD1.2 from being incorrectly plugged
2) RKH0800 cable connects KMV to KNK
3) RKH0801 cable connects KMV to KNK

Tab. 6-66: KNK03 connection points

6.7.2 Second connection point of equipment grounding conductor

See chapter 6.3.9 "Second connection point of equipment grounding conductor" on page 160

6.7.3 XD1, mains voltage

View	Connection	Function
	L1	Input for supply with mains voltage
	L2	Input for supply with mains voltage
	L3	Input for supply with mains voltage
	⏚	Equipment grounding conductor

Tab. 6-67: Pin assignment

Mechanical data

Screw terminal (connector)	Unit	max.
Connection cable Stranded wire	mm^2	6
	AWG	8
Stripped length	mm	10
Tightening torque	Nm	0.8

Tab. 6-68: Mechanical data

Electrical data

Screw terminal (connector)	Unit	Value
Occurring current load and minimum required connection cross section	A	See technical data (I_{L_cont}, I_{L_max} and A_{LN})
Occurring voltage load	V	See technical data (U_{LN})

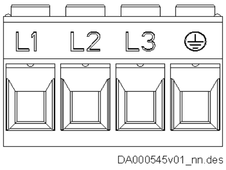
Tab. 6-69: Electrical data

Cables

Description	Value
Order type	Cable cannot be ordered. Customer assembles the cable (HAS05.1-019 accessories required).

Tab. 6-70: Cables

6.7.4 XD1.2, supply unit

View	Connection	Function
	L1	Connection to supply unit
	L2	Connection to supply unit
	L3	Connection to supply unit
	⏚	Equipment grounding conductor

Tab. 6-71: Pin assignment

Mechanical data

Screw terminal (connector)	Unit	max.
Connection cable Stranded wire	mm^2	6
	AWG	8
Stripped length	mm	10
Tightening torque	Nm	0.8

Tab. 6-72: Mechanical data

Electrical data

Screw terminal (connector)	Unit	Value
Occurring current load and minimum required connection cross section	A	See technical data (I_{L_cont}, I_{L_max} and A_{LN})
Occurring voltage load	V	See technical data (U_{LN})

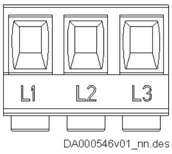
Tab. 6-73: Electrical data

Cables

Description	Value
Order type	RKH0800
Maximum allowed length	1 m

Tab. 6-74: Cables

6.7.5 XG14, mains voltage synchronization

View	Connection	Function
	L1	Connection to supply unit (XG14 L1)
	L2	Connection to supply unit (XG14 L2)
	L3	Connection to supply unit (XG14 L3)

Tab. 6-75: Pin assignment

Mechanical data

Screw terminal (connector)	Unit	max.
Connection cable Stranded wire	mm^2	6
	AWG	8
Stripped length	mm	10
Tightening torque	Nm	0.8

Tab. 6-76: Mechanical data

Electrical data

Screw terminal (connector)	Unit	Value
Nominal current	A	41
Rated voltage	V	1000

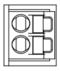
Tab. 6-77: Electrical data

Cables

Description	Value
Order type	RKH0801
Maximum allowed length	1 m

Tab. 6-78: Cables

6.7.6 XG3, mains choke temperature contact

View	Connection	Function
	1	Temperature contact
	2	

Tab. 6-79: Pin assignment

Mechanical data

Spring terminal (connector)	Unit	max.
Connection cable	mm^2	1.5
Stranded wire	AWG	16
Stripped length	mm	10

Tab. 6-80: Mechanical data

Electrical data

Screw terminal (connector)	Unit	Value
Nominal current	A	8
Nominal voltage	V	150

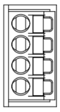
Tab. 6-81: Electrical data

Cables

Description	Value
Order type	RKH0801
Maximum allowed length	1 m

Tab. 6-82: Cables

6.7.7 XG34, mains contactor control and feedback contacts

View	Connection	Function
	1	Mains contactor control (N/C contact)
	2	
	3	Mains contactor feedback (N/O contact)
	4	

Tab. 6-83: Pin assignment

Mechanical data

Spring terminal (connector)	Unit	max.
Connection cable Stranded wire	mm^2	1.5
	AWG	16
Stripped length	mm	10

Tab. 6-84: Mechanical data

Electrical data

Screw terminal (connector)	Unit	Value
Nominal current	A	8
Rated voltage	V	160

Tab. 6-85: Electrical data

Cables

Description	Value
Order type	RKH0800
Maximum allowed length	1 m

Tab. 6-86: Cables

6.7.8 Connection cover: Mounting options

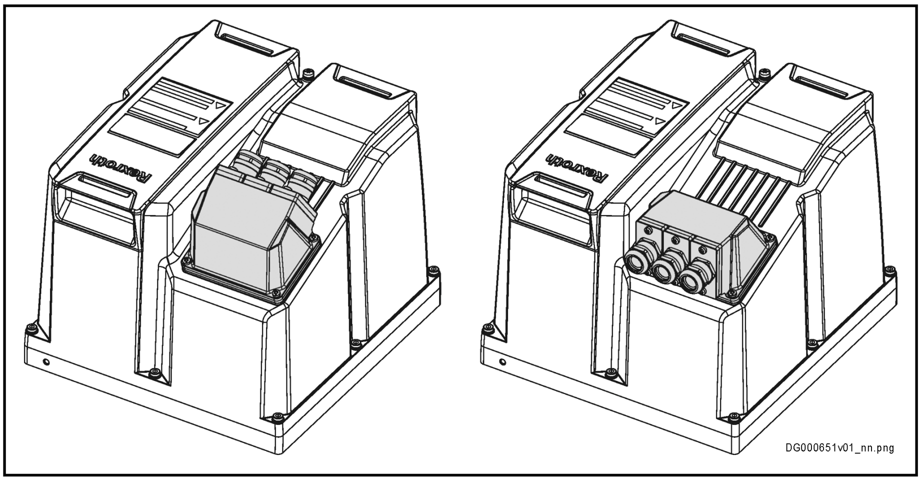


Fig. 6-20: Connection cover: Mounting options

☞ **Tightening torque** of the mounting screws: **2.5 Nm**

7 Notes on project planning

7.1 Combining the individual components

7.1.1 Power supply

The combination of the individual components mainly depends on the desired power supply component:

- HMV01, HMV02, HCS02 oder HCS03
- HCS01
- KMV03

7.1.2 Power supply by HMV01, HMV02, HCS02 or HCS03

Supply units

Both supply units (HMV01, HMV02) and converters (HCS02, HCS03) can be used as supply units for a Rexroth IndraDrive Mi drive system.

KCU at HMV and HCS - number of axes, capacitances C_y

The drive connection box KCU passes the DC bus voltage of the supply unit to the KSM/KMS via the hybrid cable. Due to decoupling components, KCU with the maximum number of KSM/KMS acts like **one more** axis with higher C_Y (capacitance against ground) for HMV01.1E, HMV02.1E supply units and HCS converters.

When selecting the supply unit or converter, observe the allowed combinations of HNF/NFD mains filter and HNL mains choke.

The sum of the electric powers of all KCU at the DC bus of the supply unit should not exceed P_{DC_cont} and P_{DC_max} of the supply unit (HMV or HCS).

$$\sum P_{DC\_cont(KCU)} \leq P_{DC\_cont(HMV,HCS)}$$

$P_{DC\_cont(KCU)}$ Continuous power KCU
$P_{DC\_cont(HMV,\ HCS)}$ Continuous power of supply unit

Fig. 7-1: Continuous power of supply unit

Instead of P_{DC_cont}, it is allowed to use the actually occurring continuous power of KCU (KSM/KMS).

$$\sum P_{DC\_max(KCU)} \leq P_{DC\_max(HMV,HCS)}$$

$P_{DC\_max(KCU)}$ KCU peak power
$P_{DC\_max(HMV,\ HCS)}$ Peak power of supply unit

Fig. 7-2: Peak power of supply unit

Notes on Project Planning With HCS02 as Supply Unit for KCU02 and KSM/KMS

The types HCS02.1E-W0054 and -W0070 are allowed as supply units for KCU02 and KSM02/KMS02.

Additional capacitance C_{DC_ext} required for HCS02!

For operation as a supply unit with low load at the motor output ($P_{out} \leq 10\ \% \times P_{DC\_cont}$; $I_{out} \leq 10\ \% \times I_{out\_cont}$, where P_{out} refers to KCU02/KSM02/KMS02 and P_{DC_cont} to HCS02), the performance data are available without additional capacitance C_{DC_ext} at the DC bus.

Use additional capacitors C_{DC_ext} at the DC bus, if the load at the motor output is higher.

If the DC bus capacitor unit HLC01.1 is used, the following **guide value** applies when determining the additional capacitance C_{DC_ext}:

- **50 µF** per kW of installed continuous power KSM/KMS, thus 700 µF for a KCU02 operated at rated power.

The power supply monitoring of KSM/KMS can be set.

See also "P-0-0114, Undervoltage threshold"

See also Functional Description of firmware → "Power supply".

7.1.3 Power supply by HCS01

HCS01.1E-W0054 drive controllers can be used to supply power to **KSM0x** motor-integrated servo drives or **KMS0x** near motor servo drives. In this case, the KCU drive connection box is not required.

See fig. 9-8 "Rexroth IndraDrive Mi system with HCS01.1E-W0054" on page 266.

7.1.4 Power supply by KMV03 and KNK03

KMV03 supply unit, KNK03 mains filter

KMV03 supply units can be used together with **KNK03** mains filters to supply power to **KSM0x** motor-integrated servo drives or **KMS0x** near motor servo drives.

7.1.5 Control voltage power requirement 42 V

Power components	Symbol	Power requirement [W]	Explanation
Basic power of the component	P_{Basic}	15	Component: KSM, KMS, KMV, …
Digital inputs/outputs	P_{IO}	2.5	Connection point X37, X38 The power component is only available when the digital outputs are used without an additional external 24V supply.
Optional safety technology S3	P_{S3}	2.5	Safety option "Safe Motion (without SBC)"
Optional safety technology SD	P_{SD}	2.5	Safety option "Safe Motion"
Optional master communication output coupling TO	P_{TO}	-	No additional power required
Optional external master communication ES	P_{ES}	-	
Optional safety technology L3	P_{L3}	n.s.	Power requirement contained in basic power of the component P_{Basic}
Motor holding brake KSM…041	P_{Br}	12	
Motor holding brake KSM…061		18	
Motor holding brake KSM…071		24	
Motor holding brake KSM…076		24	
Motor holding brake KMS		n.s.	See specification of motor holding brake of the connected motor

Tab. 7-1: Control voltage power requirement

Control voltage power requirement of one component

$$P_{N3\_42V} = P_{Basic} + P_{IO} + P_{S3/SD} + P_{Br}$$

Control voltage power requirement of multiple components of a drive line

$$P_{total} = \Sigma P_{N3\_42V}$$

Notes on project planning

7.1.6 KCU02 drive connection box

General information

Functions

The drive connection box KCU mainly fulfills the following functions:

- Passing the power supply to the drive line
- 42V supply of the KSM/KMS in the drive line
- Passing the communication signals to the drive line
- Exchanging status signals between motors and supply unit
- Displaying the status signals of the drive line for diagnostic purposes

Arrangement

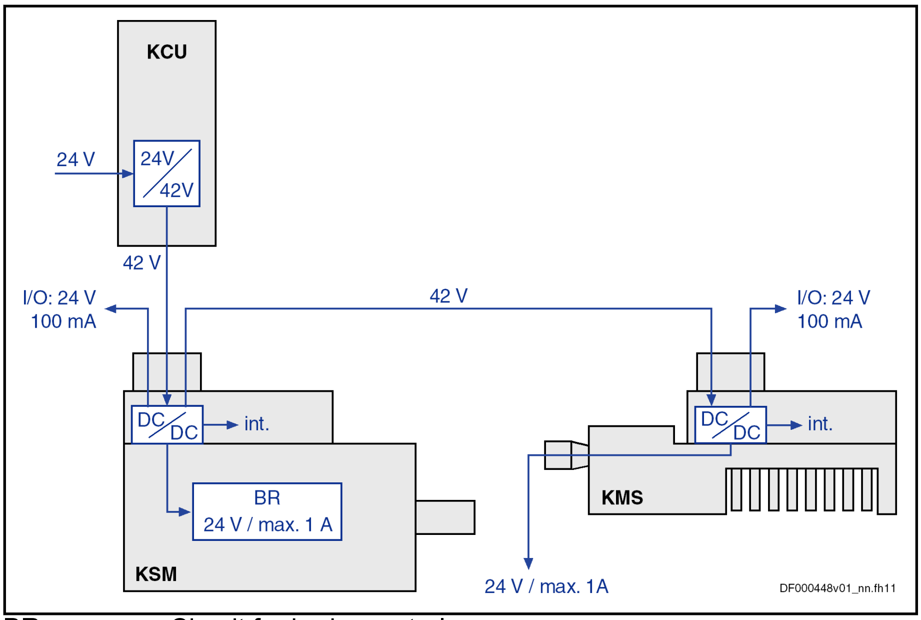
The KCU drive connection box is arranged next to the supply unit or next to other axes mounted between supply unit and KCU. Axes with a high degree of power consumption should be arranged as near as possible to the supply unit.

Control voltage supply

The KCU drive connection box needs 24V supply for operation. From the applied 24V supply,

- KCU supplies itself and
- at "X53, control voltage output" generates the 42V control voltage for the KSM/KMS in the drive line.

Control voltage KCU, KSM, KMS



BR	Circuit for brake control
I/O	Inputs/outputs
int.	Internal electronics
KCU	Drive connection box
KMS	Near motor servo drive
KSM	Motor-integrated servo drive

Fig. 7-3: Control voltage KCU, KSM, KMS

At a KCU, it is permitted to operate KSM/KMS with and without integrated holding brake (observe allowed number of axes and cable length). The load at X53 should not exceed the value of P_{out} (see technical data of KCU).

In operation under rated conditions, the sum of P_{out} and P_{Diss_cont} is generated at the "control voltage supply +24V, 0V" input of KCU as load for the 24V supply (P_{Diss_cont} = power dissipation which KCU generates by converting the 24 V voltage to 42 V; depends on the load at the 42V supply.).

☞ Dimension the 24V supply for the power consumption of KCU and the load-dependent inrush current.

Take into account that other loads (e.g. HMV, HCS) are operated at the same 24V supply.

KCU output X53 load:

$$P_{42V} = f_{cable} \times \left[n \times P_{N3(KSM)} + m \times \left(P_{N3(KSM)} \right) \right]$$

P_{42V}	KCU load at X53
f_{cable}	1.3 (correction factor for losses on the hybrid cable)
n	Number of KSM without integrated holding brake
m	Number of KSM with integrated holding brake
$P_{N3\ (KSM)}$	Power consumption KSM

Fig. 7-4: Load X53

KCU power consumption from 24V supply:

$$P_{N3(KCU)} = f_{SMPS} \times P_{42V}$$

$P_{N3\ (KCU)}$	KCU power consumption
f_{SMPS}	1.2 (correction factor for KCU power supply unit losses)
P_{42V}	KCU load at X53

Fig. 7-5: KCU power consumption from 24V supply

☞ The 24V supply has to make available the inrush current generated when each KCU drive connection box is switched on. The inrush current depends on the power consumption $P_{N3\ (KCU)}$ (see calculation above):

- $P_{N3(KCU)} \leq 288$ W

  Inrush current I_{N3_EIN} = 10 A

- 288 W < $P_{N3(KCU)}$

  Inrush current $I_{N3\_EIN} = P_{N3(KCU)}/U_{N3}$

The holding brakes integrated in KSM have no effect on the inrush current of KCU.

Power supply to KSM/KMS (KCU)

A drive line for power supply in the Rexroth IndraDrive Mi system is designed as a bus (L+, L-) and consists of:

- X54 connector at KCU
- RKH hybrid cable
- X103.1 and X103.2 connectors at KSM/KMS
- RHS0014 terminal connector at KSM/KMS

Comply with UL rating I_{Bypass}

In the case of equal load, the greatest load of the hybrid cable is on the first cable segment.

In the drive line, place powerful KSM/KMS as near as possible to the output of the drive connection box KCU.

Observe the maximum allowed bypass current I_{Bypass} in each segment (see technical data of KSM or technical data of KMS).

If necessary, install more KCU devices.

Available power at drive line

Available power P_{KCU_strang} at a drive line:

$$P_{KCU\_strang} = U_{out} \times I_{out\_max}$$

P_{KCU_strang}	Available power at drive line
V_{out}	Output voltage, depending on supply unit
I_{out_max}	Output current; see technical data of KCU

Fig. 7-6: Available power at KCU drive line

With a small number of KSM/KMS and a low degree of power consumption in a drive line (operation at partial load), the measurable value I_{strang} at the output of KCU is above the value which would result from the calculation of the power P_{LN} of KSM/KMS and U_{out} of KCU. The deviation is due to wattless currents; the influence of these currents is insignificant in operation under rated conditions.

Continuous power

Comply with continuous power

The sum of the electric powers of all KSM/KMS of a drive line should not exceed the calculated value P_{KCU_strang} of the KCU drive connection box.

$$\sum P_{LN\_nenn} \leq P_{KCU\_strang}$$

P_{LN_nenn}	Nominal power KSM/KMS
P_{KCU_strang}	Available power at drive line

Fig. 7-7: Checking the continuous power

Instead of P_{LN_nenn}, it is allowed to use the actually occurring continuous power of the KSM/KMS.

Taking the average speed and simultaneity factor into account, the sum of the installed rated motor powers therefore can be significantly higher with servo operation.

Peak power

Comply with KCU peak power

The sum of the electric powers of all KSM/KMS of a drive line should not exceed the indicated value P_{DC_max} of the KCU drive connection box.

$$\sum P_{LN\_max} \leq P_{DC\_max}$$

P_{LN_max} Peak power of KSM/KMS
P_{DC_max} KCU peak power

Fig. 7-8: KCU peak power

Derating of Peak Power

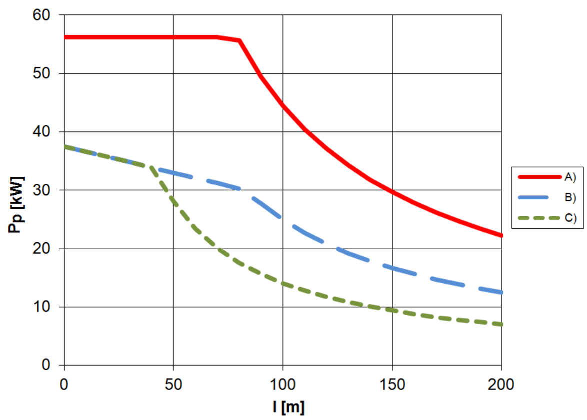
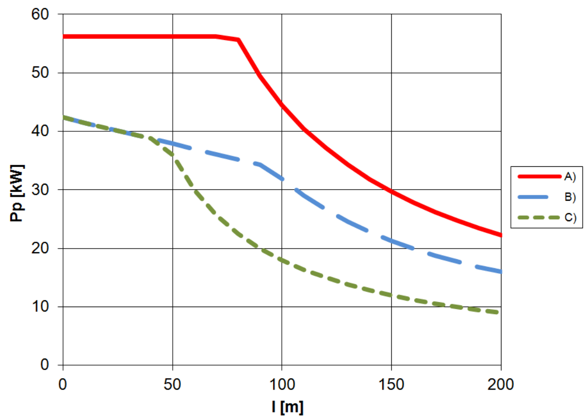
As the length of the hybrid cable increases, the peak power available at the cable end is reduced.

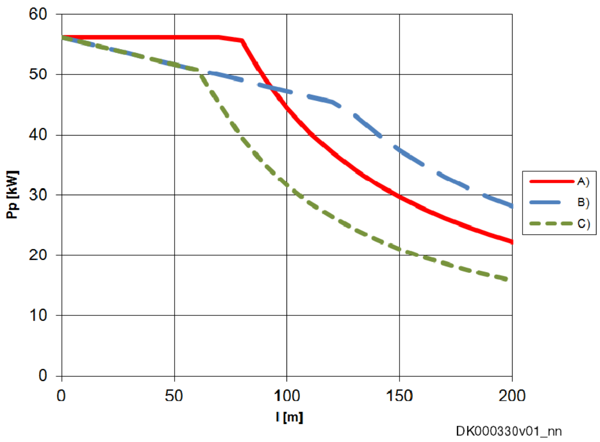
Peak power depending on the cable length

Due to occurring voltage drops, the effective length of the cable influences the available peak power at KSM/KMS.

Observe the following diagrams and the sections

- "Peak Power when Accelerating" on page 202
- " Peak Power when Decelerating" on page 203

DC 500 V	
DC 565 V (uncontrolled supply with 3 AC 400 V)	

<table>
<tr><td>DC 750 V (controlled supply)</td><td>
</td></tr>
<tr><td colspan="2">Data used for the diagrams:
• Maximum peak current of 3 × I_{Bypass}: 75 A
• Threshold of braking resistor in supply unit or converter: 820 V
See also "P-0-0833, Braking resistor threshold"
See also "P-0-0860, Converter configuration"</td></tr>
</table>

A) Peak power when decelerating
B) Peak power when accelerating (n < 0.8 × n_{eck}; n_{eck}: speed at which the torque characteristic is inflected)
C) Peak power when accelerating (n < 0.9 × n_{eck}; n_{eck}: speed at which the torque characteristic is inflected)
P_P Maximum peak power (sum of all P_{DC_max} in the drive line)
l_{total} Sum of the lengths of all hybrid cables at a KCU

Tab. 7-2: Available Peak Power vs. Cable Length for DC 500 V and DC 750 V

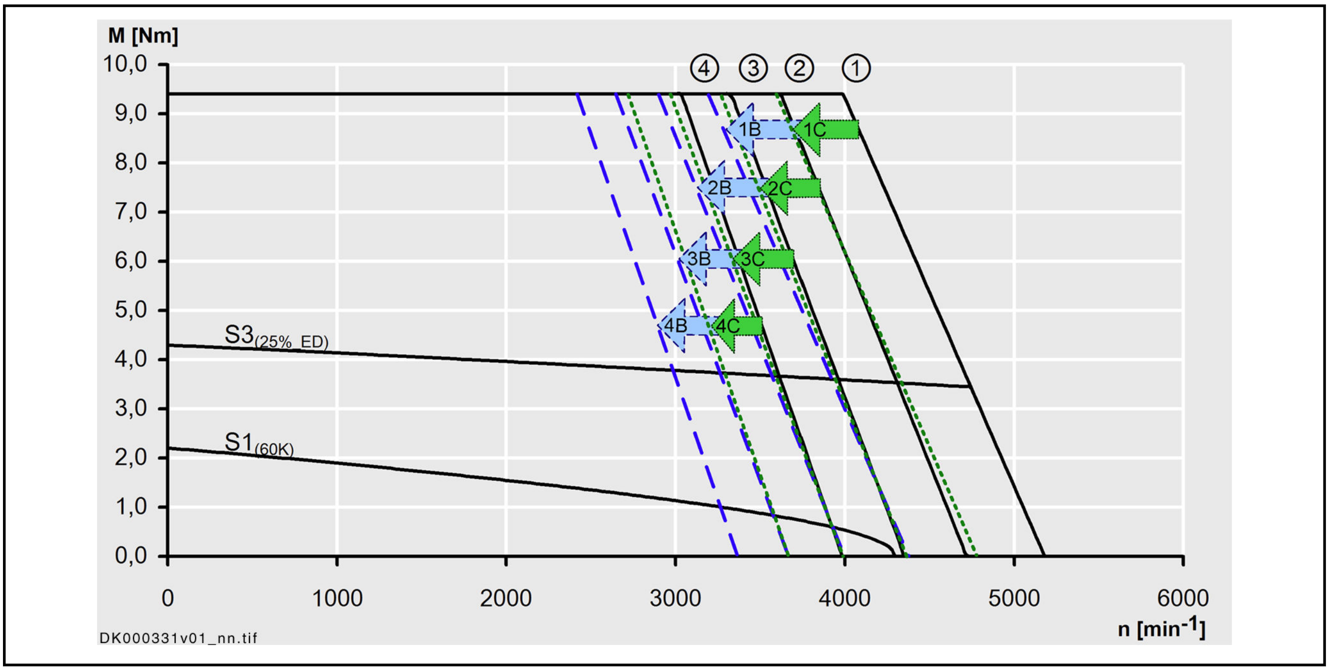
Peak Power when Accelerating

Due to voltage drops, less peak power is available at KSM/KMS with increasing length of the motor cable. During acceleration, this becomes noticeable by the reduction of the corner speed. The figure shows exemplary curves of reduction to 80% and 90% of the data sheet corner speeds. The maximum speed is proportional to the DC bus voltage available at the motor.

In the drive line, place the KSM/KMS with the greatest power as near as possible to the output of KCU.

Examples

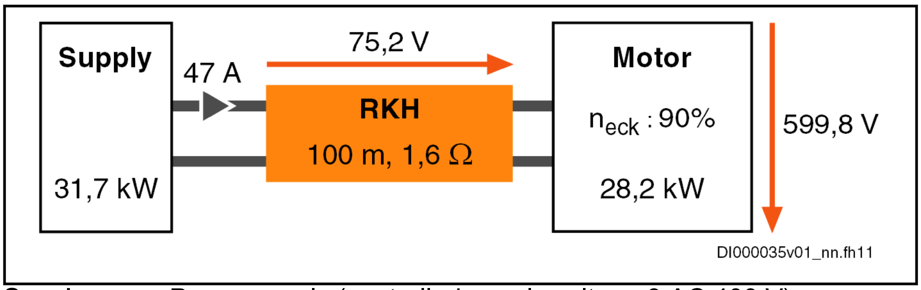
- DC 750 V and 100 m of cable length:
  - Motive and regenerative: Max. 47 kW
  - With 34 kW, a maximum speed of approx. 90% of the corner speed can be reached in motive form.
- DC 565 V and 100 m of cable length:
  - Motive: Max. 32 kW
  - Motive: Max. 45 kW
  - With 18 kW, a maximum speed of approx. 90% of the corner speed can be reached.



S1, S3	Characteristics apply to a PWM frequency of 4 kHz
①	M_{max}, controlled supply 3 AC 400 V
②	M_{max}, uncontrolled supply 3 AC 480 V
③	M_{max}, uncontrolled supply 3 AC 440 V
④	M_{max}, uncontrolled supply 3 AC 400 V
B	Corner speed reduced to 80%
C	Corner speed reduced to 90%

Fig. 7-9: Example of How Long Lines Reduce the Corner Speeds

Power Distribution



Supply	Power supply (controlled supply voltage 3 AC 400 V)
RKH	Hybrid cable
Motor	KSM or KMS and Motor

Fig. 7-10: Example of Power Distribution with Cable Length of 100 m and Corner Speed Reduced to 90%

Peak Power when Decelerating

The peak power when decelerating is **independent** of the supply unit used and the mains voltage. But the peak power is reduced as of a cable length of approx. 80 m, due to the voltage limitation taking effect in KSM/KMS.

The critical case is when all motors decelerate at the same time with peak torque out of maximum speed (e.g., in the case of E-Stop).

Notes on project planning

☞ **Observe installed motor peak power**

The sum of installed motor peak powers must be smaller than maximum peak power P_P indicated in the diagram.

If necessary, install more KCU devices.

Exception: When the design and arrangement within a drive line ensure that the occurring motor peak powers do not add.

This is the case, for example, when the drives have been mechanically connected in such a way that the energy flows to the DC bus are inversely directed when decelerating. One drive absorbs the energy which another drive in the same line delivers when decelerating. These drives must be arranged side by side in the line.

7.1.7 Hybrid cable length

Length of hybrid cable incl. communication

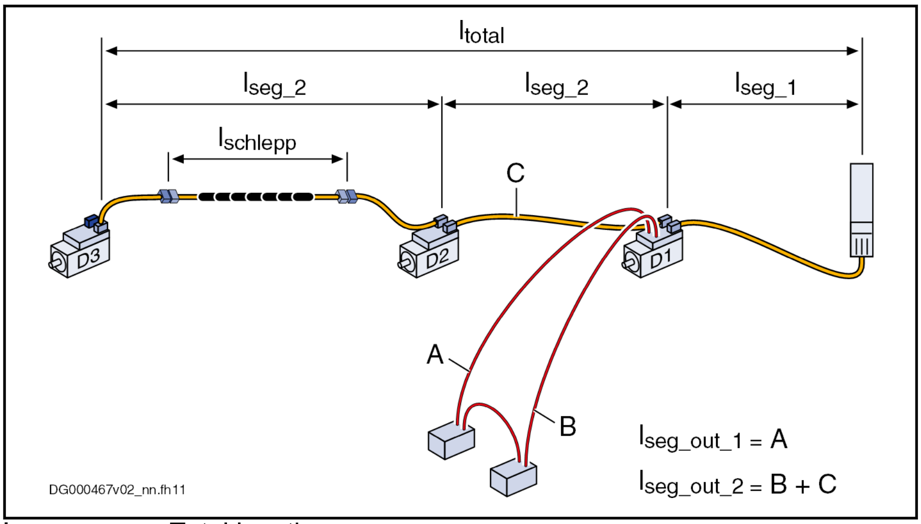
Allowed cable length depending on load

The maximum allowed total length is limited depending on the kind of load on the hybrid cable.

Observe the following limit values for total length and segment length within a drive line.

The number of KSM/KMS devices in the drive line has an influence on the allowed cable length (see also chapter "Hybrid cable length vs. KCU performance" on page 208).

Definition of the cable lengths



l_{total}	Total length
l_{seg}	Segment length
$l_{seg\_out\_1}$	Segment length with communication output coupling: D1_X108 ↔ external component
$l_{seg\_out\_2}$	Segment length with communication output coupling: [external component ↔ D1_X109] + [D1_X103.2 ↔ D2_X103.1]
$l_{schlepp}$	Flexible cable track length

Fig. 7-11: Definition of the lengths

Notes on project planning

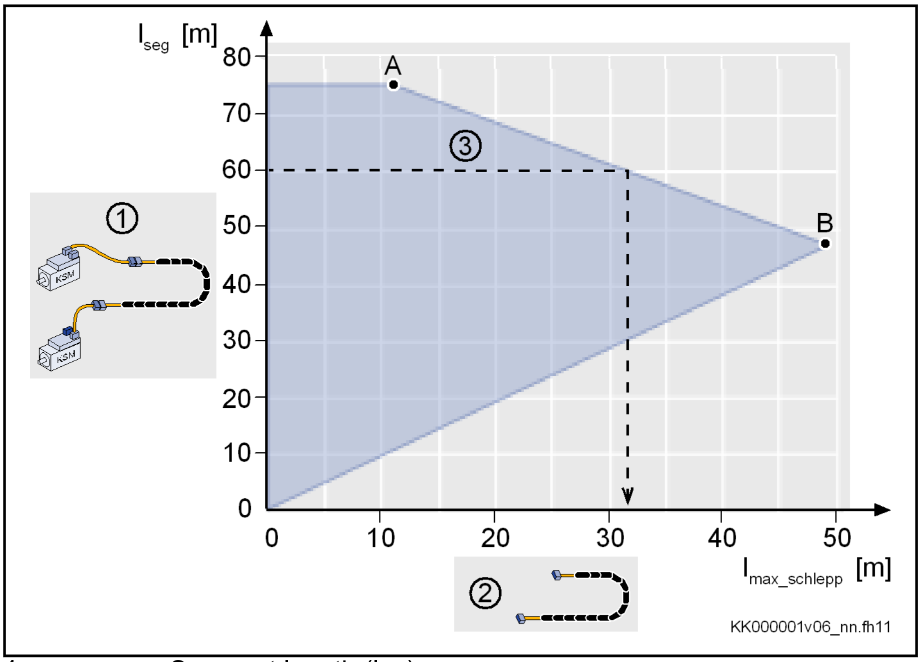
Allowed lengths

Limit values	Symbol	Unit	Value	
			min	max
For permanent routing				
Total length [1]	l_{total}	m	3	200
Segment length from supply component (e.g., KCU) to first KSM/KMS	l_{seg_1}	m	3 [2]	75
Segment length [3]	l_{seg_2}	m	1 [4]	75
Segment length with communication output coupling [5]	$l_{seg\_out\_1}$ $l_{seg\_out\_2}$	m	1.25 [4]	75
For routing with stress in flexible cable track				
Length in flexible cable track	$l_{schlepp}$	m	see fig. 7-12 "Maximum allowed cable length for routing in the flexible cable track" on page 207	

1) Total length: Total cable length from connection point of supply component (e.g., KCU) to last KSM/KMS of a drive line
2) For electric decoupling at rated current
3) Segment length: Cable length between two KSM/KMS
4) For thermal decoupling of the connection points at rated current
5) Segment length: Cable length between external component and KSM/KMS

Tab. 7-3: Cable length limit values

For routing in the flexible cable track, determine the "maximum allowed length in the flexible cable track" $l_{max\_schlepp}$ within the maximum segment length l_{seg} using the figure below.



1	Segment length (l_{seg})
2	Maximum allowed length in flexible cable track ($l_{max\_schlepp}$)
3	Example: With a segment length of 60 m, the maximum allowed length in the flexible cable track is approx. 32 m.
A	l_{seg} = 75 m; $l_{max\_schlepp}$ = 11.5 m
B	l_{seg} = 48 m; $l_{max\_schlepp}$ = 48 m

Fig. 7-12: Maximum allowed cable length for routing in the flexible cable track

The length $l_{max\_schlepp}$ taken from the figure is the length of the movable part of the cable connection between two motors. The RKH0700 cable can be used for the movable part of the flexible cable track connection so that it is replaceable and thereby easy to maintain.

Technical justification of the specified lengths: Only within the specified lengths is it ensured that the properties of the Ethernet communication (attenuation, crosstalk) remain in the allowed range during the service life of the cable.

Length of hybrid cable without communication

In preparation

Hybrid cable length vs. KCU performance

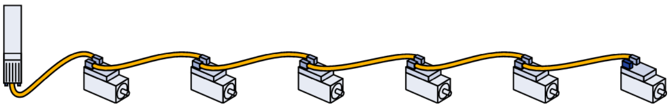
The maximum allowed hybrid cable length of a drive line can be determined using the power required by the servo drives.

☞ You can operate **a maximum of 30 KSM/KMS** at one KCU.

Install an additional KCU, if you would like to operate more than 30 KSM/KMS.

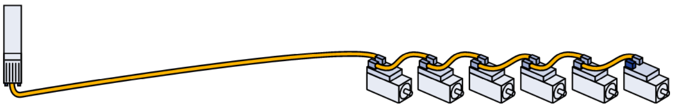
In the following paragraphs, we distinguish **3 cases**:

A: **Servo drives evenly distributed over the entire drive line**



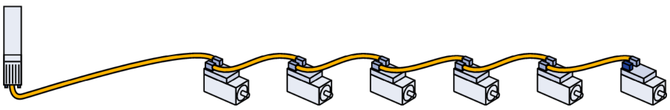
The servo drives are evenly distributed over the entire length of the drive line. The cables between the individual servo drives all have the same length.

B: **Servo drives evenly distributed at the end of the drive line**



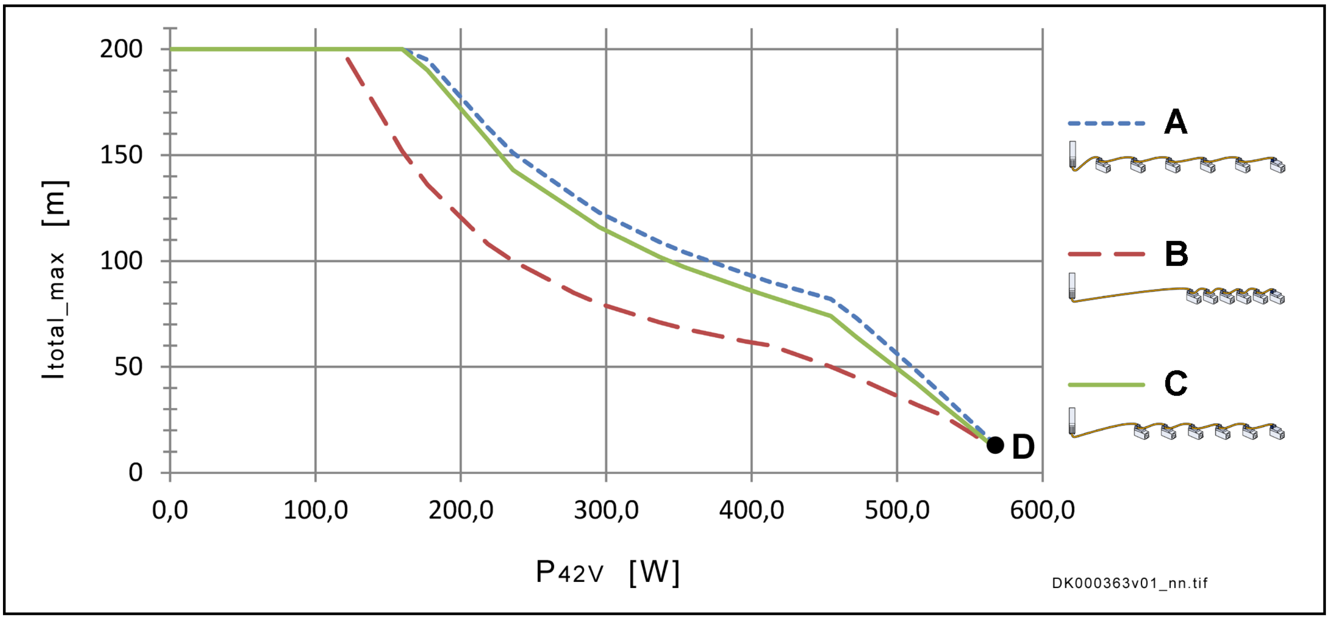
The servo drives are arranged at the end of the drive line and interconnected with short cables (1 m).

C: **Servo drives evenly distributed starting at 20% of the drive line**



The first servo drive is arranged at 20% of the length of the entire drive line. After this, the servo drives are evenly distributed up to the end of the drive line.

The figure below shows the maximum allowed hybrid cable length of a drive line depending on P_{42V} (P_{42V} = KCU output X53 load).



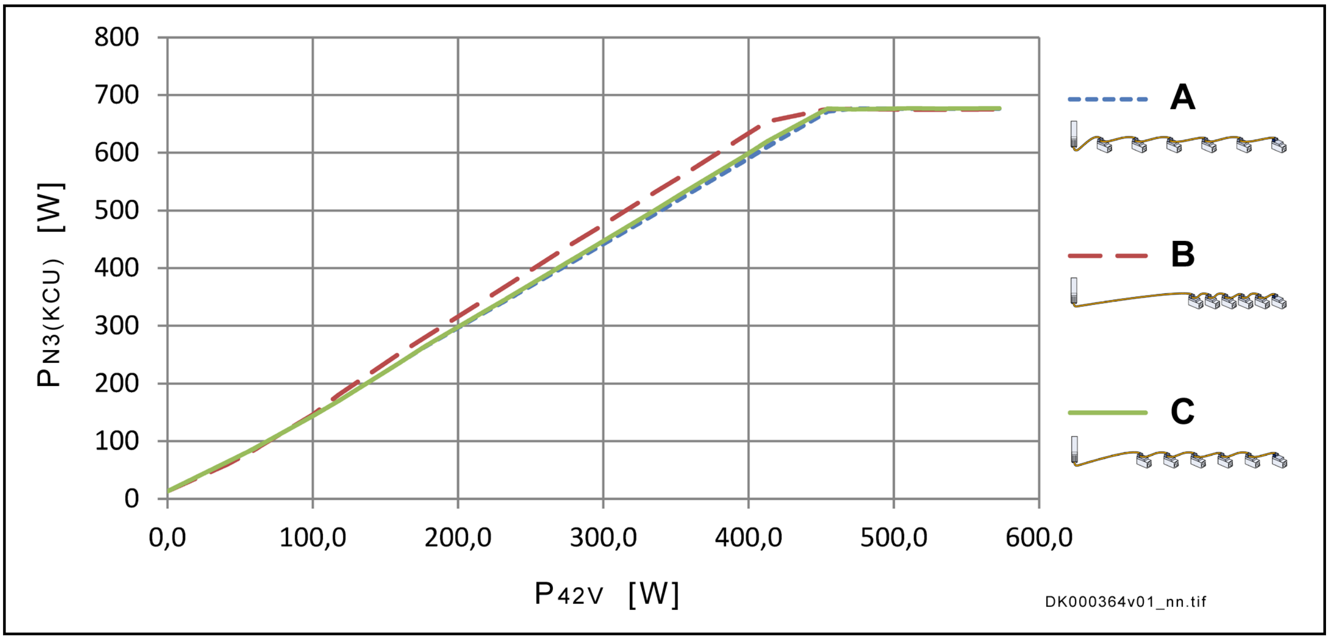
A	Servo drives evenly distributed over the entire drive line
B	Servo drives evenly distributed at the end of the drive line
C	Servo drives evenly distributed starting at 20% of the drive line
D	Limit value: Hybrid cable length = 16 m with P_{42V} = 588 W
l_{total_max}	Maximum allowed hybrid cable length of a drive line
P_{42V}	KCU output X53 load (without cable losses)

Fig. 7-13: Maximum allowed hybrid cable length of a drive line

☞ For exact calculations of the allowed hybrid cable lengths in limit cases, please contact our support team:

drivesupport@boschrexroth.de;
FAQ_IndraDriveMiV2_NumberOfAxes_CableLengths

The figure below shows $P_{N3(KCU)}$ (KCU power consumption from 24V supply) depending on P_{42V} (KCU output X53 load).



A	Servo drives evenly distributed over the entire drive line
B	Servo drives evenly distributed at the end of the drive line
C	Servo drives evenly distributed starting at 20% of the drive line
P_{42V}	KCU output X53 load (without cable losses)
$P_{N3(KCU)}$	Maximum KCU power consumption from 24V supply

Fig. 7-14: $P_{N3(KCU)}$ vs. P_{42V}

☞ $P_{N3(KCU)}$ is a value for the project planning of the 24V supply.

It is impossible to deduce thermal losses in the control cabinet from the difference between the power $P_{N3(KCU)}$ and P_{42V}. The typical losses of KCU are approx. 40% less than the maximum calculated values.

Hybrid cable length vs. KMV03 performance

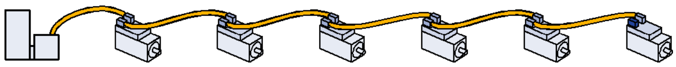
The maximum allowed hybrid cable length of a drive line can be determined using the power required by the servo drives.

☞ You can operate **a maximum of 30 KSM/KMS** at one KMV.

Install an additional KMV, if you would like to operate more than 30 KSM/KMS.

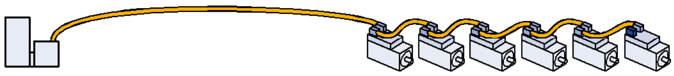
In the following paragraphs, we distinguish **3 cases**:

A: **Servo drives evenly distributed over the entire drive line**



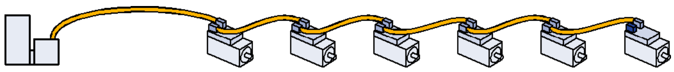
The servo drives are evenly distributed over the entire length of the drive line. The cables between the individual servo drives all have the same length.

B: **Servo drives evenly distributed at the end of the drive line**



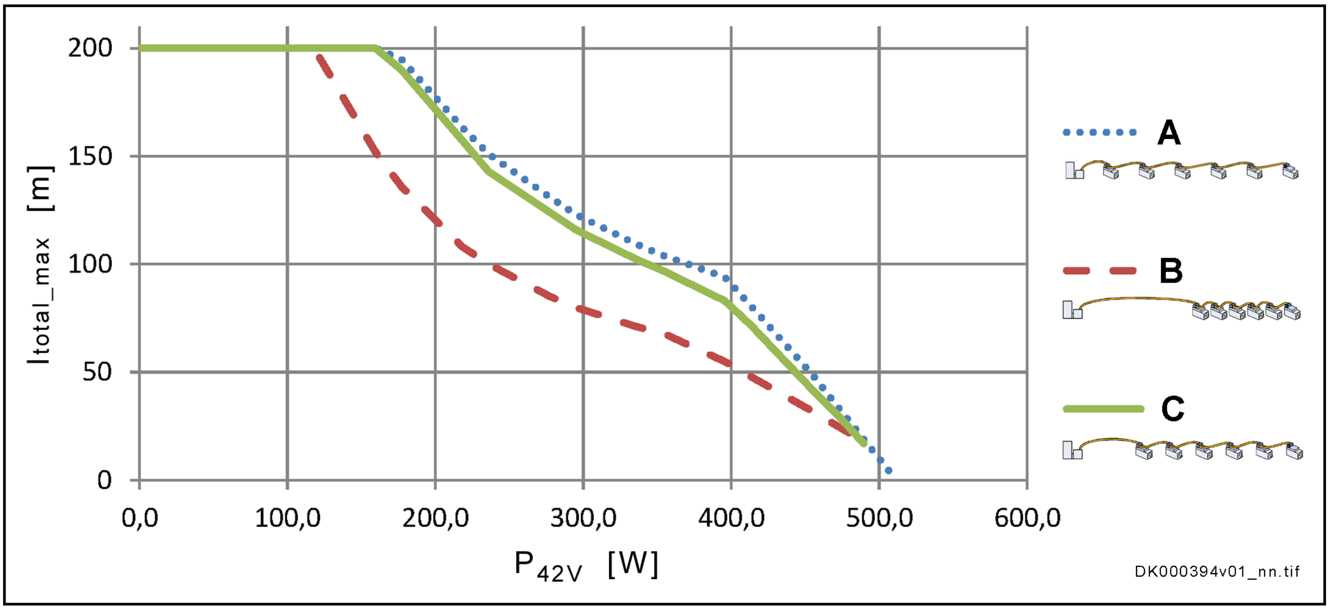
The servo drives are arranged at the end of the drive line and interconnected with short cables (1 m).

C: **Servo drives evenly distributed starting at 20% of the drive line**



The first servo drive is arranged at 20% of the length of the entire drive line. After this, the servo drives are evenly distributed up to the end of the drive line.

The figure below shows the maximum allowed hybrid cable length of a drive line depending on P_{42V} (P_{42V} = KMV output XD10 load).



A	Servo drives evenly distributed over the entire drive line
B	Servo drives evenly distributed at the end of the drive line
C	Servo drives evenly distributed starting at 20% of the drive line
l_{total_max}	Maximum allowed hybrid cable length of a drive line
P_{42V}	KMV output XD10 load (without cable losses)

Fig. 7-15: Maximum allowed hybrid cable length of a drive line

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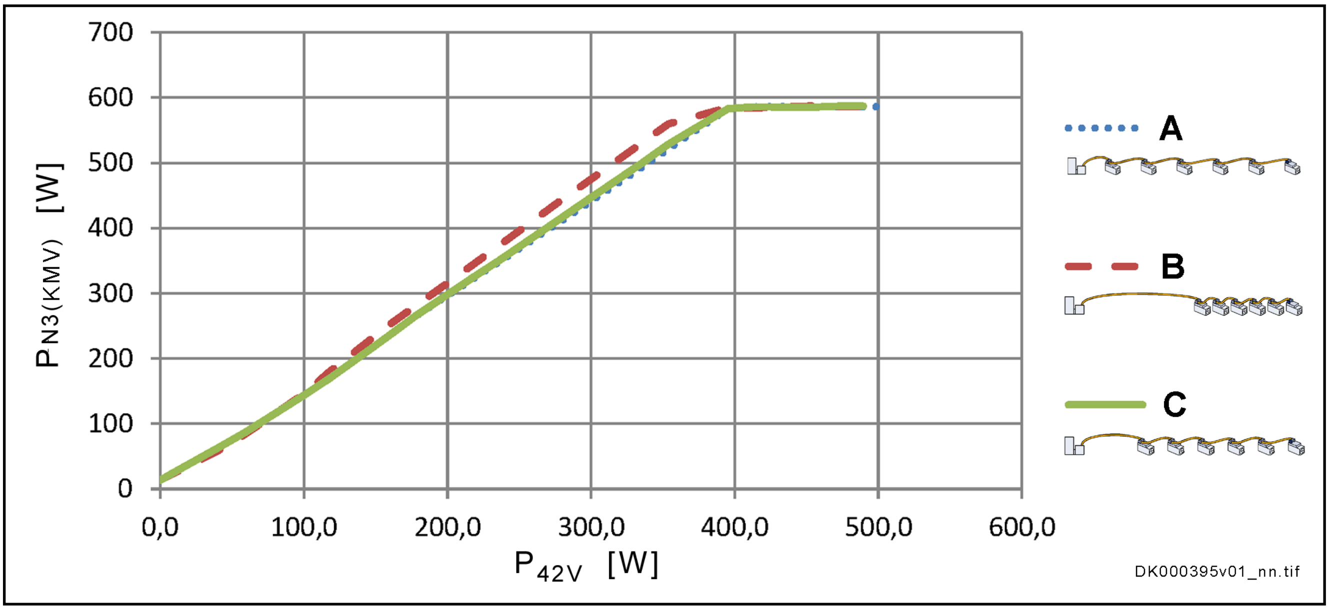
☞ For exact calculations of the allowed hybrid cable lengths in limit cases, please contact our support team:

drivesupport@boschrexroth.de;
FAQ_IndraDriveMiV2_NumberOfAxes_CableLengths

The figure below shows $P_{N3(KMV)}$ (KMV power consumption from 24V supply) depending on P_{42V} (KMV output XD10 load).



A	Servo drives evenly distributed over the entire drive line
B	Servo drives evenly distributed at the end of the drive line
C	Servo drives evenly distributed starting at 20% of the drive line
P_{42V}	KMV output XD10 load (without cable losses)
$P_{N3(KMV)}$	Maximum KMV power consumption from 24V supply

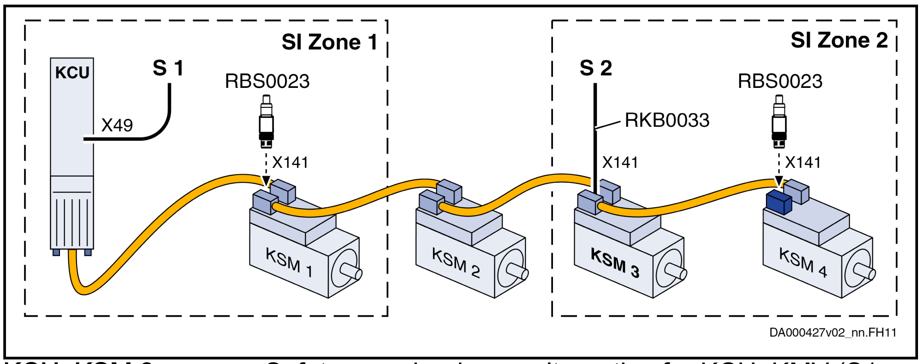
Fig. 7-16: *$P_{N3(KMV)}$ vs. P_{42V}*

7.1.8 Zone setup

Safety zones

Safety zone

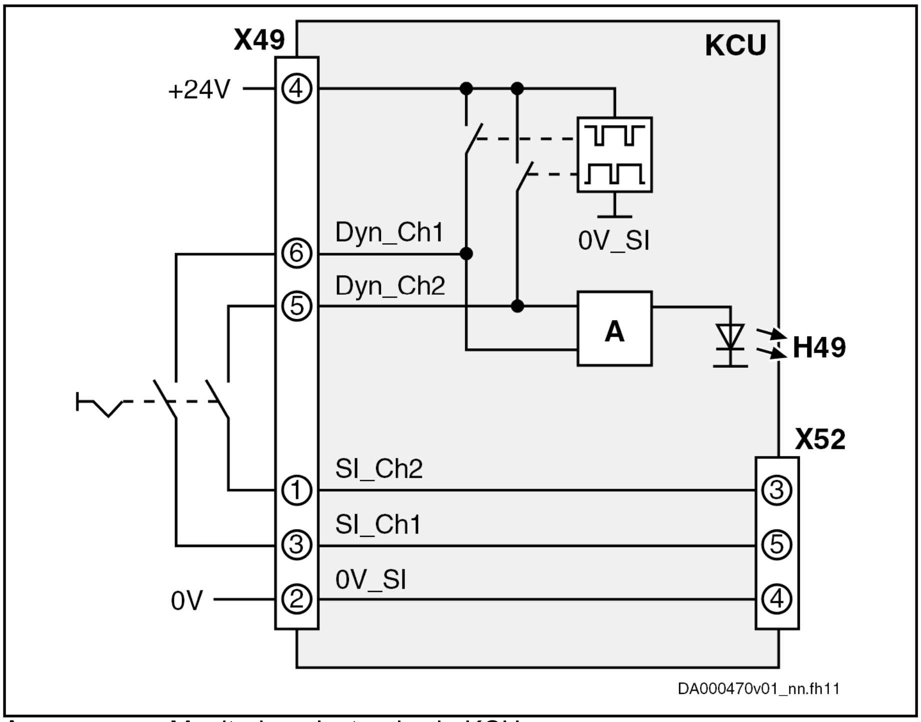
A **safety zone** consists of a **safety zone beginner** and one or several **safety zone nodes**. The example shows a drive system with 2 safety zones.



KCU, KSM 3	Safety zone beginner; alternative for KCU: KMV (S1 signal via X141 at KSM 1; KMV is not a safety zone node)
KSM 1, KSM 4	Safety zone node
KSM 2	KSM without optional safety technology ⇒ not a safety zone node
RBS0023	Connector for safety zone node at connection point X141 (only required for KSM/KMS with optional safety technology)
RKB0033	Cable for transmitting the safety-related signals
S 1, S 2	Signals of the individual safety zones
SI Zone 1, SI Zone 2	Safety zones
X49, X141	Connection points of safety technology

Fig. 7-17: Safety zones

Safety zone beginner KCU

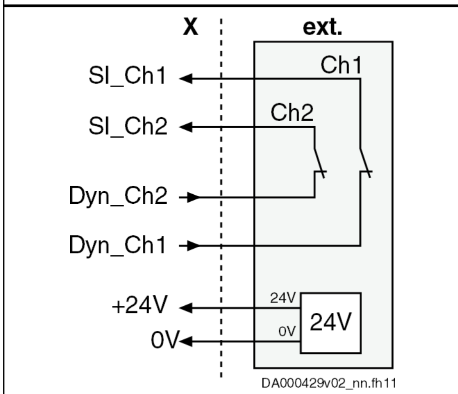
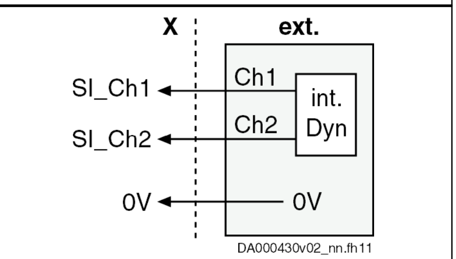


A Monitoring electronics in KCU
H49 Diagnostic display for safety technology signals

Fig. 7-18: Safety zone beginner KCU

Two options for signal input:

- Passive safety unit with internal dynamization pulses in conjunction with external safety technology contacts and an external 24V power supply unit
- Active safety unit via a safety PLC

Passive safety unit	Active safety unit
	 int. Dyn: Dynamization pulses are internally generated

ext. External safety unit for a safety zone
X Connection point of the safety zone beginner

Tab. 7-4: Signal input

Safety zone node

When a KSM/KMS **with** optional safety technology is to be a safety zone node within a safety zone, X141 has to be equipped with the connector RBS0023.

KSM/KMS **without** optional safety technology do not require the connector, because for these devices the signals are directly transmitted to the next safety zone node via X103.1 and X103.2. KSM/KMS without optional safety technology are not safety zone nodes and do not react to safety technology signals.

Documentation

The subject of safety technology is very complex so that it is not explained in detail in this Project Planning Manual.

📖For detailed information on safety technology, see the documentation "Rexroth IndraDrive Integrated Safety Technology as of MPx-1x" (mat. no.: R911332634).

E-Stop function

With KCU: The E-Stop function is wired at KCU and transmitted to KSM/KMS via the hybrid cable.

In this case, the E-Stop signal is input to the safety zone via an isolated 24V contact (X50.3) at KCU. The reference potential of the E-Stop signal within the safety zone is X53.1 (output of the DC-DC converter in KCU).

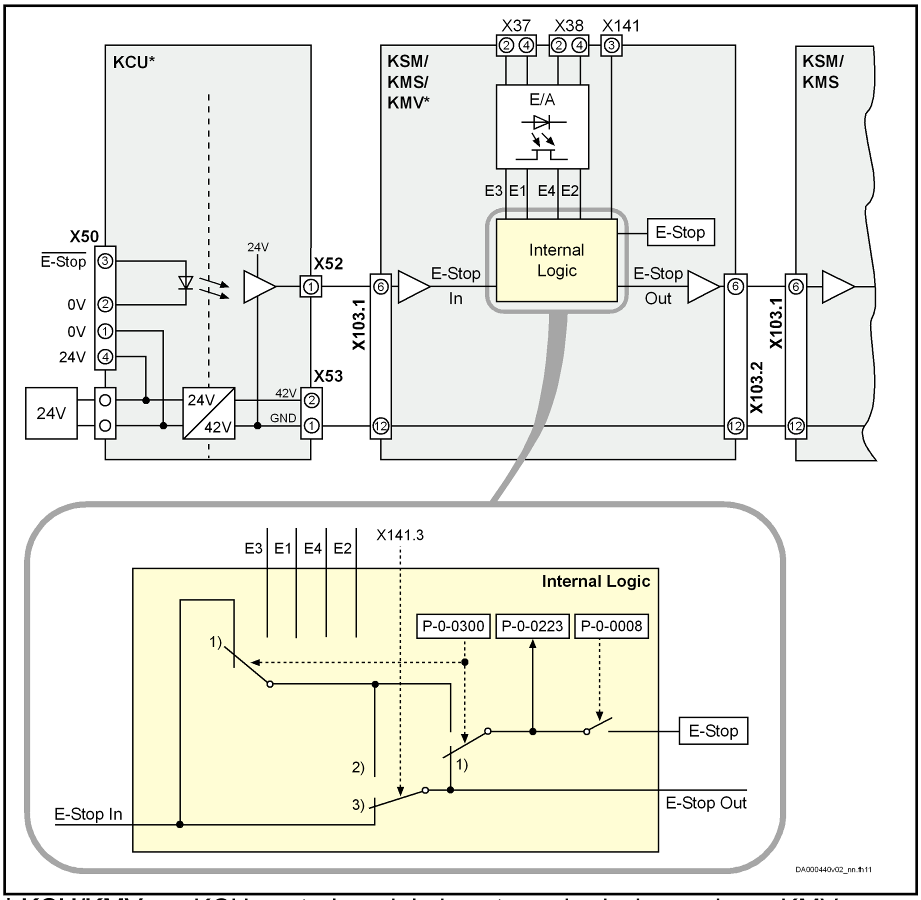
With KMV: The E-Stop function is wired at KMV (X141) and transmitted to KSM/KMS via the hybrid cable.

The E-Stop signal is amplified in each KSM/KMS.

Assigning and transmitting E-Stop signals

- If a KSM/KMS/KMV has been configured as a **safety zone beginner** (X141.3 = n. c., P-0-0249 = 2) and an **E-Stop signal has been assigned** to this KSM/KMS/KMV via an I/O (X37/X38; with KMV: X37.4/X38.4), this E-Stop signal is transmitted to the subsequent KSM/KMS (pertinent parameters: P-0-0223, P-0-0300).

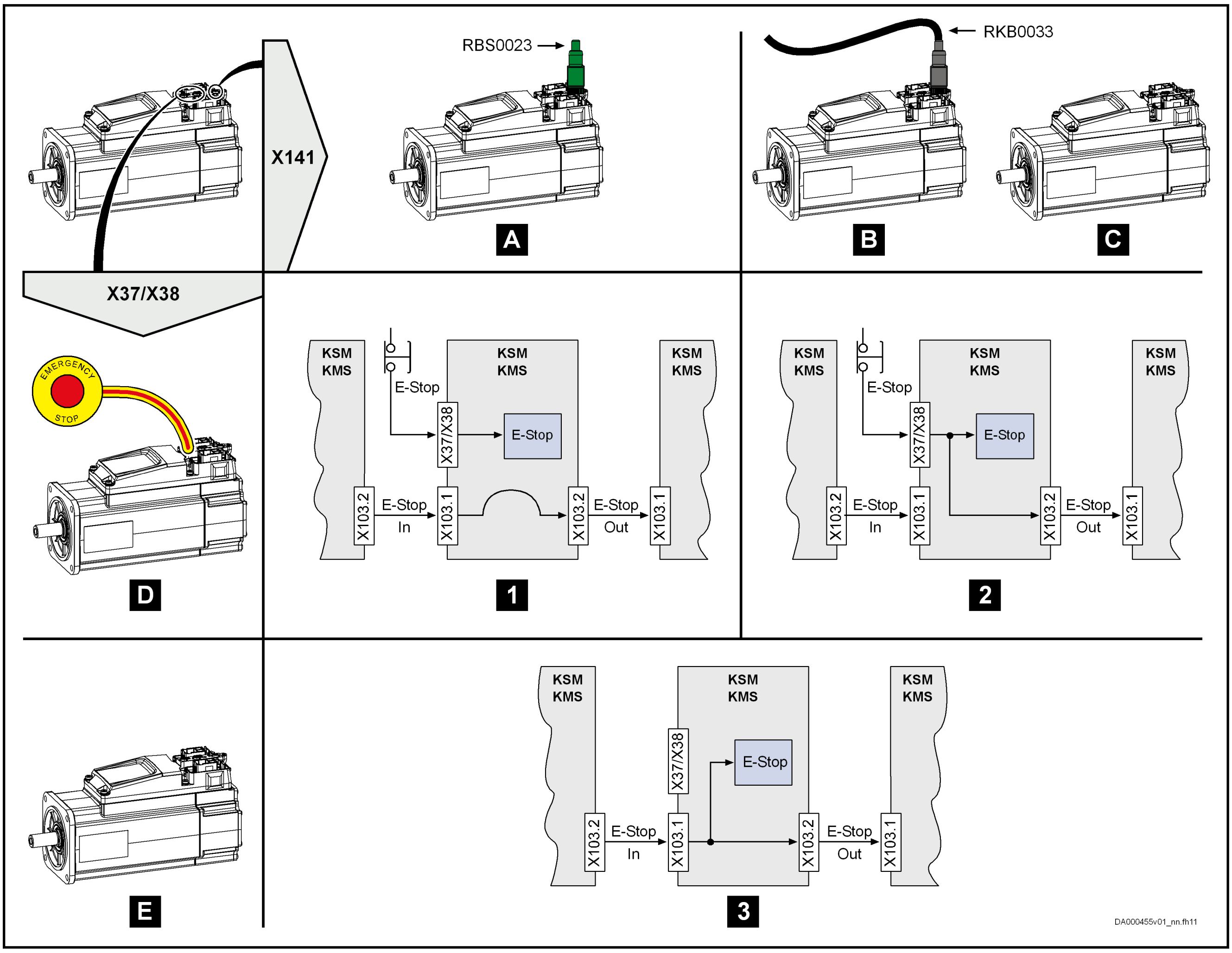
  When a new safety zone begins, a new E-Stop zone can be begun via a local I/O (X37.4/X38.4).
- If a KSM/KMS/KMV has been configured as a **safety zone beginner** (X141.3 = n. c., P-0-0249 = 2) and **no E-Stop signal has been assigned** to this KSM/KMS/KMV, the E-Stop signal of the preceding safety zone is transmitted.



*** KCU/KMV**	KCU control module is not required when using a KMV supply unit
E1, E2, E3, E4	Digital inputs
P-0-0300	Digital inputs, assignment list
P-0-0223	E-Stop input
P-0-0008	Activation E-Stop function
1)	Position of switch if P-0-0223 (E-Stop input) not entered in any element of P-0-0300 (default state)
2)	Position of switch if X141 equipped with RKB0033 cable or open; P-0-0249 = 2 (zone beginner)
3)	Position of switch if X141 equipped with RBS0023 connector; P-0-0249 = 1 (zone node)

Fig. 7-19: E-Stop zone setup

☞ The E-Stop zone setup is independent of whether a safety technology option L3 is available or not.



A	RBS0023 at X141
B	RKB0033 at X141
C	X141 not connected
D	E-Stop wired at X37/X38 and configured in P-0-0300
E	E-Stop not wired at X37/X38 and/or not configured in P-0-0300
1	Not an E-Stop zone node, local E-Stop takes effect
2	E-Stop zone beginner
3	E-Stop zone node

Fig. 7-20: Logic table of E-Stop zone setup

📖 See also Functional Description of firmware "E-Stop function".

7.1.9 Motor fan for KSM02

Fans are not available for KSM02 motor-integrated servo drives.

7.1.10 Evaluation of motor encoders at KMS

KMS near motor servo drives evaluate sin-cos encoders 1 V_{pp}.

HIPERFACE encoder: The maximum allowed nominal current consumption is 60 mA.

Encoders with reference track cannot be evaluated.

Switching off power supply via firmware

The "parking axis" firmware command (C1600) causes the encoder power supply to be switched off.

7.1.11 Length of motor cables and encoder cables at KMS

The allowed length of motor cables at connection X156 or X104 of KMS is limited (see description of connection point X156 or X104).

7.1.12 Operation with standard motors

KMS02 near motor servo drives without X104 connection (encoder interface = "NNN") are provided for operating converter-proof standard motors..

Guide value "Rise of voltage at output"

When selecting **standard motors**, make sure that they comply with the occurring voltage load "rise of voltage at output" (see KMS data sheet).

Selecting standard motors

The table below shows the nominal powers P_{nenn} of standard motors which can be operated. The data are subject to the following conditions:

- Motor design:

  4-pole standard motor (2 pole pairs) with rated voltage 3 AC 400 V, 50 Hz at mains voltage U_{LN} ≥ 3 AC 400 V or
- Operation at minimum switching frequency f_s= f_s (min.)
- Rotary field at output with f_{out}>f_{out_still}
- Overload ratio K = P_{DC_peak} / P_{DC_base} according to performance profile "UEL_P_e"

Observe the performance data P_{DC_peak} and P_{DC_base} in the performance profile "UEL_P_e" of the supply unit and the performance data of the KCU drive connection box.

Selecting standard motors 3 AC 400 V - exemplary profiles

Description	Symbol	Unit	KMS02.1B-A018	KMS03.1B-A036	KMS03.1B-B036
Nominal power standard motor 3 AC 400 V; 50 Hz; t > 10 min; K = 1.0; f_s = 4 kHz1)	P_{Nenn}	kW	Less than or equal to 2.2	-	
Nominal power standard motor 3 AC 400 V; 50 Hz; t = 60 s; T = 10 min; K = 1.1; f_s = 4 kHz2)	P_{Nenn}	kW	Less than or equal to 1.5	-	
Nominal power standard motor 3 AC 400 V; 50 Hz; t = 60 s; T = 5 min; K = 1.5; f_s = 4 kHz3)	P_{Nenn}	kW	Less than or equal to 1.5	-	
Nominal power standard motor 3 AC 400 V; 50 Hz; t = 2 s; T = 20 s; K = 2.0; f_s = 4 kHz4)	P_{Nenn}	kW	Less than or equal to 2.2	-	
Last modification: 2016-02-11					

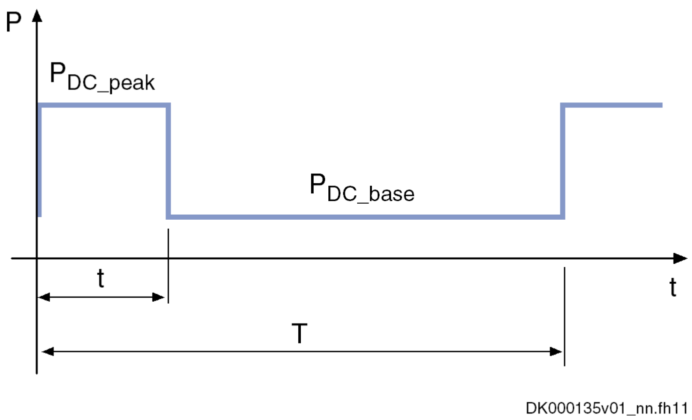
1) 2) 3) 4) See UEL_P_e profile definition

Tab. 7-5: KMS - Selecting standard motors 3 AC 400 V - exemplary profiles

Performance Profile "UEL_P_e"

The following performance profiles have been defined for converters and inverters.

Observe the allowed performance data P_{DC_peak} and P_{DC_base} in the corresponding performance profile of the supply unit or converter.

Profile	Explanation
Performance profile "UEL_P_e" 	Characteristic of the selection of standard motors and servo drives.

Tab. 7-6: Definition of Performance Profiles, Infeeding Supply Units and Converters

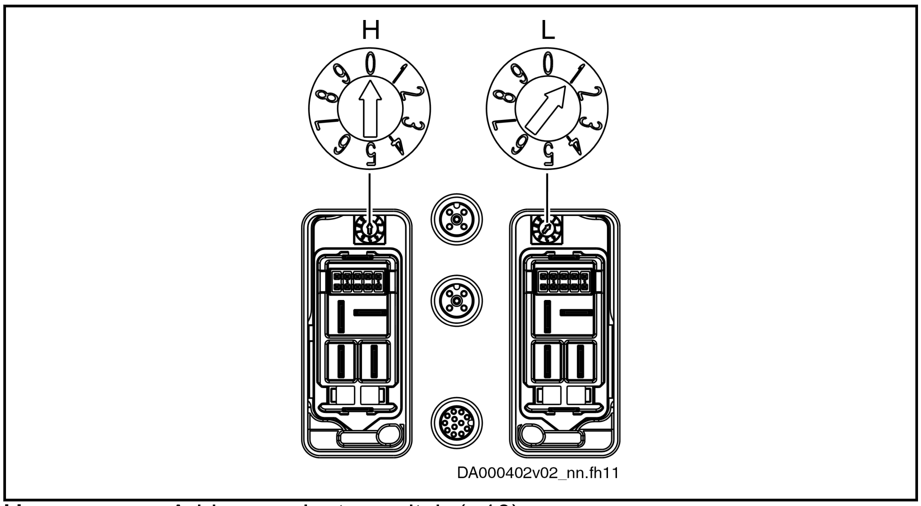
7.2 Notes on electrical project planning

7.2.1 Address Selector Switch

⚠ WARNING High electrical voltage! Danger to life by electric shock!

Before viewing the address, switch off power supply and wait until the 30-minute discharge time has elapsed. Pull off the connectors form X103.1 and X103.2 only thereafter.

Set the address for each KSM/KMS with the H and L rotary switches. The rotary switches are hidden under the X103.1 and X103.2 connector hoods.



H Address selector switch (×10)
L Address selector switch (×1)

Fig. 7-21: Address Selector Switch

Setting	Description
"00" H = 0 L = 0	"00" is the factory setting of the address selector switches. This setting is **not** applied. The individual drive address must be set in parameter "S-0-1040, Drive address of master communication".
"01" … "99" H = 0 … 9 L = 0 … 9 Drive address = H×10 + L	Settings of the address selector switches are applied to "S-0-1040, Drive address of master communication" during the booting process. Example for setting drive address "14": H = 1, L = 4 ⇒ drive address = 1×10 + 4 = 14
See also documentation Parameter Description: • "S-0-1040, Drive address of master communication" • "S-0-1046, List of slave addresses in device" • "P-0-4089.0.3, Device Address"	

Tab. 7-7: Setting the Drive Address at H and L

Order in drive line

The order of the addresses in a drive line can be selected as desired.

7.2.2 IP configuration

The active Engineering IP address is contained in the parameter S-0-1020. There are two functionally different methods to write the parameter S-0-1020:

- Automatic assignment of the IP address
- Manual assignment of the IP address

Automatic assignment

Automatic assignment means: The drive generates its Engineering IP address automatically with the value of the drive address (S-0-1040). The drive address can be set **via a control unit or via the address selector switches**. The IP address then consists of:

- Subnet address (192.168.0.0, after the basic parameters were loaded)
- Drive address

The following conditions must have been fulfilled for the automatic setting:

- A class C network (subnet mask: 255.255.255.0) was entered in parameter S-0-1021
- The list element 3 of the parameter S-0-1020 (address within the subnet) should not have been actively written after the basic parameters had been loaded

Example in condition as supplied:

1. Address selector switches at H = 1 and L = 3
2. Boot the drive (drive applies the value 13 to S-0-1040)
3. Drive has the IP address 192.168.0.13 with subnet mask 255.255.255.0

Manual assignment

Manual assignment of the IP address means: The desired value is always directly written to the parameter S-0-1020. The drive address or the address selector switches are without effect.

The value in S-0-1020 is only valid after the IP settings have been activated (C6100 Command Activate IP settings) or after the drive has been booted (C6400 Reboot command) for the Engineering communication. The manual setting applies as soon as at least one of the two following conditions has been fulfilled:

- The parameter S-0-1021 contains a value other than 255.255.255.0
- The list element 3 of the parameter S-0-1020 was actively written

Once the IP address has been manually written, the IP address can only be changed by writing it manually again.

Only after the basic master communication parameters have been loaded can the IP address be assigned automatically again, e.g. via the address selector switches.

7.2.3 Current limitation

The current limitation makes sure that neither drive controller nor motor are damaged by overload, as long as the motor temperature remains below

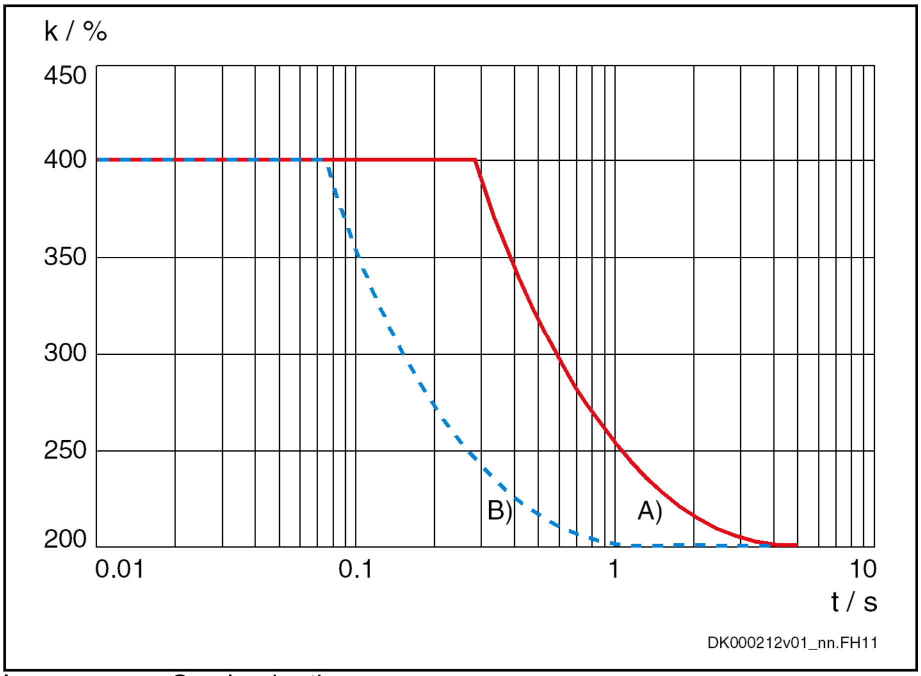
100 °C. When the housing temperature exceeds 100 °C, overtemperature shutdown takes place.

Above 200% of the continuous torque at standstill an I^2t limitation[1)] starts. It limits the temperature of winding and electronics to the safe working range.

In standstill (turning shaft n < ~ 60 min^{-1}), the current is limited in a more restrictive way, due to the concentration of losses in one phase. For bigger motors, the continuous torque at standstill can be less than 200% of the continuous torque at standstill 60 K.

The limitation starts at 100% of thermal drive load. To have reserve capacity (e.g., for dynamic processes or increased friction), the drive system should not be dimensioned with more than 80% of thermal drive load. The drive load should be checked during the initial commissioning.

See also "P-0-0141, Thermal drive load"



k	Overload ratio
A)	Turning shaft n > ~ 60 min^{-1}
B)	Standstill n < ~ 60 min^{-1}

Fig. 7-22: Example of current limitation

☞ To determine the resulting torque or current limitations, additionally take the motor current limitations into account. See "KSM02 characteristics" or for KMS02 the data sheet of the motor used.

7.2.4 Motor temperature

Since the electronics is thermally connected to the motor housing, the amplifier temperature is the most important load variable. This temperature is measured and can be read as parameter "S-0-0384, Amplifier temperature". It is slightly higher than the housing temperature and should not exceed 100 °C. Operation under rated conditions causes temperature rise of 60 K.

If 105 °C are exceeded, the motor temperature warning is generated; after 30 seconds, power is switched off.

1) *The product of the square of the current and the time results in a constant*

The motor has been correctly dimensioned, if the difference between amplifier temperature read from the parameter and ambient temperature remains at less than 60 K in operation.

See also "S-0-0384, Amplifier temperature".

7.2.5 Switching frequency

The nominal values refer to a switching frequency of 4 kHz. Operation with 8 kHz is possible, but should be avoided where possible. Continuous torque and peak torque are considerably reduced at 8 kHz and the higher basic losses cause higher motor temperature rise already in no-load operation.

See also "P-0-0001, Switching frequency of the power output stage".

7.3 Notes on mechanical project planning

7.3.1 Mounting clearance

The mounting clearance has to comply with both mechanical and thermal requirements. The mechanical requirements are complied with by taking the dimensions of the components and their attached constructions (e.g. cables) into account. Observe the minimum mounting clearances (dimensions) specified in the dimensional drawings.

To comply with the thermal requirements, it has to be possible to dissipate the power dissipation generated in the mounting clearance (e.g. control cabinet) while the (local) ambient temperature does not exceed the allowed ambient temperature T_{a_work}.

KCU ventilation

Take the air intake and air outlet into account for ventilation.

Observe the data d_{top}, d_{bot} and d_{hor} in the data sheet of KCU.

KSM, KMS mounting clearance

Make sure there is sufficient heat dissipation (e.g., ventilation, surface) in the mounting clearance, particularly in the case of "closed" mounting situations. Make sure that the cooling air can freely circulate around the housing surface to avoid pockets of heat. Keep the housing surface which has a cooling effect free from insulating dirt.

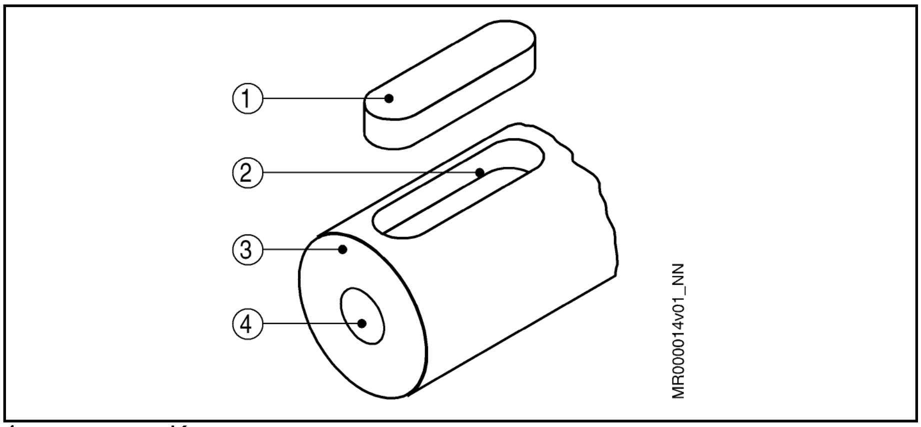
7.3.2 Output shaft

Plain shaft

The recommended standard design provides a friction-locked shaft-hub connection without backlash and excellent running smoothness. Use clamping sets, clamping sleeves or clamping elements to couple the machine elements to be driven.

Output shaft with key

The optional key according to DIN 6885, sheet 1, edition 08-1968, permits keyed transmission of torques with constant direction, with low requirements to the shaft-hub connection.



1	Key
2	Keyway
3	Motor shaft
4	Centering hole

Fig. 7-23: Output shaft with key

The machine elements to be driven additionally have to be secured in the axial direction via the centering hole on the end face.

NOTICE

Damage to the shaft! In case of intense reversing duty, the seat of the key may wear out. Increasing deformations in this area can then lead to breakage of the shaft!

Preferably use plain output shafts.

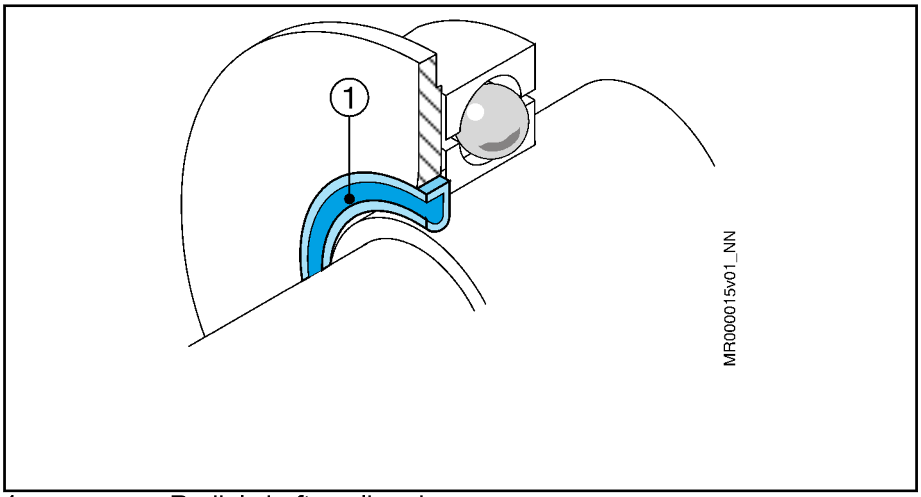
Balancing with the complete key

The motors have been balanced with the **complete** key. This means that the machine element to be driven must be balanced without a key.

☞ Modifications to the keys may be made only by the users themselves and on their own responsibility. Rexroth does not provide any warranty for modified keys or motor shafts.

Output shaft with shaft sealing ring

The motors have been designed with radial shaft sealing rings according to DIN 3760 - design A.



1 Radial shaft sealing ring

Fig. 7-24: Radial shaft sealing ring

Wear

Radial shaft sealing rings are rubbing seals. This means that they are subject to wear and generate frictional heat.

Wear of the rubbing seal can be reduced only if lubrication is adequate and the sealing point is clean. Here, the lubricant also acts as a coolant, supporting the discharge of frictional heat from the sealing point.

- Prevent the sealing point from becoming dry and dirty. Always ensure adequate cleanliness.

Resistance

The materials used for the radial shaft sealing rings are highly resistant to oils and chemicals. However, the suitability test for the particular operating conditions lies within the machine manufacturer's responsibility.

☞ The complex interactions between the sealing ring, the shaft and the fluid to be sealed, as well as the particular operating conditions (frictional heat, soiling, etc.), do not allow calculating the lifetime of the shaft sealing ring.

Vertical mounting positions IM V3

The degree of protection on the flange side of motors with a shaft sealing ring is IP 65. Therefore, tightness is ensured only in case of splashing fluids. Fluid levels present on side A require a higher degree of protection. If the motor is mounted in vertical position (output shaft pointing up), there should not be any fluid present at the output shaft.

Design information

Rexroth recommends that any direct contact of the output shaft and the radial shaft sealing ring with the processing medium (coolant, material corrosion) should be avoided by the machine or installation design.

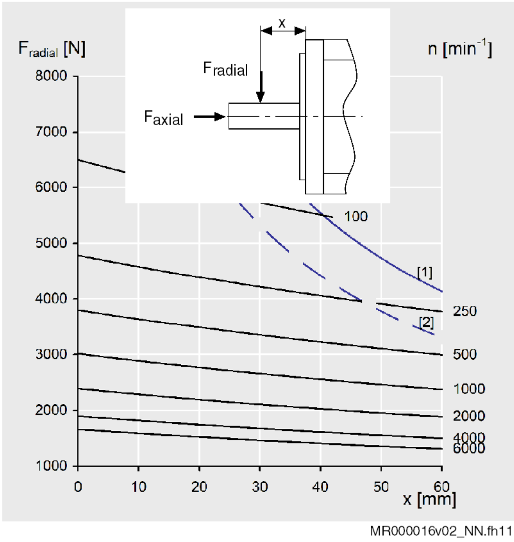
7.3.3 Bearings and shaft load

General information

During operation, both radial and axial forces act upon the motor shaft and the motor bearings. The design of the machine, the selected motor type and the attachment of driving elements on the shaft side have to be adapted to one another to ensure that the specified load limits are not exceeded.

Notes on project planning

Radial load, axial load



[1]	Breakage characteristic of the plain shaft
[2]	Breakage characteristic of the shaft with keyway
n	Arithmetic mean speed
x	Point of application of force

Fig. 7-25: Exemplary shaft load diagram

Maximum allowed radial force F_{radial_max}

The maximum allowed radial force F_{radial_max} depends on the following factors:

- Shaft break load
- Point of application of force x
- Shaft design (plain [1]; with keyway [2])

Allowed radial force F_{radial}

The allowed radial force F_{radial} depends on the following factors:

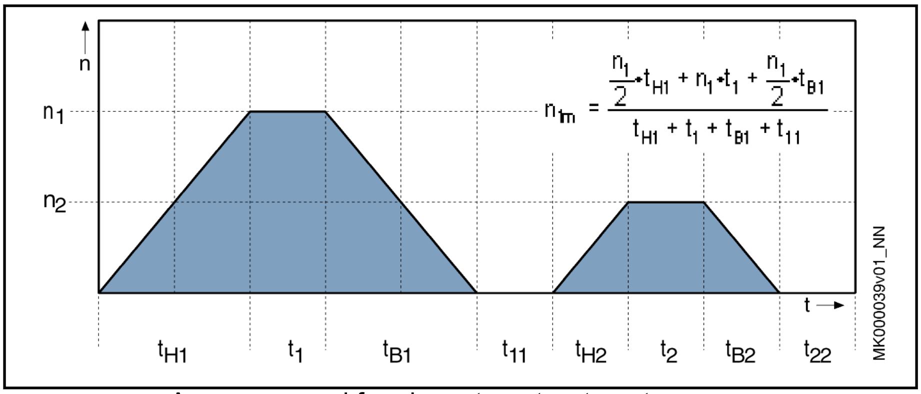
- Arithmetic mean speed (n_{mean})
- Point of application of force x
- Bearing service life

Allowed axial force F_{axial}

The maximum allowed axial force F_{axial} is specified in the technical data.

Average speed

The run-up and braking times can be ignored in the calculation, if the time in which the drive is operated at a constant speed is significantly greater than the acceleration and braking time. In the exact calculation of the average speed according to the following example, the run-up and braking times are taken into account.



n_{1m}	Average speed for phase $t_{H1} + t_1 + t_{B1} + t_{11}$
n_{2m}	Average speed for phase $t_{H2} + t_2 + t_{B2} + t_{22}$
n_1; n_2	Processing speed
t_{H1}; t_{H2}	Run-up time
t_1; t_2	Processing time
t_{B1}; t_{B2}	Braking time
t_{11}; t_{22}	Standstill time

Fig. 7-26: Average speed

A complete processing cycle can consist of several phases with different speeds. In this case, the average is to be generated from all phases.

Bearing service life

The nominal service life of the bearings is L10h > 30,000 h (according to DIN ISO 281, ed. 1990), if the permissible radial and axial forces are not exceeded.

NOTICE **Risk of damage by inadmissible loads!**

Possible consequences of inadmissible loads: Premature failure of the bearings due to increased wear or mechanical damage.

Avoid exceeding the load limits.

Mechanical bearing service life at increased radial force

Otherwise, the bearing service life is reduced as follows:

$$L_{10h} = \left(\frac{F_{radial}}{F_{radial\_ist}}\right)^3 \cdot 30000$$

L_{10h}	Bearing service life (according to ISO 281, ed. 12/1990)
F_{radial}	Determined allowed radial force in N (newton)
F_{radial_ist}	Actually acting radial force in N (newton)

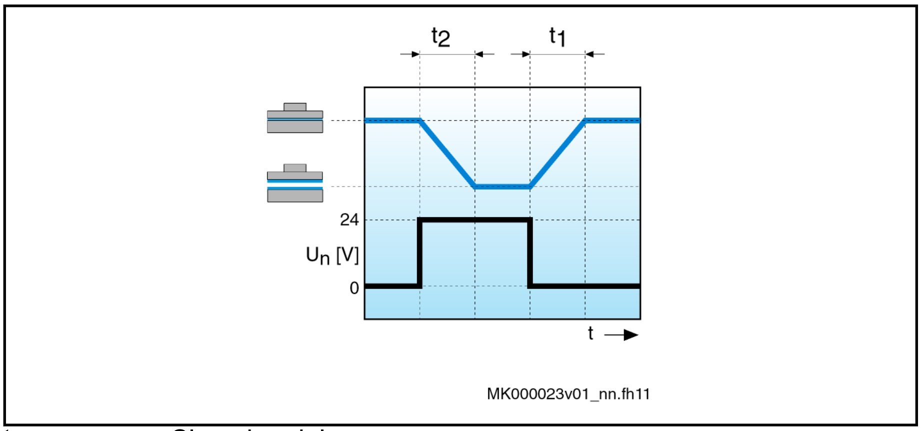
Fig. 7-27: Calculating the bearing service life L10h if the allowed radial force F_{radial} is exceeded

☞ Under no circumstances may the actually acting radial force F_{radial_act} be higher than the maximum allowed radial force F_{radial_max}.

7.3.4 Holding brakes

Brake control and supply

The integrated holding brake is supplied from the control voltage U_{N3}. It can only be switched via the firmware or SERCOS commands. It is an electrically releasing holding brake.



t_1 Clamping delay

t_2 Release delay

Fig. 7-28: Holding brake diagram

The holding brake should not be used to stop the turning motor during normal operation! The holding brake should not be used for safety-relevant purposes either.

☞ Holding brakes are available as an option. The supplied holding brake has been adapted to the corresponding motor!

Safety requirements

In normal operation, use the brake only when at standstill and when performing the drive-integrated brake check. The holding brake is required for holding the axis when the machine is in a de-energized state.

Observe the safety requirements during the system design:

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

Observe supplementary standards and guidelines. For European countries:

- DIN EN 954 / 03.97 Safety-related parts of control systems

- Information Sheet for vertical axes

Published by the institution for statutory accident insurance and prevention, technical committee iron and metal II:

Süddeutsche Metall-Berufsgenossenschaft

Fachausschuss Eisen und Metall II

Wilhelm-Theodor-Römheld-Str. 15

55130 Mainz

USA: See National Electrical Code (NEC), National Electrical Manufacturers' Association (NEMA), as well as local engineering regulations.

Generally, the following applies: Observe the national regulations!

⇒ The standard equipment motor holding brake is not sufficient to guarantee personal safety!

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

⇒ 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 an external braking/arrester/clamping mechanism or
- Ensuring sufficient counterbalancing of the vertical axes
- Other appropriate measures

Controlling the holding brake

The control electronics controls the integrated holding brake which excludes user errors.

Function check

Before commissioning and in operation, check the holding brake for its function in periodic intervals (e.g., every 8 hours) with an appropriate check. By applying a defined torque to the motor, check whether the holding brake has completely released. For additional information and data, see Functional Description of firmware (index entry "Motor holding brake → Function check").

Electrically releasing holding brake

The **electrically releasing** holding brake is used to hold the axes at standstill and when the drive enable signal is off. When the supply voltage fails and the drive enable signal has been switched off, the **electrically releasing** holding brake will automatically apply.

NOTICE **Risk of damage!**

Do not use the holding brake as a service brake for moving axes.

Sizing holding brakes

The physical conditions of holding brakes require consideration of two states. In addition to normal operation, failures have to be considered. The effective braking torques are physically different:

Normal operation

In **normal operation**, using the holding brake for clamping (holding) an axis in standstill, the "static holding torque" (M4) – static friction (friction coefficient μ_H) specified in the data sheets takes effect.

Failure (E-Stop)

In the case of **failure (E-Stop)**, where the holding brake is used to decelerate a moving axis, the "dynamic braking torque" – sliding friction (friction coefficient μ_G) applies.

The dynamic braking torque is lower than the indicated static holding torque M4. It is approx. 0.75 … 0.8 x M4. Therefore, observe the following description of dynamic sizing.

Dynamic sizing

The load torque has to be lower than the minimum dynamic torque which the brake can provide. Otherwise, the dynamic brake torque is not sufficient to stop the axis.

If a mass is to be decelerated in a defined time or over a defined distance, the mass inertia of the whole system additionally has to be taken into account.

Other important aspects for sizing

The holding brake is not a safety brake (cf. DIN EN 954 / 03.97 and Information Sheet for vertical axes published by the institution for statutory accident insurance and prevention ["Süddeutsche Metall-Berufsgenossenschaft"]). Due to uncontrollable disturbances, such as film rust on the brake friction surface, the holding brake torque can be reduced. Additionally, overvoltage and too high temperatures can weaken the permanent magnets and the brake.

Sizing - Recommendation

Considering these factors, the following recommendation can be given for sizing holding brakes at axes:

The holding torque required for the application should not exceed a maximum of 60% of the static holding torque (M4) of the holding brake used.

NOTICE **Holding torque reduction and premature wear occur when braking moving axes!**

Do not use the holding brake to stop a moving axis during normal operation. This is allowed for E-Stop situations only. In this situation, the specified rated torque of the holding brake (M4) is reduced to the dynamic braking torque. Complete deterioration of the holding brake can be expected after approx. 20,000 revolutions of the brake when applied.

Observe the commissioning instructions for holding brakes. See also Functional Description of firmware (index entry "Motor holding brake → Operating behavior").

7.3.5 Mechanical attachment of driving elements

General information

For all attachments of driving elements to the output shaft (e.g., gears, couplings, pinions), the following instructions absolutely have to be observed.

Redundant bearings

Generally, redundant bearings are to be avoided by all means when attaching driving elements. The tolerances inevitably present in such cases will lead to additional forces acting on the bearing of the motor shaft and, should the occasion arise, to a distinctly reduced service life of the bearing.

☞ If redundant attachment cannot be avoided, it is absolutely necessary that you consult Rexroth.

Gear attachment

The machine design and the attachment elements used have to be carefully adapted to the motor type so that the load limits of shaft and bearing are not exceeded.

When gears are attached to motors, this changes the thermal connection of the motor to the machine or installation design.

According to the gear type, the heat generation at the gear is different. In any case, gear attachment reduces the heat dissipation of the motor via the flange. This has to be taken into account when doing the project planning for the installation.

To avoid thermal overload of motors when using gears, it is necessary to reduce the specified performance data.

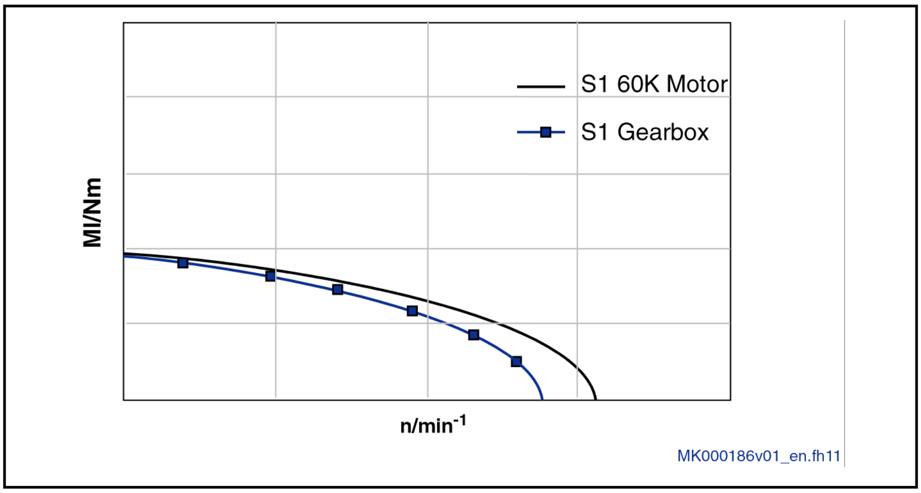


Fig. 7-29: Qualitative change in the S1 characteristic in the case of gear attachment

☞ The torques indicated in the motor characteristics have to be reduced by approx. 10–20% when gears are attached.

Observe all other notes and requirements contained in the documentations on the gears used.

Coupling attachment

The machine design and the attachment elements used have to be carefully adapted to the motor type so that the load limits of shaft and bearing are not exceeded.

NOTICE Risk of damage!

When connecting extremely stiff couplings, the radial force which constantly changes the angular position may cause an impermissibly high load on the shaft and bearing.

Bevel gear pinions or skew bevel driving pinions

Owing to thermal effects, the flange-side end of the output shaft may shift by up to 0.6 mm in relation to the motor housing. If helical driving pinions or bevel gear pinions directly attached to the output shaft are used, this change in position will lead to

- a shift in the position of the axis if the driving pinions are not defined axially on the machine side
- a thermally dependent component of the axial force if the driving pinions are defined axially on the machine side.

  This causes the risk of exceeding the maximum allowed axial force or of the backlash within the gears increasing to an impermissible degree.

☞ In such cases, you should therefore preferably use drive elements with their own bearings which are connected to the motor shaft via axially compensating couplings.

---

8 Identification

8.1 Scope of supply

8.1.1 KCU02

Standard	Optional
• KCU02 • Documentation	• Connection and mounting accessory HAS01.1-050 • Accessory for shield connection HAS02.1-015 • Mounting accessory HAS03 • Long Multi-Ethernet cable RKB0011 • Short Multi-Ethernet cable RKB0013

Tab. 8-1: Scope of Supply

8.1.2 KSM02/KMS02

Standard	Optional
• KSM02 or • KMS02 • Documentation	• RBS0023 Connector for safety zone user • RKB0033 Safety technology cable (X141 ↔ external safety unit) • RKB0043 Cable for communication (M12-D ↔ M12-D) • RKB0044 Cable for communication (M12-D ↔ RJ-45) • RKS0010 Interface cable (M12-A ↔ open ends) • HAS10 Fixing clip for hybrid cables

Tab. 8-2: Scope of Supply

8.1.3 KMS03

Standard	Optional
• KMS03 • Documentation	• RBS0023 Connector for safety zone node • RKB0033 Safety technology cable (X141 ↔ external safety unit) • RKB0043 Cable for communication (M12-D ↔ M12-D) • RKB0044 Cable for communication (M12-D ↔ RJ-45) • RKS0010 Interface cable (M12-A ↔ open ends) • HAS05.1-018 Dummy plate for KMS03 encoder connection • HAS10 Fixing clip for hybrid cables

Tab. 8-3: Scope of supply

8.1.4 KMV03

Standard	Optional
• KMV03 • Documentation	• HAS05.1-020 KMV03 control voltage • HAS10 Fixing clip for hybrid cables

Tab. 8-4: Scope of supply

8.1.5 KNK03

Standard	Optional
• KNK03	• HAS05.1-019 KNK03 mains voltage

Tab. 8-5: Scope of supply

8.2 Identifying and checking the delivered components

8.2.1 KSM type plate

Arrangement

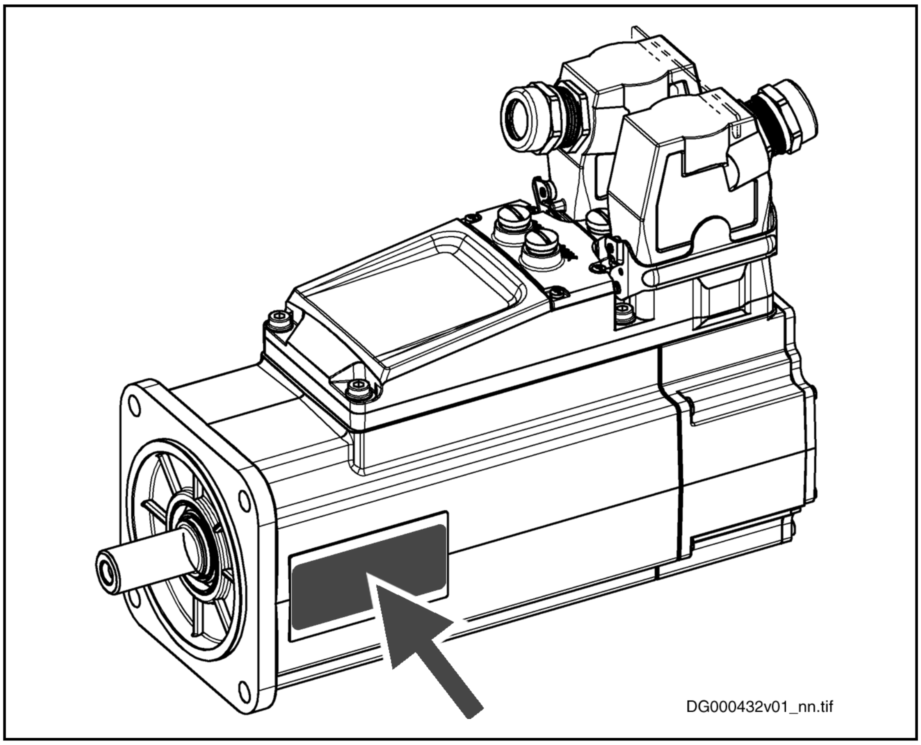
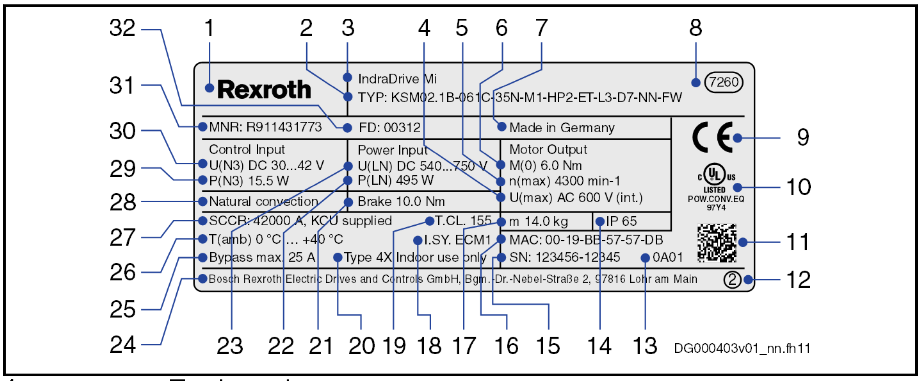


Fig. 8-1: Type plate arrangement

Identification

Design



1	Trademark
2	Type designation
3	Product range
4	Max. supply voltage
5	Maximum speed
6	Continuous torque at standstill
7	Country of manufacture
8	Manufacturing plant
9	CE conformity label
10	UL label
11	2-D bar code
12	Manufacturer code
13	Hardware revision index
14	Degree of protection in accordance with IEC 60529
15	Serial number
16	MAC address (Ethernet ID)
17	Mass
18	Insulation system
19	Insulation class according to EN 60085
20	Ambient conditions according to UL50/50E
21	Holding brake torque (optional)
22	Rated power (t > 10 min)
23	Rated input voltage, power (UL)
24	Company address
25	Maximum bypass current (UL)
26	Ambient temperature during operation
27	Short circuit current rating (UL); SCCR
28	Cooling type
29	Rated power consumption control voltage input at U_{N3} (UL)
30	Rated control voltage input (UL)
31	Parts number
32	Production date

Fig. 8-2: Type Plate KSM02

8.2.2 KMS02 type plate

Arrangement

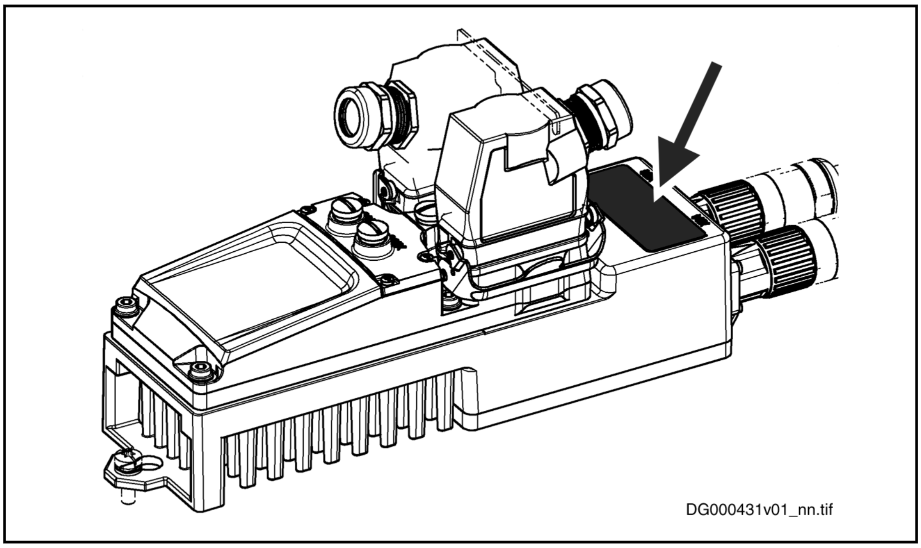
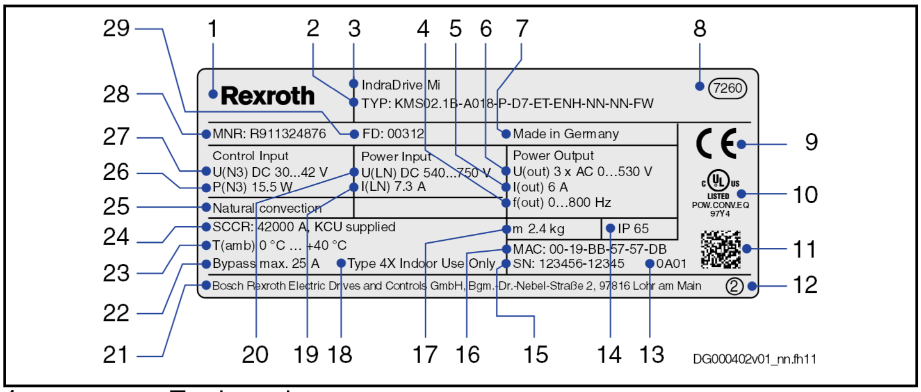


Fig. 8-3: Type plate arrangement

Identification

Design



1	Trademark
2	Type designation
3	Product range
4	Output frequency range
5	Output current
6	Output voltage
7	Country of manufacture
8	Manufacturing plant
9	CE conformity label
10	UL label
11	2-D bar code
12	Manufacturer code
13	Hardware revision index
14	Degree of protection in accordance with IEC 60529
15	Serial number
16	MAC address (Ethernet ID)
17	Mass
18	Ambient conditions according to UL50/50E
19	Rated input current (UL)
20	Rated input voltage (UL)
21	Company address
22	Maximum bypass current (UL)
23	Allowed ambient temperature
24	Short circuit current rating (UL)
25	Cooling type
26	Rated power consumption control voltage input at U_{N3} (UL)
27	Rated control voltage input (UL)
28	Parts number
29	Production date

Fig. 8-4: Type Plate KMS02

8.2.3 KMS03 type plate

Arrangement

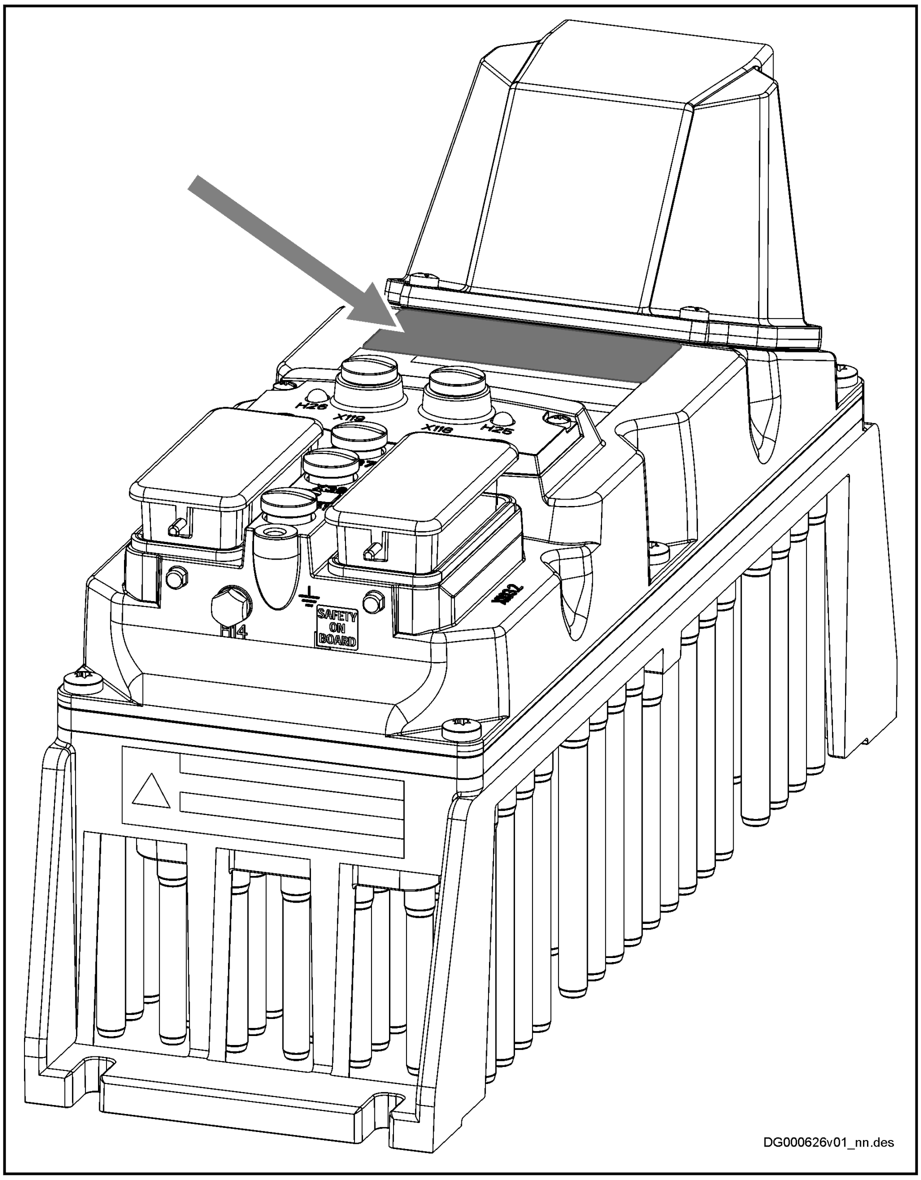
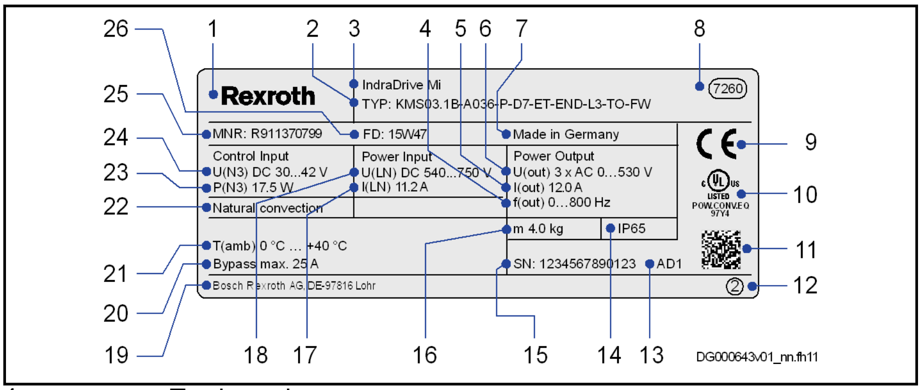


Fig. 8-5: Type plate arrangement

Identification

Design



1	Trademark
2	Type designation
3	Product range
4	Output frequency range
5	Output current
6	Output voltage
7	Country of manufacture
8	Manufacturing plant
9	CE conformity label
10	UL label
11	2-D bar code
12	Manufacturer code
13	Hardware revision index
14	Degree of protection in accordance with IEC 60529
15	Serial number
16	Mass
17	Rated input current
18	Rated input voltage
19	Company address
20	Maximum bypass current
21	Allowed ambient temperature
22	Cooling type
23	Rated power consumption control voltage input at U_{N3}
24	Control voltage input
25	Material number
26	Production date

Fig. 8-6: KMS03 type plate

8.2.4 KMV03 type plate

Arrangement

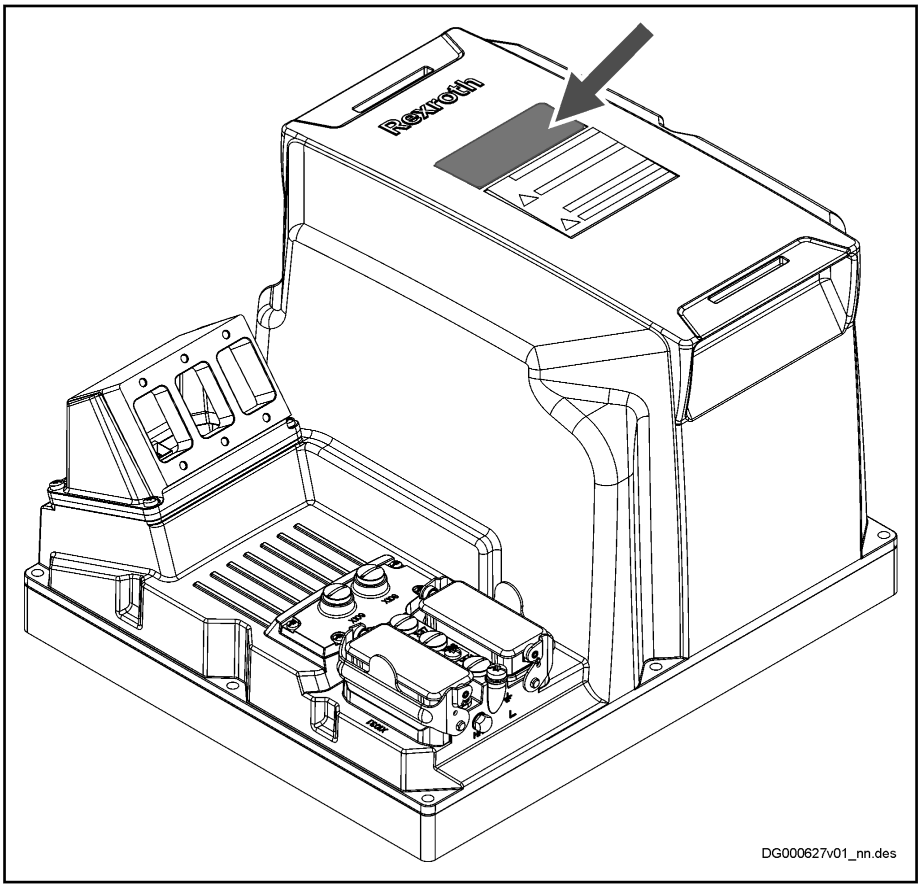
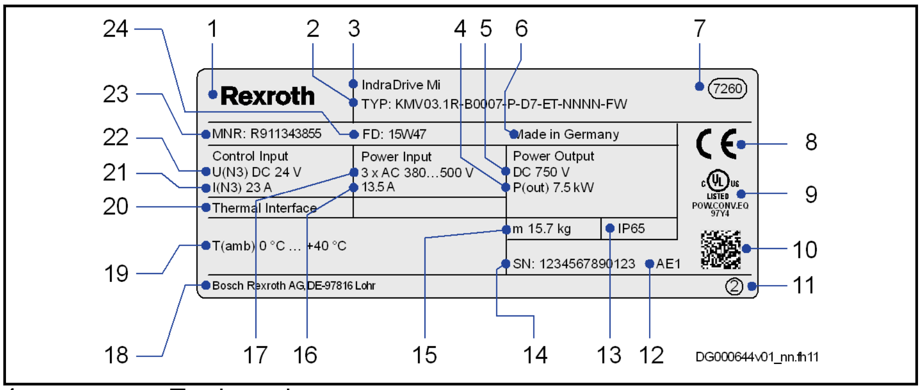


Fig. 8-7: Type plate arrangement

Identification

Design



1	Trademark
2	Type designation
3	Product range
4	Nominal power
5	DC bus voltage
6	Country of manufacture
7	Manufacturing plant
8	CE conformity label
9	UL label
10	2-D bar code
11	Manufacturer code
12	Hardware revision index
13	Degree of protection in accordance with IEC 60529
14	Serial number
15	Mass
16	Rated input current
17	Rated input voltage
18	Company address
19	Allowed ambient temperature
20	Cooling type
21	Control current input
22	Control voltage input
23	Material number
24	Production date

Fig. 8-8: KMV03 type plate

8.2.5 KNK03 type plate

Arrangement

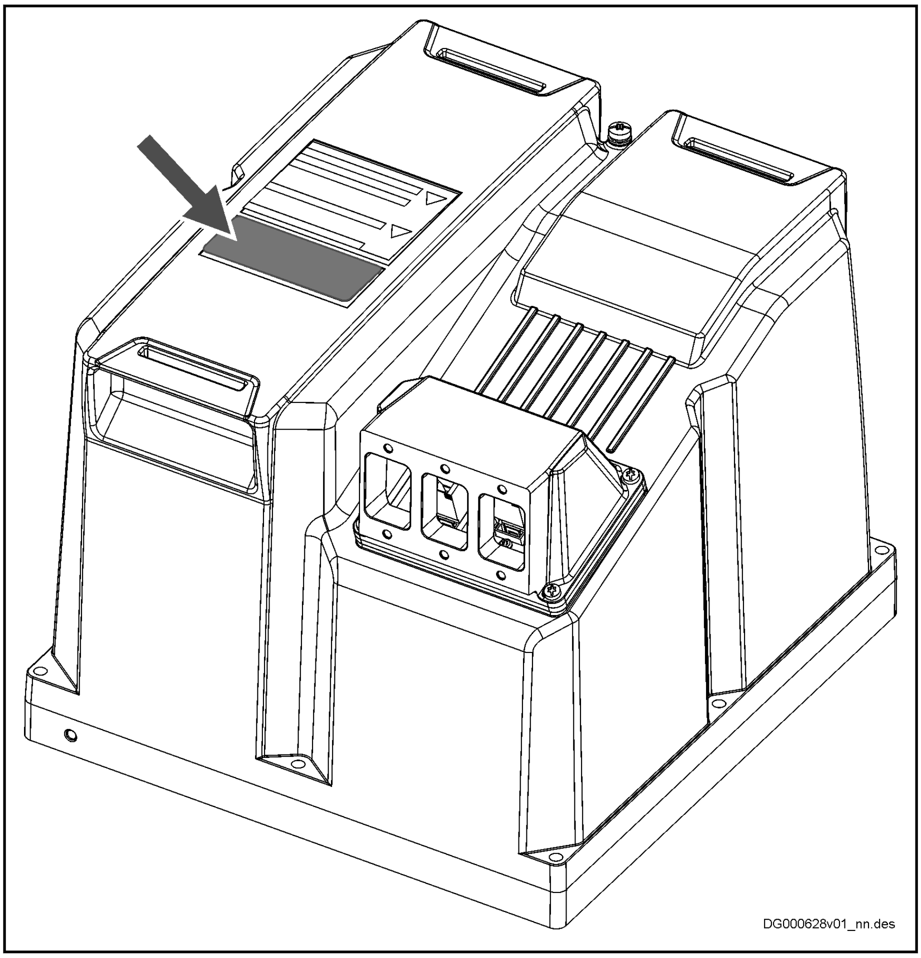
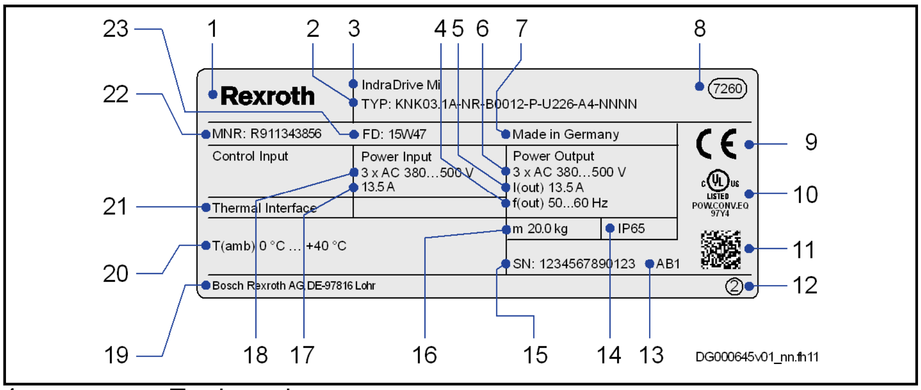


Fig. 8-9: Type plate arrangement

Design

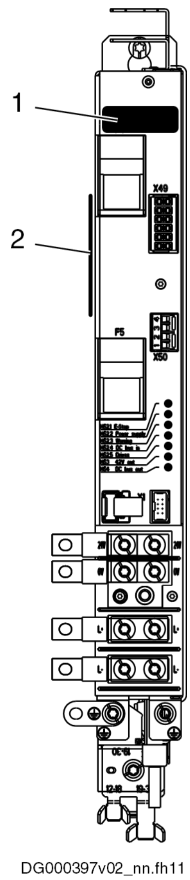


1	Trademark
2	Type designation
3	Product range
4	Frequency range
5	Output current
6	Output voltage
7	Country of manufacture
8	Manufacturing plant
9	CE conformity label
10	UL label
11	2-D bar code
12	Manufacturer code
13	Hardware revision index
14	Degree of protection in accordance with IEC 60529
15	Serial number
16	Mass
17	Rated input current
18	Rated input voltage
19	Company address
20	Allowed ambient temperature
21	Cooling type
22	Material number
23	Production date

Fig. 8-10: KNK03 type plate

8.2.6 Plates at KCU02

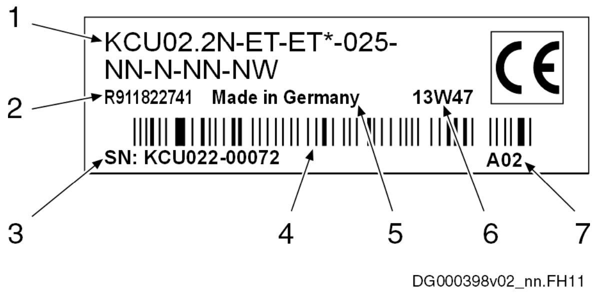
Arrangement



1	Type plate
2	UL performance data plate

Fig. 8-11: Arrangement of the plates

Type plate design



1	Device type
2	Material number
3	Serial number
4	Bar code
5	Country of manufacture
6	Production week; example 13W47: year 2013, week 47
7	Hardware revision index

Fig. 8-12: Type Plate

Identification

Design of UL performance data plate

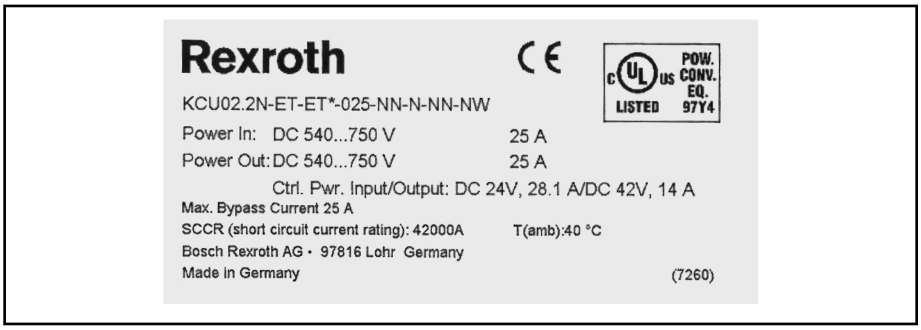


Fig. 8-13: UL performance data plate

9 Mounting and installation

9.1 Introduction

9.1.1 Important notes

Safety

⚠ WARNING **Injuries caused by live parts! Lifting of heavy loads!**

Install the motors only when they have been de-energized and are not connected electrically.

Use suitable lifting gear, protective equipment and protective clothing during transport.

Observe the safety instructions contained in the preceding chapters.

Carry out all working steps extremely carefully. In this way, you minimize the risk of accidents and damages.

Qualified technical staff

Any work at the installation and the drives or in their vicinity may be carried out only by appropriately trained technical staff.

Make sure that all persons carrying out installation work, maintenance work or operational activities at the installation are adequately familiar with the contents of this documentation, as well as with all warnings and precautionary measures contained therein.

Qualified technical staff must be trained, instructed and qualified to switch electrical circuits and devices on and off in accordance with technical safety regulations, to ground them and to mark them. Qualified technical staff must possess appropriate safety equipment and have been trained in first aid.

Handling the devices

⚠ CAUTION **Injuries or damage and invalidation of the warranty due to improper handling!**

Avoid mechanical stressing, throwing, tipping or dropping of the products.

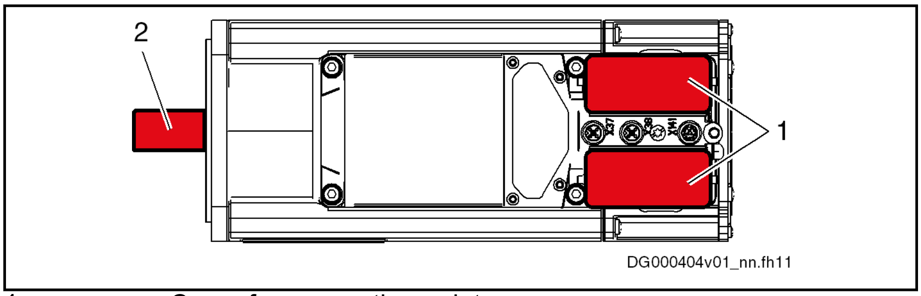
Use only suitable lifting gear.

Use suitable protective equipment and protective clothing during transport. Wear safety shoes.

Protect the products against dampness and corrosion.

At delivery, the output shafts have protective sleeves and the connection points have covers. During transport and storage, the protective sleeves and covers must be attached to the device.

- Remove the protective sleeves just before mounting.
- Also use the protective sleeves if you return the goods.



1 Cover for connection point
2 Protective sleeve for shaft

Fig. 9-1: Protective sleeves

- Avoid damage to the motor flange and drive shaft.
- Avoid impacts on the drive shaft.

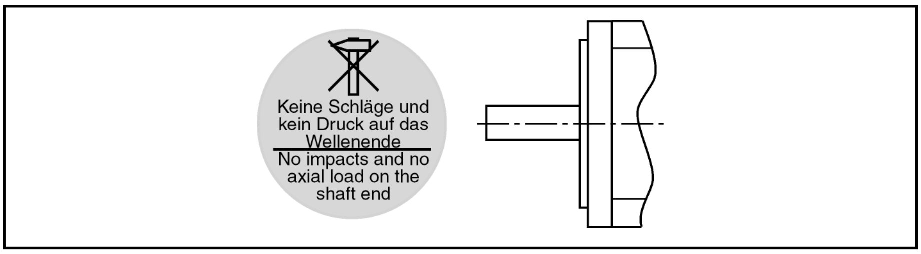


Fig. 9-2: Handling the shaft end

Impacts on the shaft end damage encoder and ball bearing! Driving elements, such as pulleys, coupling disks or toothed wheels, may only be mounted or dismounted by evenly heating up the driving elements or with the appropriate tool for mounting and dismounting.

9.1.2 System overview

Available connection points

The electrical connections of all sizes of KSM/KMS have been standardized:

- Two **power connections** (hybrid connectors for power, control voltage, master communication and status messages) to loop through the bus cable
- Two **I/O connectors** (M12, 5-pin)
- One **safety technology** interface (M12, 12-pin)
- Optional: two connection points for connecting the communication (M12, 4-pin)

Notes

All connections have been designed as plug-in connectors. This ensures easy, quick and error-safe mounting and commissioning when using ready-made Rexroth connection cables.

9.1.3 Cold plate

Required cold plate properties:

Description	Unit	Value
Surface temperature	°C	≤ 60
Flatness	mm	≤ 0.1
Surface roughness	-	Rz 6.3

Tab. 9-1: Cold plate

9.2 KSM

9.2.1 Required Steps to Follow

Preparations for Mounting

Make the following preparations for mounting:

1. Procure tools, auxiliary materials, measuring and test equipment.
2. Check all components for visible damage. Defective components mustn't be mounted.
3. Ensure that dimensions and tolerances on the installation side are suitable for motor attachment (for details, see dimensional drawing).
4. Check whether all components, mounting surfaces and threads are clean.
5. Ensure that mounting can be done in a dry and dust-free environment.
6. Ensure that the holder for the motor flange is without burrs.
7. Remove the protective sleeve of the motor shaft and keep it for further use.

If the Optional Holding Brake is Used

Check whether the motor holding brake attains the holding torque specified in the data sheet. If the holding brake does not attain the specified holding torque, check the functioning of the holding brake (see chapter "Holding Brake – Commissioning and Maintenance Instructions " on page 316).

Mounting KSM

Mounting for Easy Servicing

To allow trouble-free servicing, make sure that the following aspects are fulfilled after you have mounted KSM:

- Connection points X37, X38 and X141 are easily accessible
- Connection points X108 and X109 are easily accessible

  To allow easy and quick drive diagnostics, the terminal connector of the communication cable should be extended to a directly accessible point
- Address selector switches are easily accessible
- Diagnostic LED H14 is visible

Notes on Mounting

- Avoid jamming or getting stuck of the centering collar on the motor side.
- Avoid damage to the insertion fitting on the installation side.
- Check the stability and precision of the connection before you proceed.

9.2.2 Mechanical Interfaces

Flange Mounting

Motor-integrated servo drives KSM are manufactured for flange mounting (type of construction B05). Details for the mounting holes can be found in the corresponding dimensional drawing.

For flange mounting, we recommend using the screws and tightening torques listed in the table below.

Motor size	Recommended screw size	Tightening torque [Nm]	Minimum strength
KSM02.1B-041	M6	10,4	8.8
KSM02.1B-061	M8	25	8.8
KSM02.1B-071 KSM02.1B-076	M10	51	8.8
The screw specifications apply when screwed into steel; for other materials, determine the reach of the screws.			

Tab. 9-2: Mounting Screws

☞ The screwed connections for flange assembly must be able to take up both the force due to weight of the motor and the forces acting during operation.

9.2.3 Practical tips

⚠ WARNING **High electrical voltage! Danger to life by electric shock!**

Never remove live hybrid cable connectors (X103.1, X103.2).

Observe the following aspects for installation and mounting:

- The hybrid cable coming from the supply unit has to be plugged in X103.1 of the first KSM/KMS of a drive line.
- KSM/KMS have been equipped with two power connectors X103.1 and X103.2 which allow the hybrid cable to be looped through. Depending on the configuration, KSM/KMS is provided with a terminal connector at X103.2.

9.3 KMS

9.3.1 Required steps to follow

Preparations for mounting

Make the following preparations for mounting:

1. Procure tools, auxiliary materials, measuring and test equipment.
2. Check all components for visible damage. Defective components mustn't be mounted.
3. Ensure that dimensions and tolerances on the installation side are suitable for attachment (for details, see dimensional drawing).
4. Check whether all components, mounting surfaces and threads are clean.
5. Ensure that mounting can be done in a dry and dust-free environment.

Mounting KMS

Notes on mounting

1. To allow trouble-free **servicing**, make sure that the following aspects are fulfilled after KSM has been mounted:
   - Connection points are easily accessible
   - Address selector switches are easily accessible
   - Diagnostic LED is visible
2. **Preferably mount the device to a conductive surface.** If this is impossible, later on connect the second connection point of equipment grounding conductor at the device to the equipment grounding system of the installation.
3. For the dimensions of the mounting holes, see the dimensional drawing of the device.
4. Data of the **mounting screws**:

   Devices of cooling type "A":
   - Thread: M6
   - Tightening torque: 6 Nm
   - Head diameter: < 11 mm

   Devices of cooling type "B":
   - Thread: M5
   - Tightening torque: 6 Nm

Cold plate

Devices of cooling type "B" are mounted on a cold plate.

Required cold plate properties:

See chapter 9.1.3 "Cold plate" on page 251.

9.4 KCU02

9.4.1 Mounting depths

Adjusting Mounting Depths

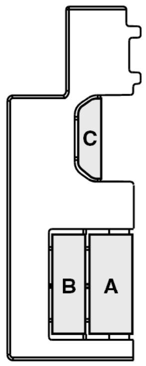
HMV01 and HCS03 devices have greater mounting depths than the drive connection box KCU. For connecting the drive connection box KCU to an HMV01 or HCS03 device, you must therefore use the control cabinet adapter HAS03.1-002 which compensates the different mounting depths.

9.4.2 Touch Guard

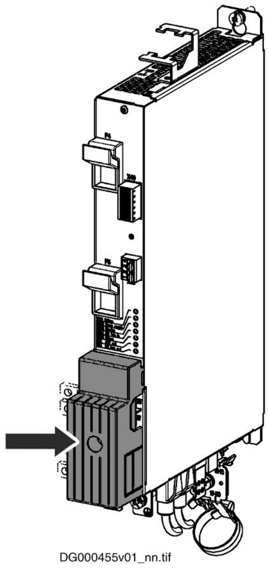
⚠ WARNING **Lethal electric shock by live parts with more than 50 V!**

- The appropriate **touch guard** must be mounted for each device following connection work.

  Never operate the device without mounted touch guard.
- Never mount a damaged touch guard.
- Immediately replace a damaged touch guard by an undamaged touch guard.
- Keep the cutouts at the touch guard as small as possible. Only remove the cutouts if necessary.

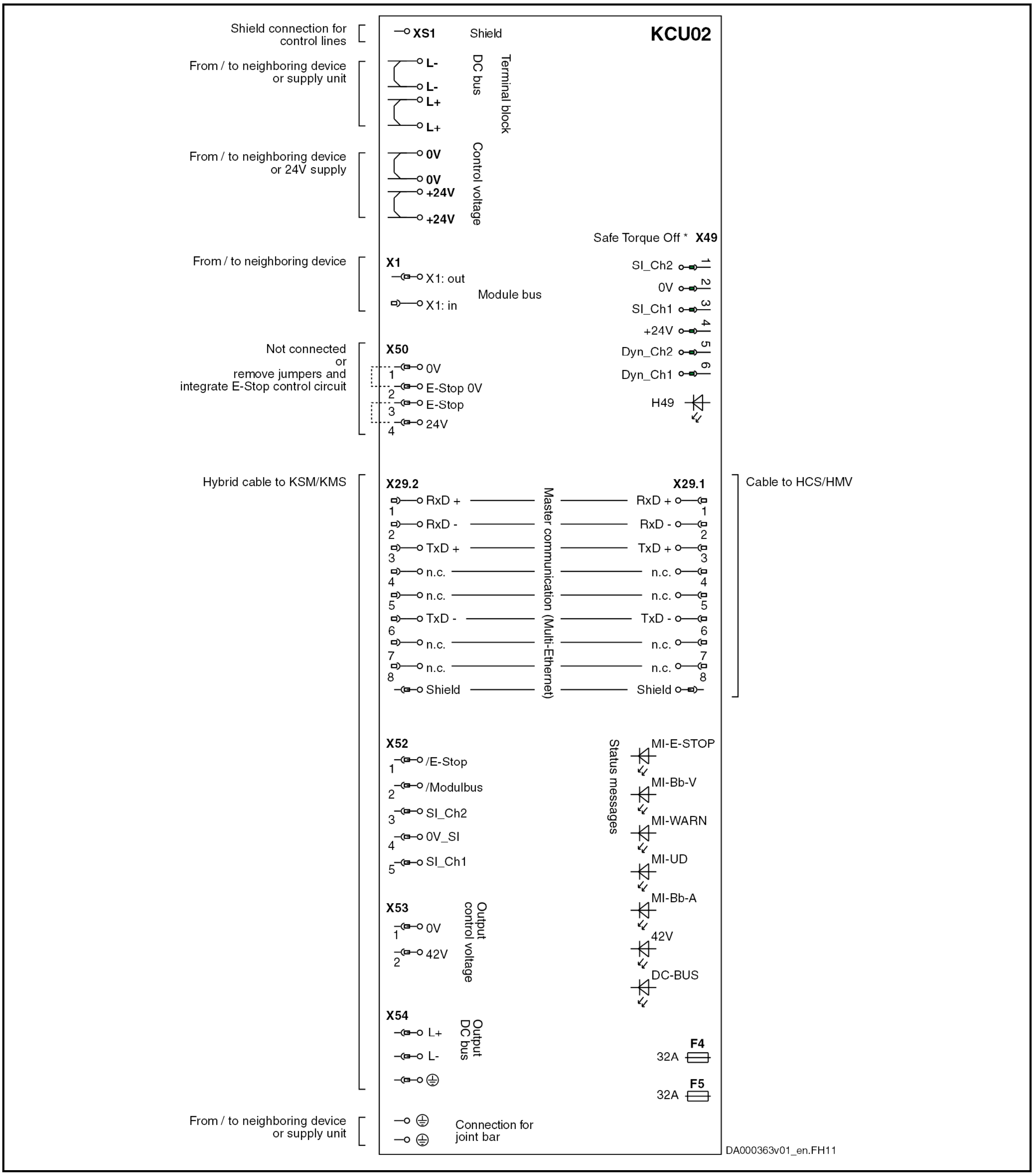
<table>
<tr>
<td>DG000456v01_nn.FH11</td>
<td>Cutouts at the Touch Guard
• If the DC bus and the control voltage are connected by means of contact bars, only cutout A may be removed from the touch guard.
• If the DC bus and the control voltage are connected by means of cables (e.g. in case of multiple-line arrangement), cutouts A, B and C may be removed from the touch guard.
• At the first and last device in a line of interconnected devices, cutouts may not be removed from the outer side of the touch guard.</td>
</tr>
</table>

Tab. 9-3: Cutouts at the Touch Guard

 DG000455v01_nn.tif	The touch guard is fixed to the device with a screw. Tightening torque: Max. 2.8 Nm

Tab. 9-4: Touch Guard at Device

9.4.3 KCU02 connection diagram



* Optional

Fig. 9-3: Connection Diagram KCU02

9.5 KNK03/KMV03

9.5.1 Arranging the devices

Mount the KMV supply unit to the left of the KNK mains filter. The connection points at KMV then can be accessed and wired more easily.

9.5.2 Mounting

Notes on mounting

1. **Preferably mount the device to a conductive surface.** If this is impossible, later on connect the second connection point of equipment grounding conductor at the device to the equipment grounding system of the installation.
2. For the dimensions of the mounting holes, see the dimensional drawing of the device.
3. Data of the **mounting screws**:

   Devices of cooling type "B":

   - Thread: M5
   - Tightening torque: 6 Nm
4. To allow trouble-free **servicing**, make sure that the following aspects are fulfilled after KSM has been mounted:
   - Connection points are easily accessible
   - Address selector switches are easily accessible
   - Diagnostic LED is visible

Cold plate

Devices of cooling type "B" are mounted on a cold plate.

Required cold plate properties:

See chapter 9.1.3 "Cold plate" on page 251.

9.6 Electrical connection

9.6.1 General information

⚠ WARNING **High electrical voltage! Danger to life by electric shock!**

Working within the range of live parts is extremely dangerous. Therefore:

- Any work required on the electric system may be carried out only by skilled electricians. It is absolutely necessary to use power tools.
- Before starting work, the system must be de-energized and the power switch be secured against unintentional or unauthorized re-energization.
- Before starting work, the appropriate measuring equipment must be used to check whether parts of the system are still under residual voltage (e.g. caused by capacitors, etc.). Wait to allow the system to discharge.

⚠ WARNING **Personal injury or property damage by interrupting or connecting live lines!**

Interrupting or connecting live lines may cause unpredictable dangerous situations or lead to property damage. Therefore:

- Connect and disconnect plug-in connectors only when they are dry and de-energized.
- During operation of the installation, all plug-in connectors must be locked.

⚠ WARNING **Risk of short circuit caused by liquid coolant or lubricant!**

Short circuits of live lines may cause unpredictable dangerous situations or lead to property damage. Therefore:

- Provide exposed mating sides of power plug-in connectors with safety caps when installing or replacing drive components, if you cannot exclude that they might be moistened with liquid coolant or lubricant.

9.6.2 Notices

The motor cable is a hybrid cable in which the communication line has been integrated. Only the hybrid cable by Rexroth can ensure the function. It is supplied as ready-made cable. The outgoing direction of the hybrid cable cannot be changed subsequently!

NOTICE **Risk of damage by subsequently changing the outgoing direction of the hybrid cable!**

Do not try to reverse the cable outgoing direction of a ready-made connector! The flexible leads in the connector have individual lengths for each outgoing direction.

NOTICE **Risk of damage by leakage of the connection points!**

If vibrations affect the hybrid cable: Install strain relief near the connection points (X103.1, X103.2) so that the connectors are not affected by high vibration loads. This can avoid possible leakage (entering liquid).

When ordering the ready-made hybrid cables, always indicate the desired outgoing direction: See chapter 5.8.1 "RKH hybrid cable incl. communication, technical data" on page 106.

Ready-made hybrid cables have been coded in such a way that X103.1 and X103.2 cannot be interchanged when connecting the cables.

9.6.3 Electrical interfaces

Overall connection diagram

☞ At the **first** KSM/KMS, always plug the hybrid cable RKH in connection point **X103.1**.

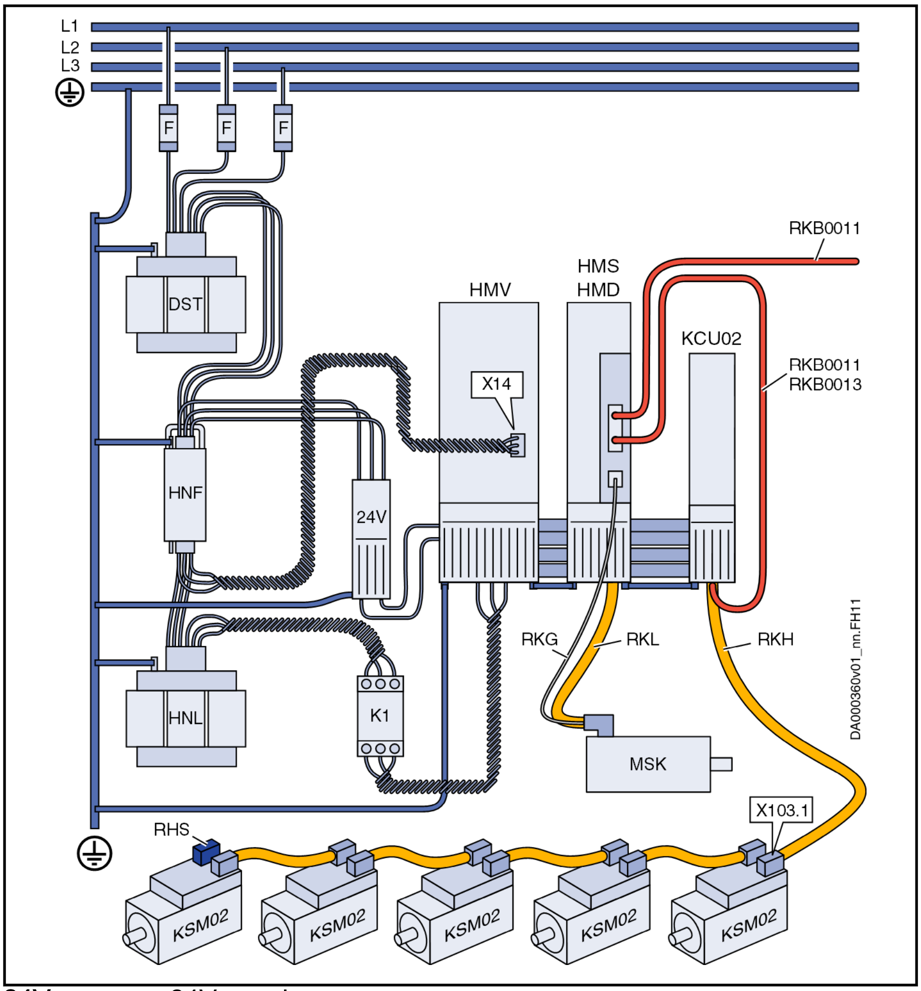
Always terminate the unassigned connection at the **last** KSM/KMS with a **terminal connector RHS**.

The figures below show **examples.** Other possibilities of mains connection are described in the documentation "Rexroth IndraDrive Drive Systems with HMV01/02, HMS01/02, HMD01, HCS02/03".

The **additional components** (DST, HNL, HNF …) contained in the figure are not absolutely necessary. As regards the detailed configuration of a drive system, see documentation "Rexroth IndraDrive Drive Systems with HMV01/02, HMS01/02, HMD01, HCS02/03".

HMV01 used as supply unit

Drive System Rexroth IndraDrive Mi with HMV01 Supply Unit:

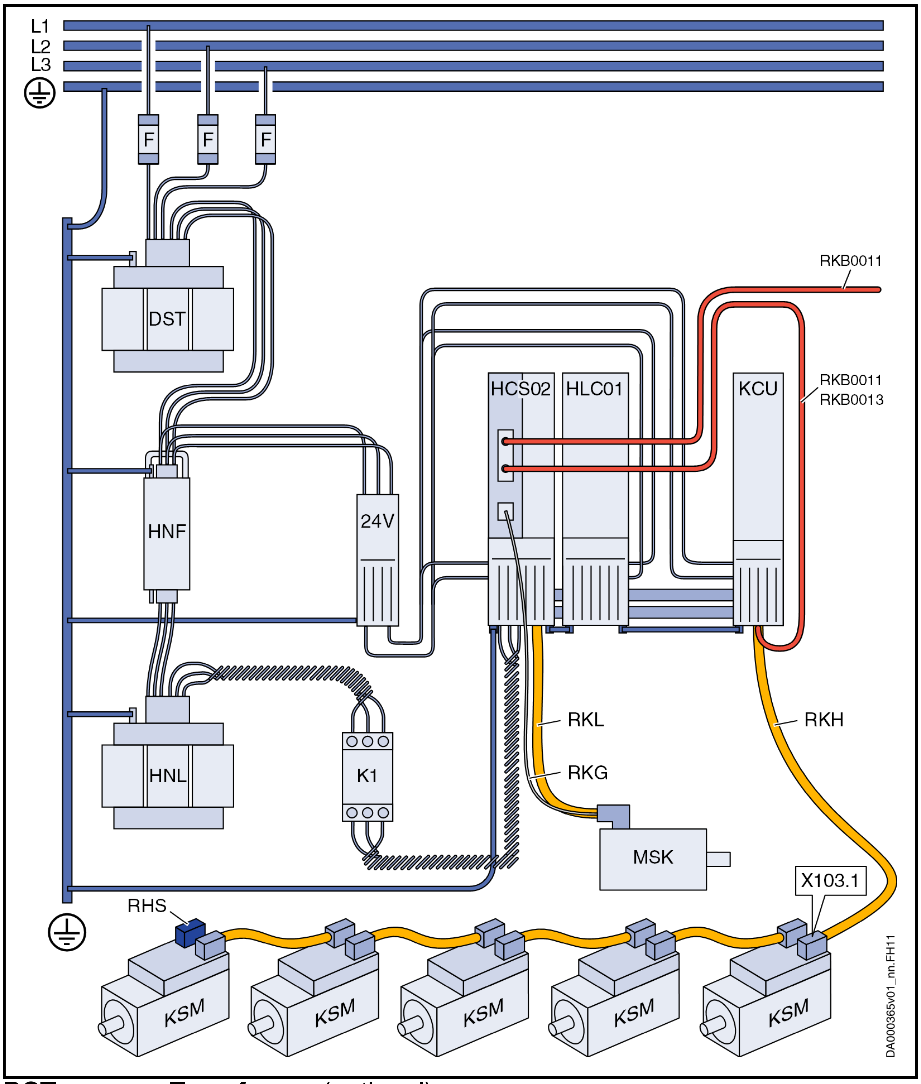


24V	24V supply
DST	Transformer (optional)
F	Fuses
HMD, HMS	Inverter (optional)
HMV01	Supply unit
HNF	Mains filter
HNL	Mains choke
K1	Mains contactor (only for supply units without integrated mains contactor, e.g. HMV01.1R-W0120)
KCU	Drive connection box
KSM	Motor-integrated servo drive
MSK	Servo motor (optional)
RHS	Terminal connector
RKB	Communication cable
RKG	Encoder cable (optional)
RKH	Hybrid cable
RKL	Motor cable (optional)
X14	Mains synchronization (only with regenerative HMVs)
X103.1	Connection of hybrid cable RKH at first KSM

Fig. 9-4: Drive System Rexroth IndraDrive Mi with HMV01

HCS02 used as supply unit

Drive System Rexroth IndraDrive Mi with HCS02 Supply Unit:

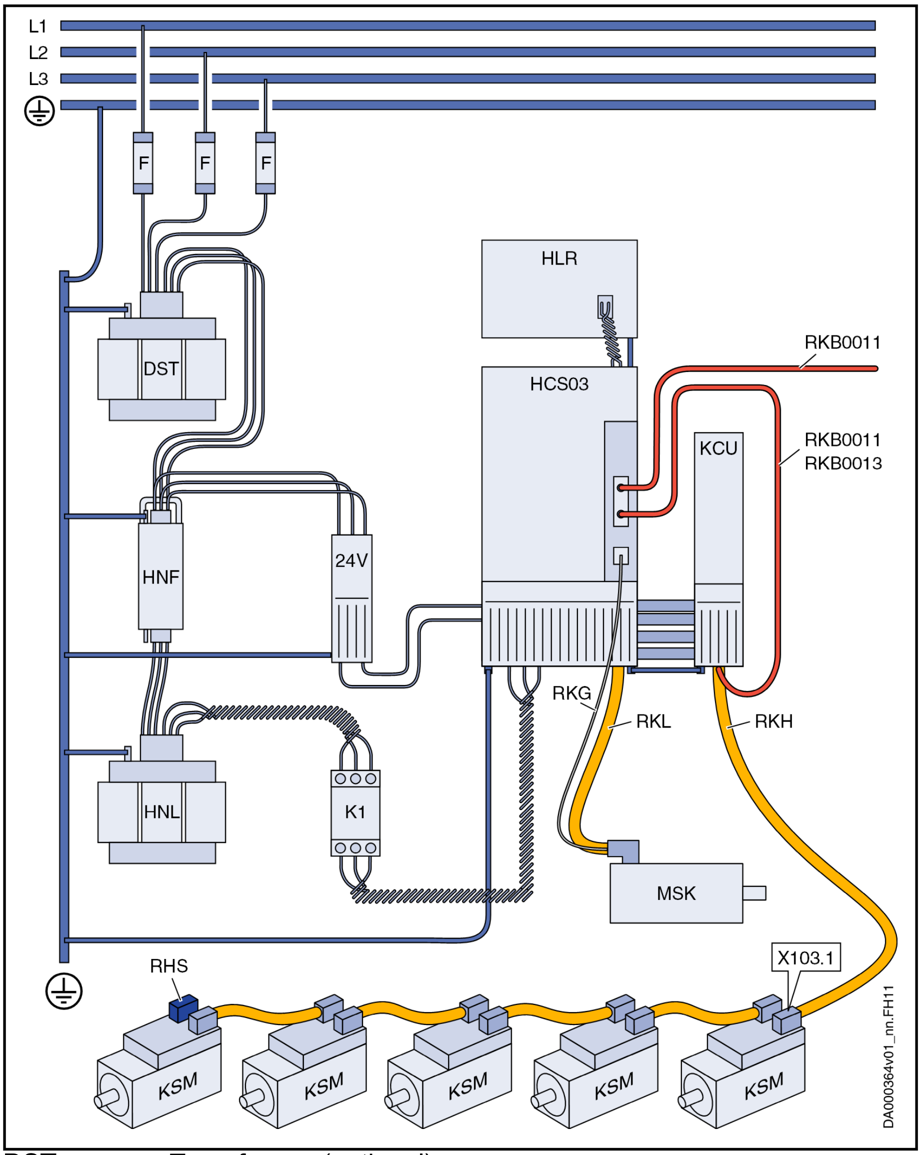


DST	Transformer (optional)
F	Fuses
HCS02	Converter (HCS02.1E-W0054 or HCS02.1E-W0070)
HNF	Mains filter
HNL	Mains choke (optional)
HLC01	DC bus capacitor unit (optional only with low load of motor output at HCS02)
K1	Mains contactor
KCU	Drive connection box
KSM	Motor-integrated servo drive
MSK	Servo motor
24V	24V supply
RHS	Terminal connector
RKB	Communication cable
RKG	Encoder cable
RKH	Hybrid cable
RKL	Motor cable
X103.1	Connection of hybrid cable at first KSM

Fig. 9-5: Drive System Rexroth IndraDrive Mi with HCS02

HCS03 used as supply unit

Drive System Rexroth IndraDrive Mi with HCS03 Supply Unit:



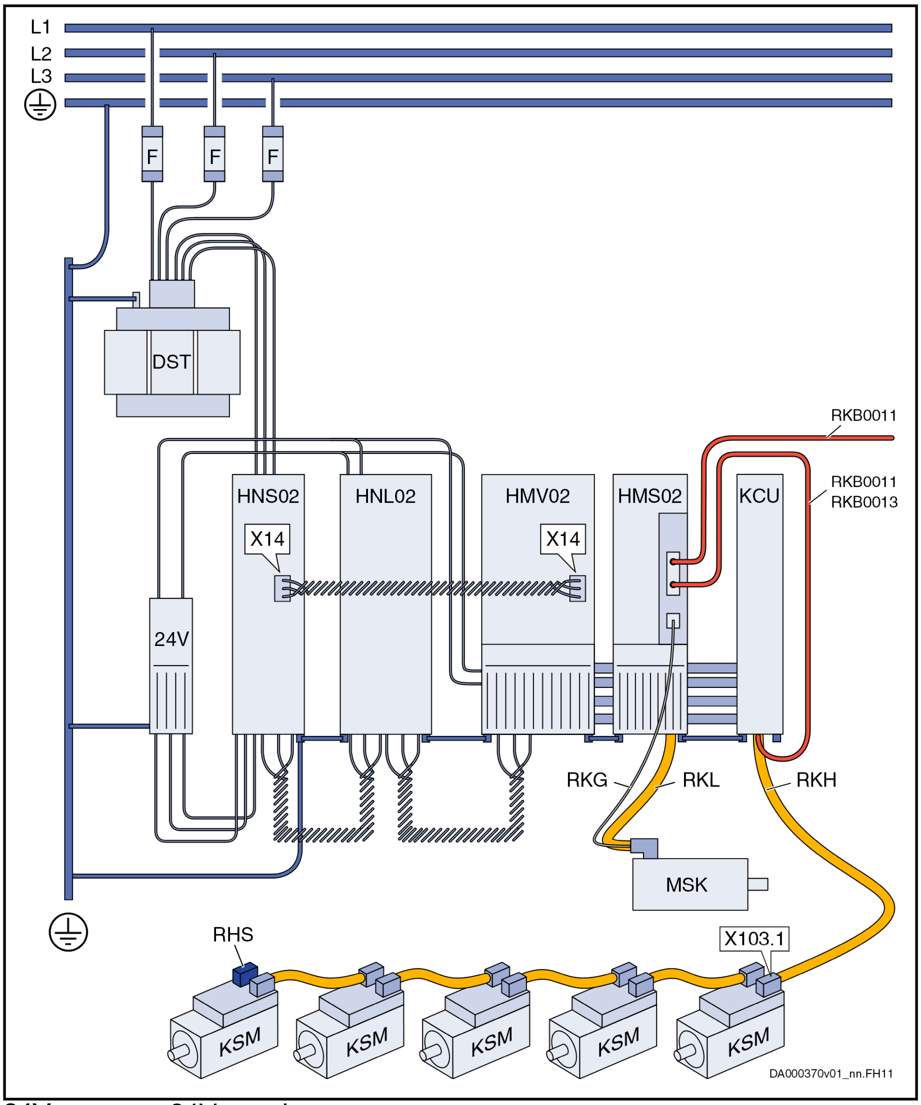
DST	Transformer (optional)
F	Fuses
HCS03	Converter
HLR	Braking resistor (optional)
HNF	Mains filter
HNL	Mains choke (optional)
K1	Mains contactor
KCU	Drive connection box
KSM	Motor-integrated servo drive
MSK	Servo motor
RHS	Terminal connector
RKB	Communication cable
RKH	Hybrid cable
RKG	Encoder cable
RKL	Motor cable
24V	24V supply

X103.1 Connection of hybrid cable at first KSM

Fig. 9-6: Drive System Rexroth IndraDrive Mi with HCS03

HMV02 used as supply unit

Drive System Rexroth IndraDrive Mi with HMV02 Supply Unit:

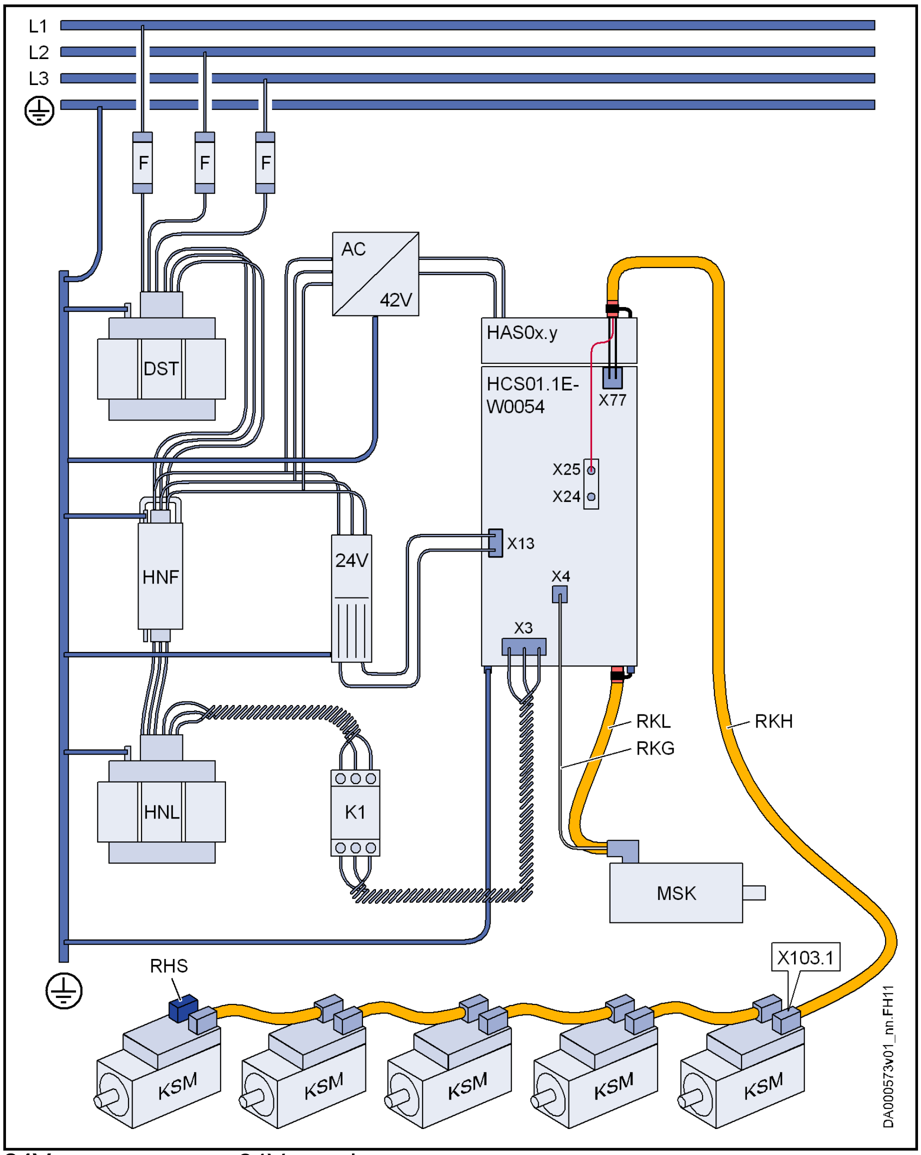


24V	24V supply
DST	Transformer (optional)
F	Fuses
HMS02	Inverter (optional)
HMV02	Supply unit
HNS02	Mains filter with switch-disconnector
HNL02	Mains choke
KCU	Drive connection box
KSM	Motor-integrated servo drive
MSK	Servo motor (optional)
RHS	Terminal connector
RKB	Communication cable
RKG	Encoder cable (optional)
RKH	Hybrid cable
RKL	Motor cable (optional)
X14	Mains synchronization (only with regenerative HMVs)
X103.1	Connection of hybrid cable RKH at first KSM

Fig. 9-7: Drive System Rexroth IndraDrive Mi with HMV02

HCS01.1E-W0054 used as supply unit

Rexroth IndraDrive Mi system with HCS01.1E-W0054 used as supply unit



24V	24V supply
AC/42V	42V supply
DST	Transformer (optional)
F	Fuses
HAS0x.y	Connection accessories (in preparation)
HCS01.1E-W0054	Drive controller
HNF	Mains filter; depending on the Y-capacitances of KSM/KMS
HNL	Mains choke (optional)
K1	Mains contactor
KSM	Motor-integrated servo drive (alternative: KMS near motor servo drive and motor)
MSK	Servo motor
RHS	Terminal connector
RKG	Encoder cables
RKH	Hybrid cable; hybrid cable to be ordered for connection to HCS01 is currently in preparation

RKL	Motor cable
X103.1	Connection of hybrid cable at first KSM

Fig. 9-8: Rexroth IndraDrive Mi system with HCS01.1E-W0054

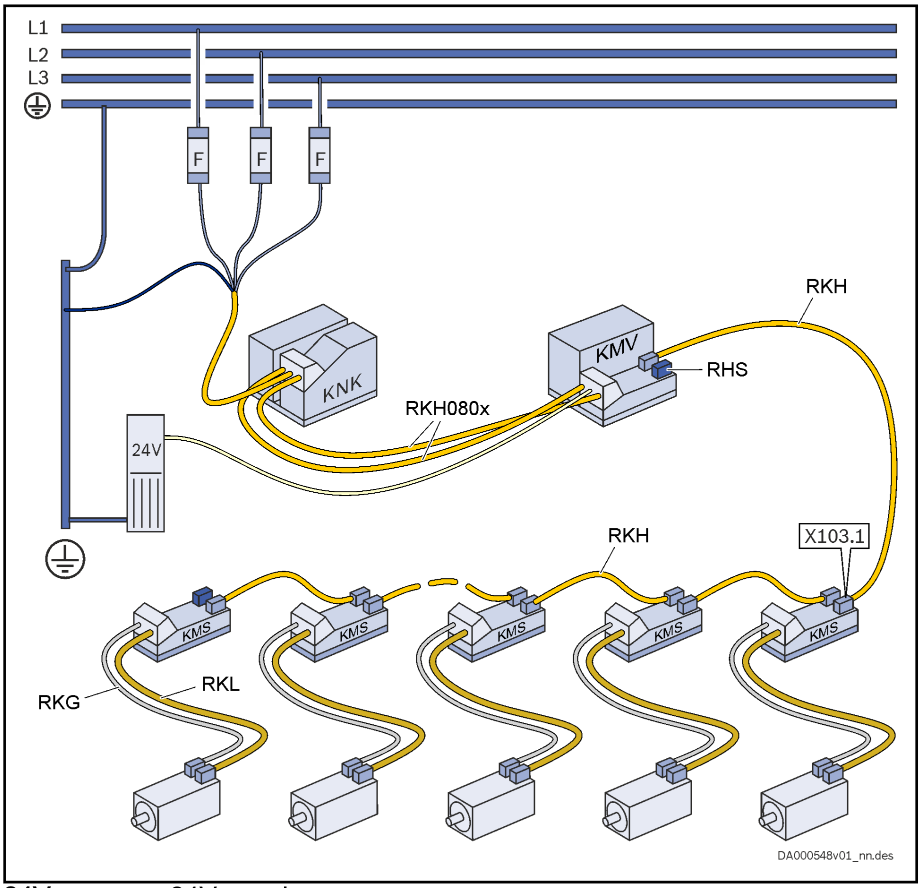
☞ The drive system shown here with HCS01.1E-W0054 as a supply unit currently **has not been generally released**.

In individual cases, Rexroth can authorize application-specific releases of the system. For this purpose, please contact our Drive Support (drivesupport@boschrexroth.de; DE_TN_51_IndraDrive_Mi_mit_HCS01_als_Versorger_V1.0.pdf).

For information on **HCS01** drive controllers, please see the Project Planning Manual "Rexroth IndraDrive Cs Drive Systems with HCS01" (R911322210).

KMV03 used as supply unit

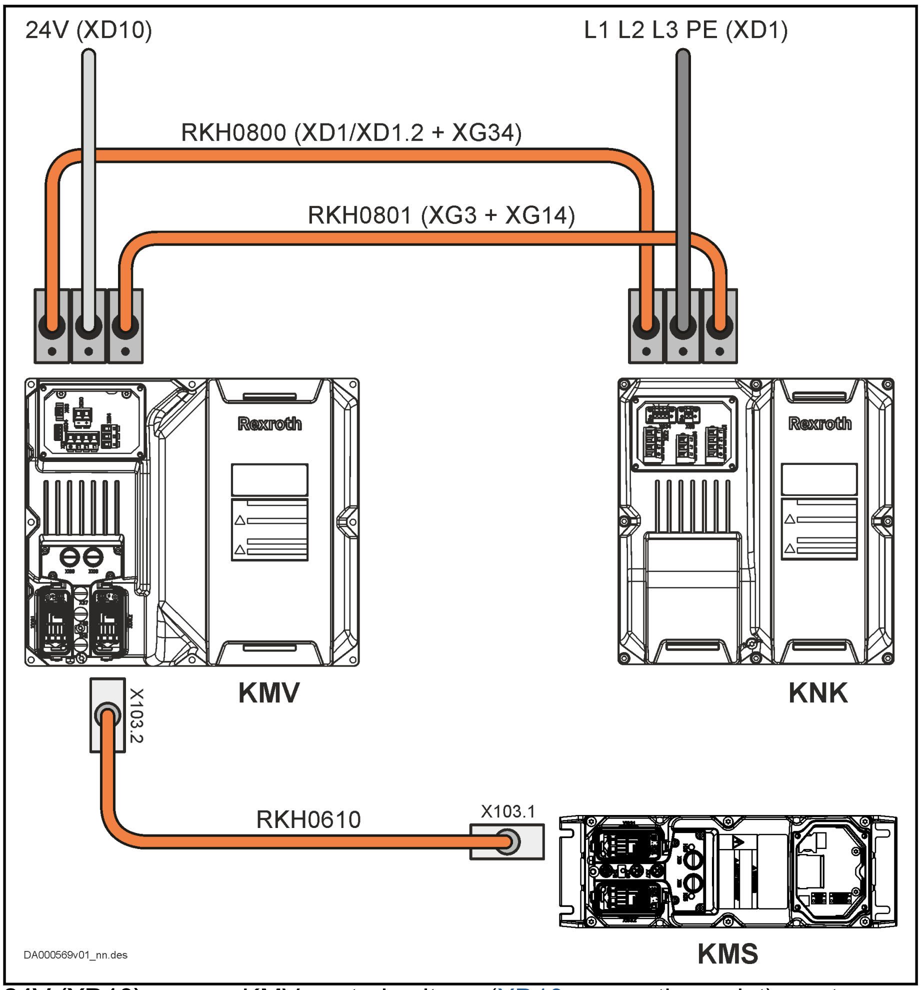
Rexroth IndraDrive Mi system with KMV03 used as supply unit:



24V	24V supply
F	Fuses
KNK	Mains filter with integrated mains choke and integrated mains contactor
KMV	Supply unit
KMS	Near motor servo drive
RHS	Terminal connector
RKG	Encoder cable (optional)
RKH	Hybrid cable
RKL	Motor power cable
X103.1	Connection of RKH hybrid cable at first KMS

Fig. 9-9: Rexroth IndraDrive Mi system with KNK03, KMV03, KMS03

Cables for Rexroth IndraDrive Mi system with KMV03 used as supply unit



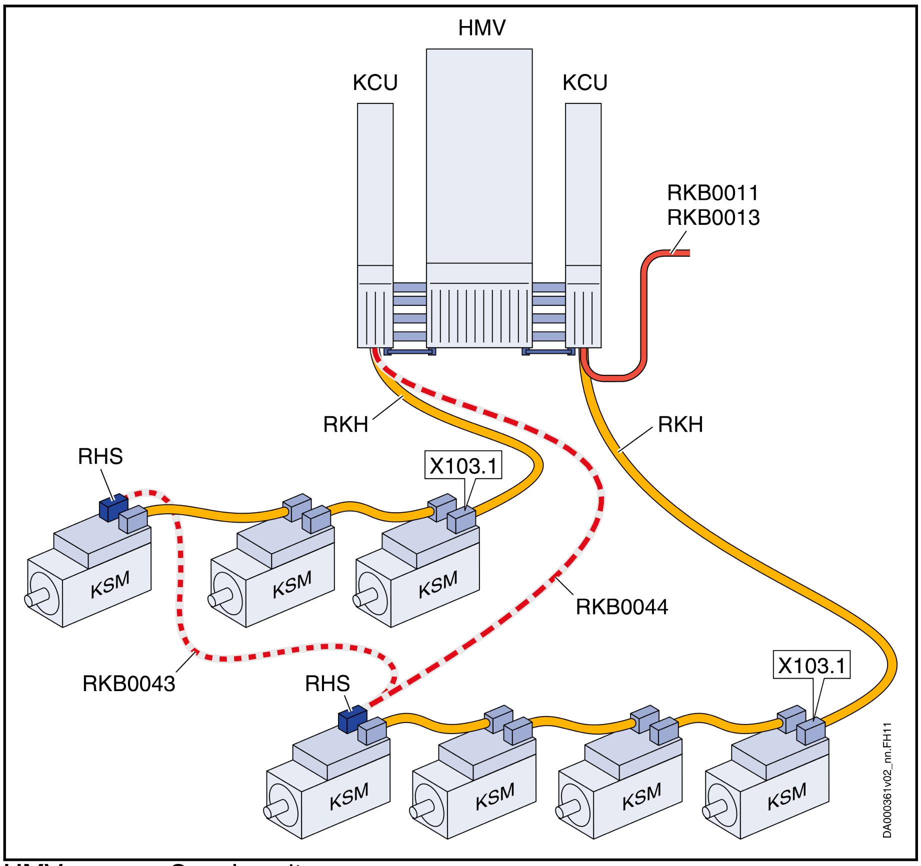
24V (XD10)	KMV control voltage (XD10 connection point); customer assembles the cable (HAS05.1-020 accessories required)
L1 L2 L3 PE (XD1)	KNK mains voltage and equipment grounding conductor (XD1 connection point); customer assembles the cable (HAS05.1-019 accessories required)
RKH0610	Exemplary ready-made hybrid cable; connects KMV (X103.2) to KMS/KSM (X103.1); the actual hybrid cable (RKH0xxx) depends on the desired cable outgoing directions at the X103.1 and X103.2 connection points
RKH0800	Ready-made hybrid cable; connects KMV (XD1, XG34) to KNK (XD1.2, XG34)
RKH0801	Ready-made hybrid cable; connects KMV (XG3, XG14) to KNK (XG3, XG14)

Fig. 9-10: Cables for Rexroth IndraDrive Mi system with KMV03 used as supply unit

Parallel drive lines

At the **first** KSM/KMS, always plug the hybrid cable RKH in connection point **X103.1**.

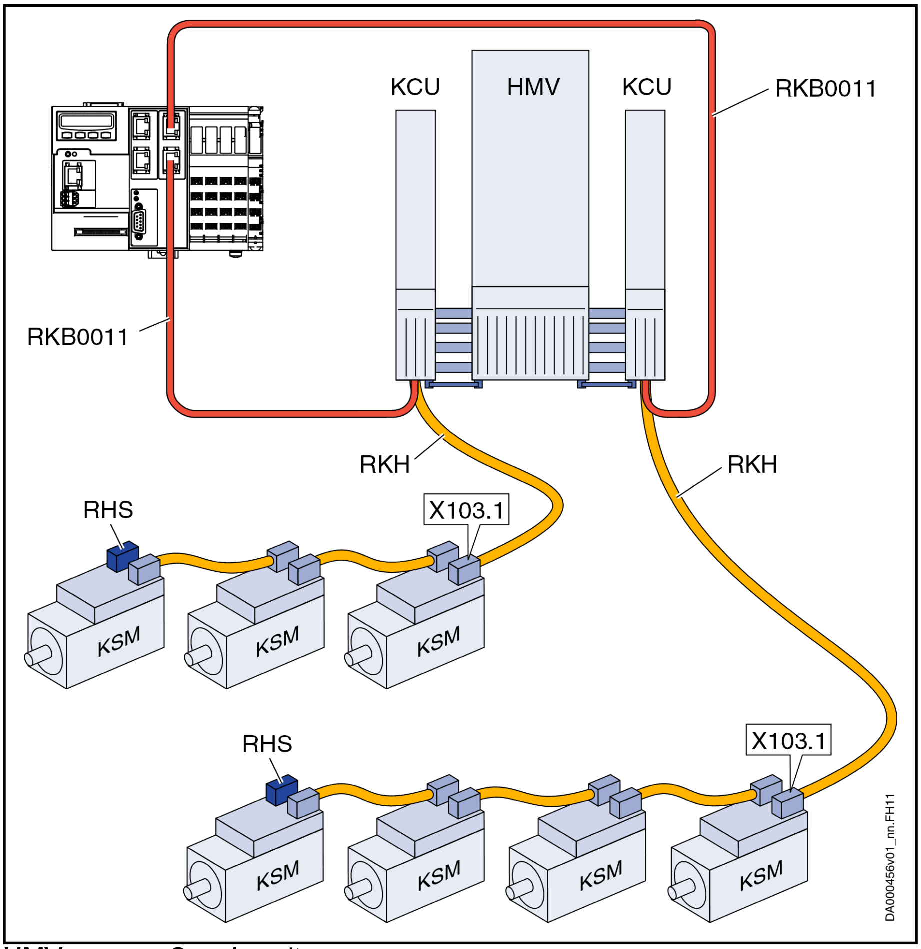
Always terminate the unassigned connection at the **last** KSM/KMS with a **terminal connector RHS**.



HMV	Supply unit
KCU	Drive connection box
KSM	Motor-integrated servo drive
RKB	Communication cable; RKB0044 (RHS ↔ KCU) **or** RKB0043 (RHS ↔ RHS; if the RKB0043 cable is used, it is necessary to additionally interconnect the second connection points of the equipment grounding conductor of the two KSM with a separate cable)
RHS	Terminal connector
RKH	Hybrid cable
X103.1	Hybrid cable connection

Fig. 9-11: Parallel drive lines

In the case of 2 drive lines (2 KCUs) and 2 unassigned communication interfaces at the higher-level control unit, both KCUs can be directly connected to the control unit.



HMV	Supply unit
KCU	Drive connection box
KSM	Motor-integrated servo drive
RKB	Communication cable
RHS	Terminal connector
RKH	Hybrid cable
X103.1	Hybrid cable connection

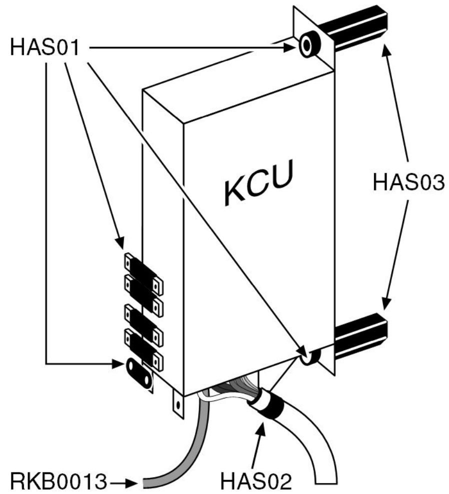
Fig. 9-12: Parallel drive lines with two KCUs and higher-level control unit

2 KCU vs. 2 KMV

Instead of 1 HMV + 2 KCU, it is possible to use 2 KMV for parallel drive lines.

10 Accessories

10.1 Overview

<table>
<tr><th>KCU</th><th colspan="2">KSM, KMS</th></tr>
<tr>
<td>

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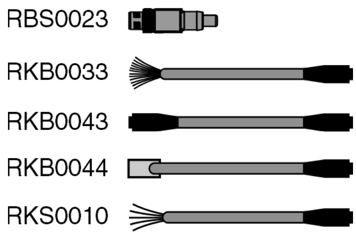
<td>

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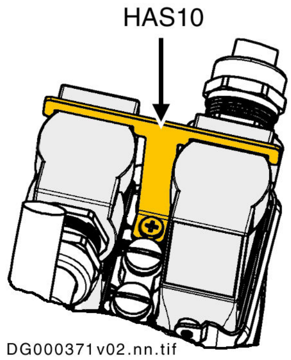
<td>

DG000371v02.nn.tif</td>
</tr>
<tr>
<td>

- HAS01
Basic accessory
- HAS02
Shield connection of hybrid cable
- HAS03
Control cabinet adapter
- RKB0013
Short Multi-Ethernet cable for connection to the neighboring device
- netSWITCH sercos III
The accessory connects a sercos III network into a standard Ethernet network.

</td>
<td>

- RBS0023
Connector for safety zone user
- RKB0033
Cable with open ends (X141 ↔ external safety unit)
- RKB0043
Cable for communication (M12-D ↔ M12-D)
- RKB0044
Cable for communication (M12-D ↔ RJ-45)
- RKS0010
Cable with open ends (M12-A ↔ open)

</td>
<td>

Fixing clip for hybrid cables

- HAS10.1-001-001
For devices **without** optional communication output coupling (X108, X109).
- HAS10.1-001-002
For devices **with** optional communication output coupling (X108, X109).

</td>
</tr>
</table>

Tab. 10-1: Accessories

10.2 HAS01, basic accessory

For the KCU drive connection box, you need the basic accessory HAS01.1-050-072-MN.

The basic accessory HAS01 contains:

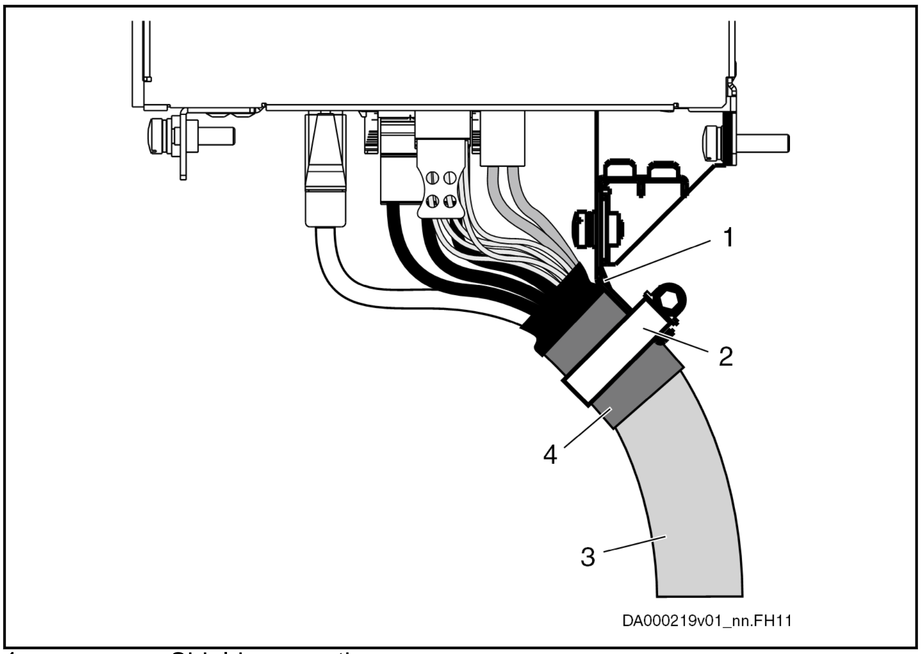
- Parts for fixing the device
- Contact bars for connecting
  - the DC bus
  - the control voltage supply
- Joint bar for connecting equipment grounding conductors of KCU and neighboring device

📖 For a detailed description, see documentation "Rexroth IndraDrive Additional Components and Accessories".

10.3 HAS02, shield connection

☞ For proper and correct installation of KSM and KCU, use the RKH hybrid cable and the **HAS02.1-015-NNN-NN** accessory.

The **HAS02.1-015-NNN-NN** accessory connects the shield of the hybrid cable to the housing of the KCU drive connection box.



1	Shield connection
2	Clip
3	Hybrid cable
4	Shield of hybrid cable

Fig. 10-1: Shield connection

- Mount the shielding plate (1) to the drive connection box KCU according to the desired outgoing direction of the hybrid cable (horizontal or 45°).
- According to the diameter of the hybrid cable (3), the shielding plate (1) provides two supports (12–18 mm or 19–30 mm). Fix the hybrid cable (3) to the corresponding support with a clip (2). Make sure that the shield (4) of the hybrid cable has good contact with the shielding plate (1).

10.4 HAS03, control cabinet adapter

HMV01 and HCS03 devices have greater mounting depths than the KCU drive connection box. To connect the KCU drive connection box to an HMV01 or HCS03 device, you therefore have to use the **HAS03.1-002** control cabinet adapter which compensates the different mounting depths.

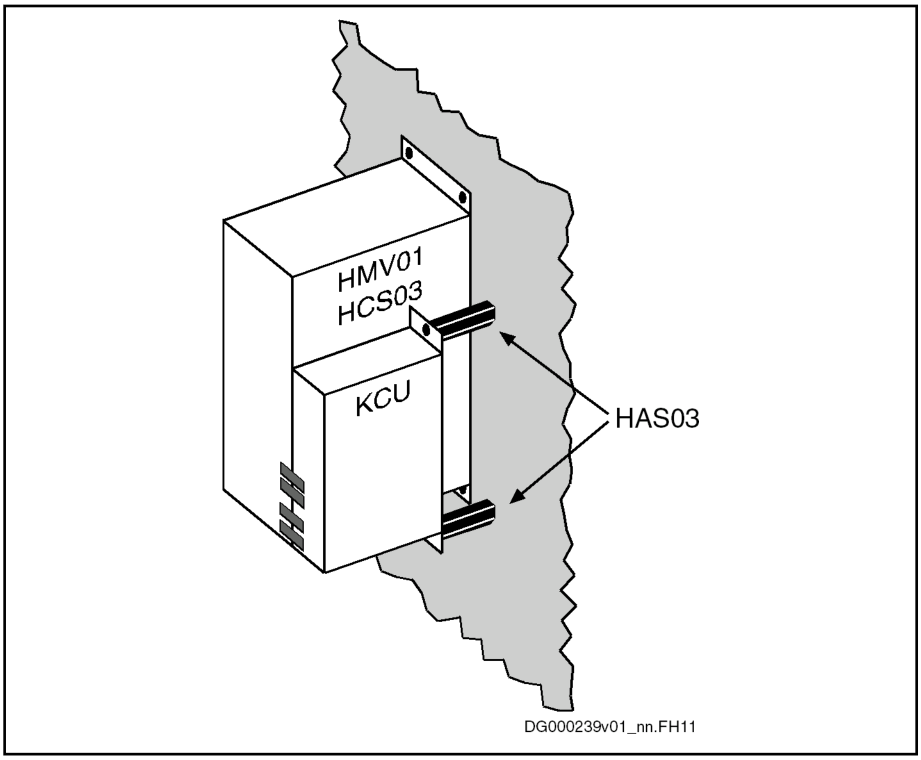


Fig. 10-2: HAS03

For a detailed description, see documentation "Rexroth IndraDrive Additional Components and Accessories".

10.5 HAS05.1-018, dummy plate for KMS03 encoder connection

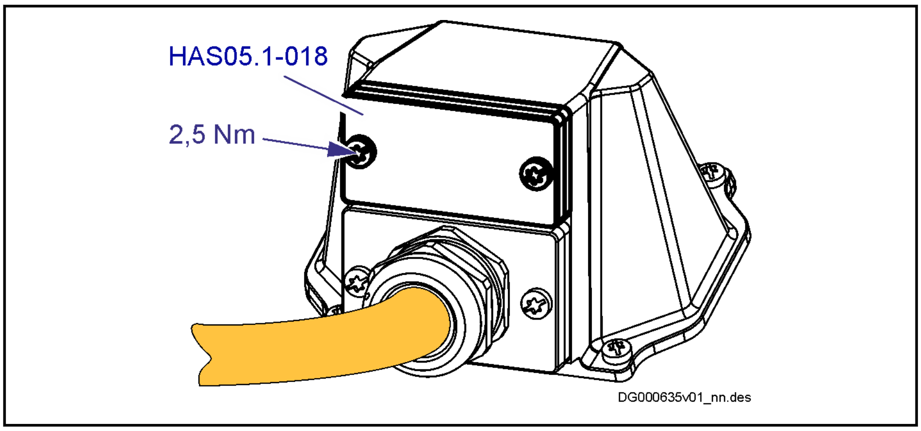


Fig. 10-3: HAS05.1-018, dummy plate for KMS03 encoder connection

10.6 HAS05.1-019, KNK03 mains voltage

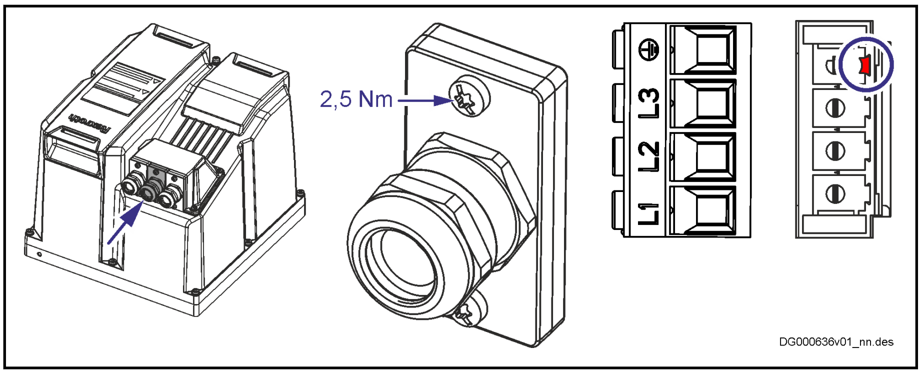


Fig. 10-4: HAS05.1-019, KNK03 mains voltage

The accessory contains the following parts:

- Cable gland (plastic, M20, range: 6 … 12 mm)
- Plate incl. screws
- Connector (screw terminal)
- Coding pin

10.7 HAS05.1-020, KMV03 control voltage

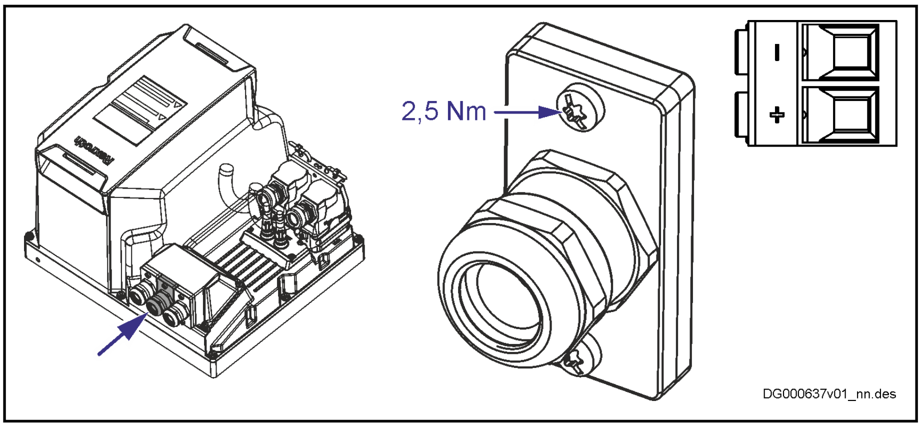


Fig. 10-5: HAS05.1-020, KMV03 control voltage

The accessory contains the following parts:

- Cable gland (plastic, M20, range: 6 … 12 mm)
- Plate incl. screws
- Connector (screw terminal)

10.8 HAS10, mechanical mounting parts

10.8.1 Type code

Short type designation	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	H	A	S	1	0	.	1	-	0	0	1	-	0	0	2	-	N	N																						
	①			②			③		④				⑤				⑥																							

①	**Product:** HAS = IndraDrive accessories
②	**Series:** 10 = Mechanical mounting parts
③	**Design:** 1 = 1
④	**Device assignment [1]:** 001 = KSM01.2, KSM02.1 KMS01.2 and KMS02.1 002 = HMU05.1 and HCS05.1
⑤	**Other properties [2]:** 001 = Fixing clip of connectors for increased vibration resistance 002 = Fixing clip of connectors and master communication for increased vibration resistance 003 = Dummy cover for slide-in ducts: 1 × parallel module / 1 × motor mains module / 1 × control section 004 = Motor monitor grounding 005 = Mounting plate for device width 200 mm 006 = Mounting plate for device width 220 mm
⑥	**Other design:** NN = None

Tab. 10-2: HAS10, type code

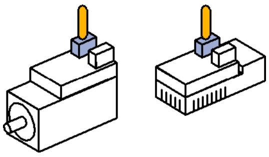
10.8.2 Use

Use

HAS10	Use
HAS10.1-001-**001**-NN	Fixing clip for hybrid cables at devices **without** option TO, ES …
HAS10.1-001-**002**-NN	Fixing clip for hybrid cables at devices **with** option TO, ES …
HAS10.1-001-**003** … **006**-NN	Mechanical mounting parts for HMU05 universal inverters. Further information: See HMU05 Project Planning Manual.

Tab. 10-3: HAS10

Restricted Usage of the Accessory:



The accessory **cannot** be used at **hybrid cables with a vertical outgoing direction** of the cable from the connector.

HAS10.1-001-001-NN

The accessory **HAS10.1-001-001-NN** consists of a fixing clip with a screw.

The fixing clip is screwed to a KSM or KMS and increases the vibration resistance of the connected hybrid cable connectors.

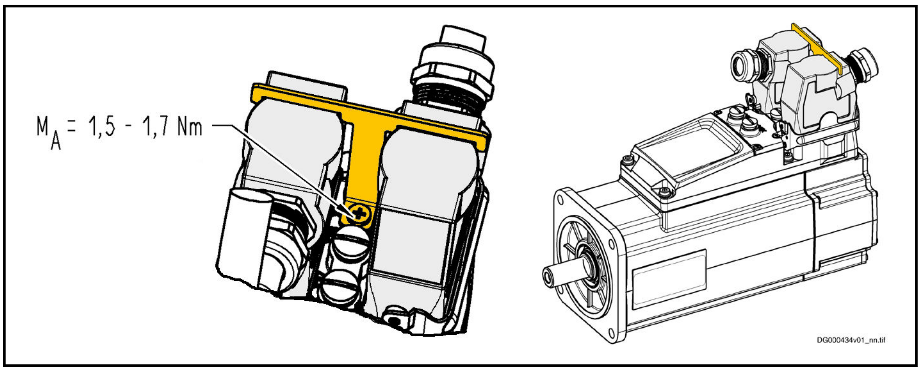


Fig. 10-6: HAS10.1-001-001-NN

HAS10.1-001-002-NN

The **HAS10.1-001-002-NN** accessory consists of the following parts:

- Fixing clip with screw (tightening torque: 1.5 … 1.7 Nm)
- RKB0043 cable
- Cable tie

The fixing clip increases the vibration resistance of the connected hybrid cable connectors. The RKB0043 cable is fixed to the fixing clip with 2 cable ties.

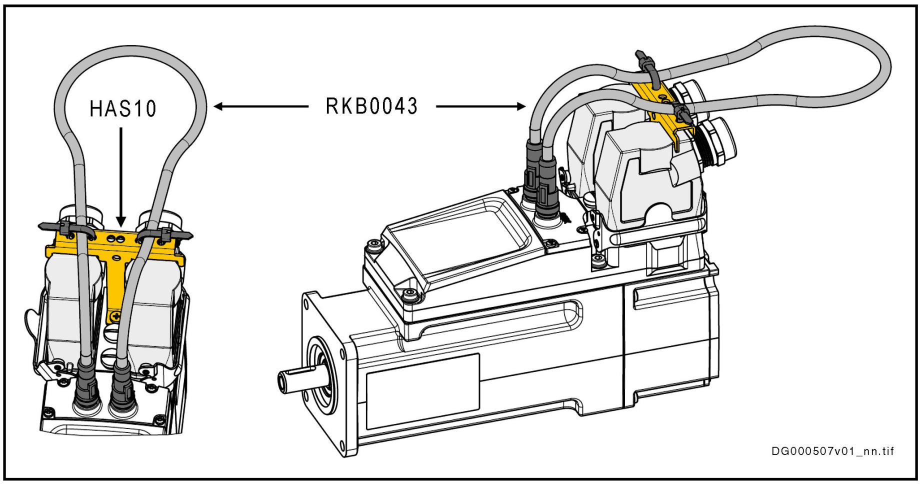


Fig. 10-7: HAS10.1-001-002-NN

10.8.3 Scope of supply

Scope of supply

Components of the accessory: see product insert

Product insert HAS10.1-001-001-NN

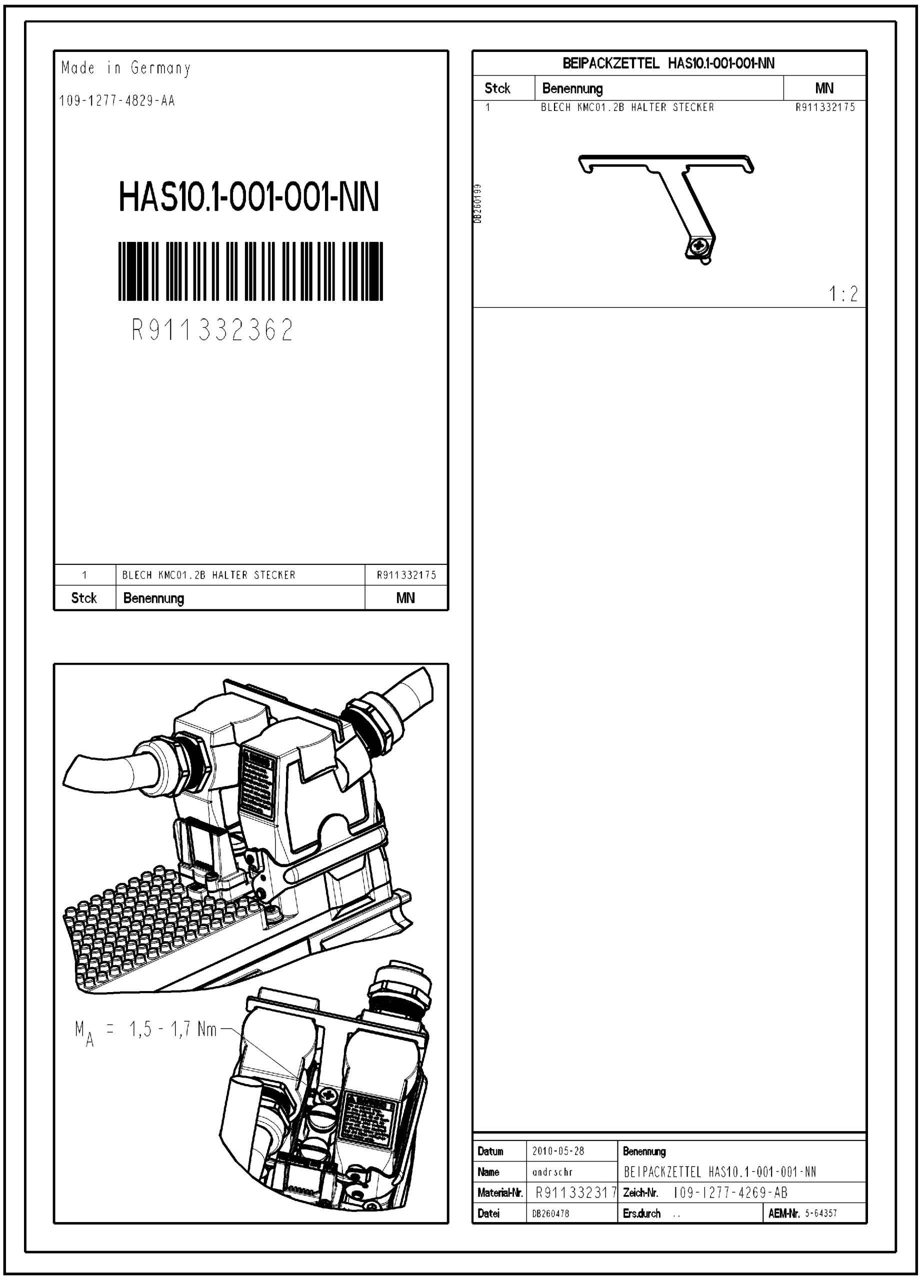


Fig. 10-8: Product insert HAS10.1-001-001-NN

Product insert HAS10.1-001-002-NN

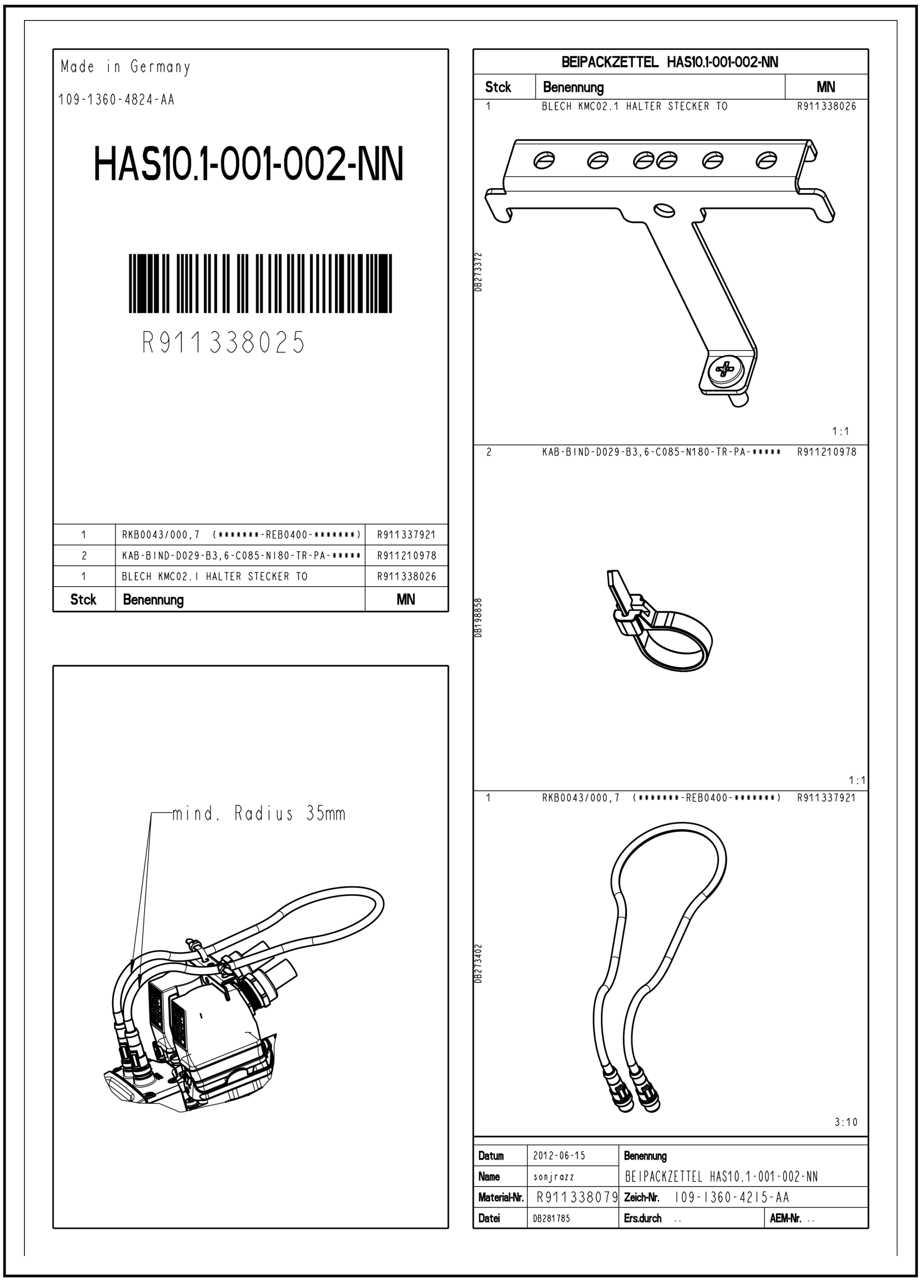


Fig. 10-9: Product insert HAS10.1-001-002-NN

10.9 RKB0011, Multi-Ethernet Cable

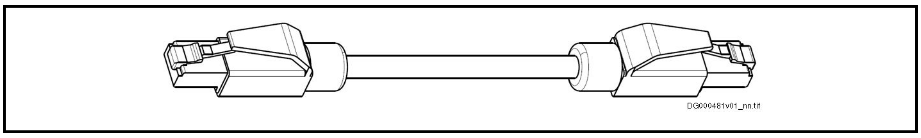


Fig. 10-10: RKB0011

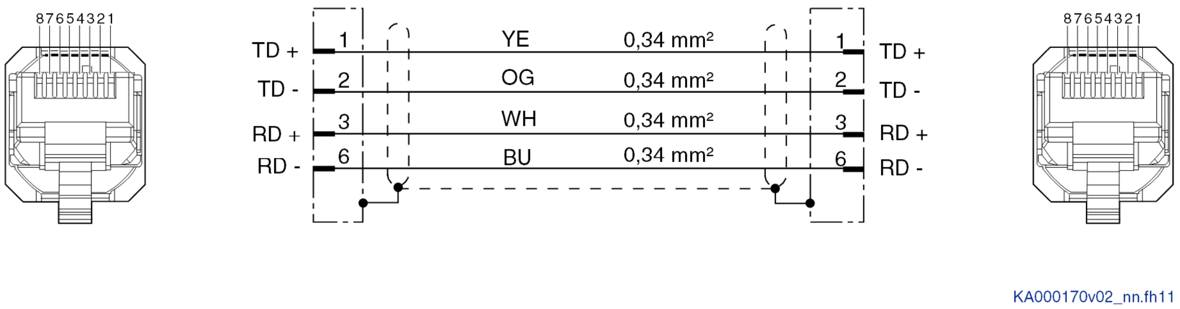
Use The cable connects the drive system to the higher-level control.

Length That Can Be Ordered, Order Code

Length	Order code	Parts number
Select as desired (max. 100 m)	RKB0011/xxx,x (xxx,x = length in meters) Example: 13.5 m ⇒ RKB0011/013,5	R911316888
5 m	RKB0011/005,0	R911321548

Tab. 10-4: RKB0033

RKB0011		
Plug-in connector bus	Bulk cable	Plug-in connector bus
RBS0016/S01 (RJ-45, 4-pin)	REB0400	RBS0016/S01 (RJ-45, 4-pin)



Tab. 10-5: Interconnection Diagram RKB0011

10.10 RKB0013, Multi-Ethernet Cable

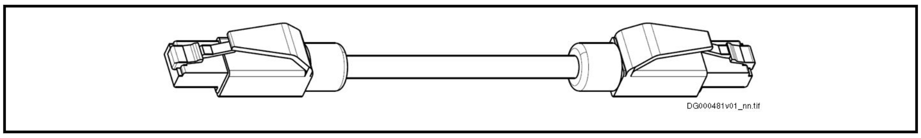


Fig. 10-11: RKB0013

Use

Short cable for connecting a drive connection box KCU to a neighboring device in the control cabinet.

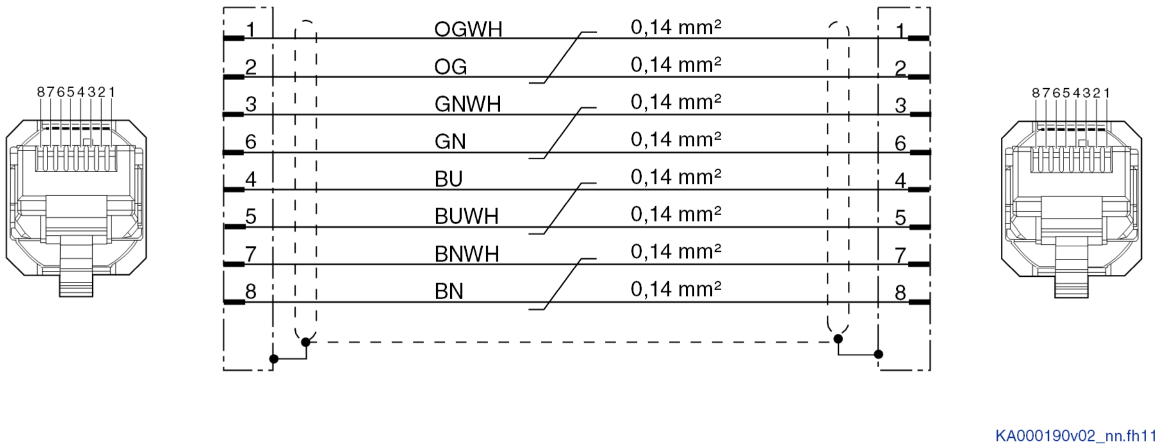
Minimum bending radius: 30.75 mm

Length That Can Be Ordered, Order Code

Length	Order code	Parts number
0.55 m	RKB0013/00,55	R911317801

Tab. 10-6: RKB0013

RKB0013		
Plug-in connector bus	**Bulk cable**	**Plug-in connector bus**
RJ-45, 8-pin	sercos III cable, 100-Base-T, CAT5E, shielded	RJ-45, 8-pin



Use instruction: only fixed lengths

Tab. 10-7: Interconnection Diagram RKB0013

10.11 RKB0033, cable for safety technology

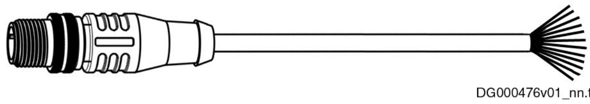


Fig. 10-12: RKB0033

Assignment

For devices with safety option L3. The cable can be used to form a new safety zone within a drive line in a distributed manner.

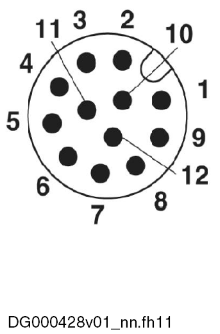
Length that can be ordered, order code

Length	Order code	Material number
1.5 m	RKB0033 / 001,5	R911334865
10 m	RKB0033 / 010,0	R911335718

Tab. 10-8: RKB0033

RKB0033		
Plug-in connector	**Bulk cable**	**Plug-in connector**
M12, 12-pin	Bus cable	Open ends

Interconnection diagram



1	SI_Ch1	BN
3	Zone_Br	WH
6	SI_0V_In	YE
4	+24V	GN
5	SI_Ch1_In	PK
8	Dyn_Ch1	GY
7	SI_Ch2_In	BK
10	SI_0V	VT
9	24V_Br	RD
2	SI_Ch2	BU
11	GND	GYPK
12	Dyn_Ch2	RDBU

Use instruction: only fixed lengths

Tab. 10-9: RKB0033 parts

10.12 RKB0043, Communication Cable

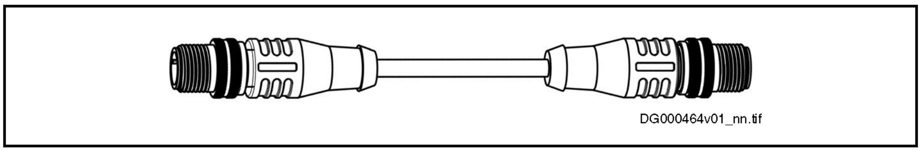


Fig. 10-13: RKB0043

Assignment

1. For devices with unused communication output coupling (X108, X109). The cable connects the connection points X108 and X109.
2. For devices with terminal connector RHS0014. The cable connects two devices via the terminal connectors RHS0014.

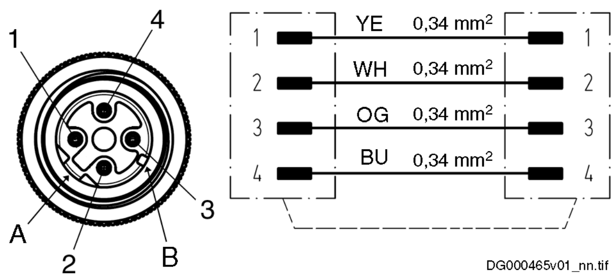
Length That Can Be Ordered, Order Code, Material Number

Length	Order code	Material number
To be freely selected	RKB0043/xxx,x (xxx,x = length in meters)	R911172134

Tab. 10-10: RKB0043

RKB0043		
Plug-in connector	Bulk cable	Plug-in connector
M12, 4-pin, male, D-coded	Bus cable (REB400)	M12, 4-pin, male, D-coded

Interconnection diagram



A: Coding groove; B: Coding nose

Tab. 10-11: Parts RKB0043

10.13 RKB0044, Communication Cable

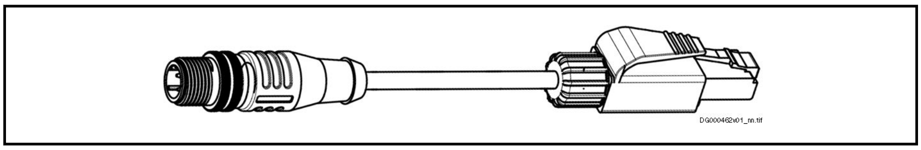


Fig. 10-14: RKB0044

Assignment

1. For devices with communication output coupling: The cable connects the other communication nodes via the connection points X108 and X109.
2. The cable connects the terminal connector RHS0014 to the following components:
   - Another KCU
   - Other communication nodes
   - A higher-level control unit

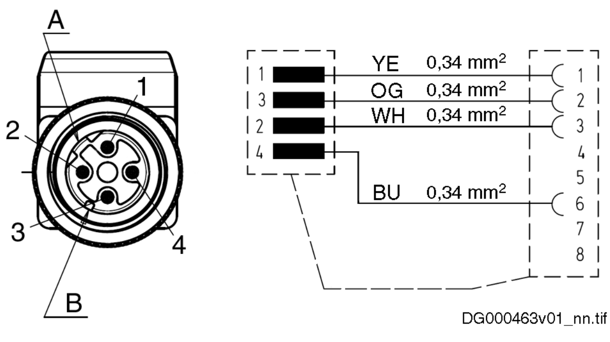
Length That Can Be Ordered, Order Code, Material Number

Length	Order code	Material number
To be freely selected	RKB0044/xxx,x (xxx,x = length in meters)	R911172135

Tab. 10-12: RKB0044

RKB0044		
Plug-in connector	**Bulk cable**	**Plug-in connector**
M12, 4-pin, male, D-coded	Bus cable (REB400)	RJ-45

Interconnection diagram



A: Coding groove; B: Coding nose

Tab. 10-13: Parts RKB0044

10.14 RKS0010, Interface Cable

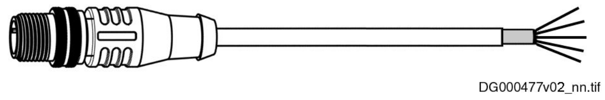


Fig. 10-15: RKS0010

Assignment

Cable to connect digital I/Os to X37 or X38.

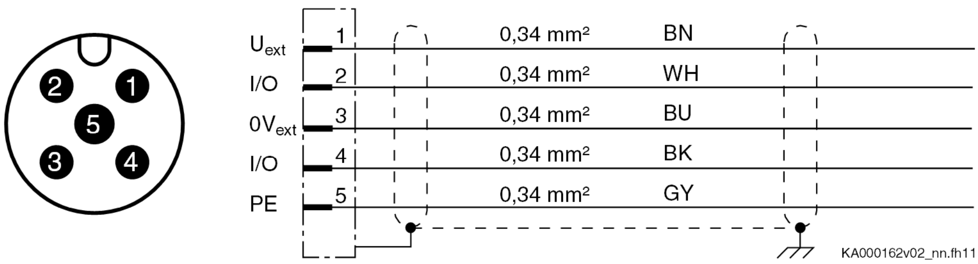
Length That Can Be Ordered, Order Code, Material Number

Length	Order code	Material number
3 m	RKS0010 / 03,0	R911322843

Tab. 10-14: RKB0013

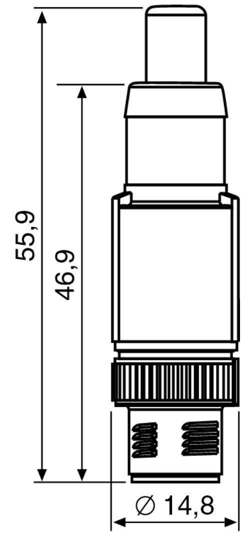
RKS0010		
Plug-in connector	Bulk cable	Plug-in connector
M12, A-coded, shielded	n.s.	Open ends

Interconnection diagram

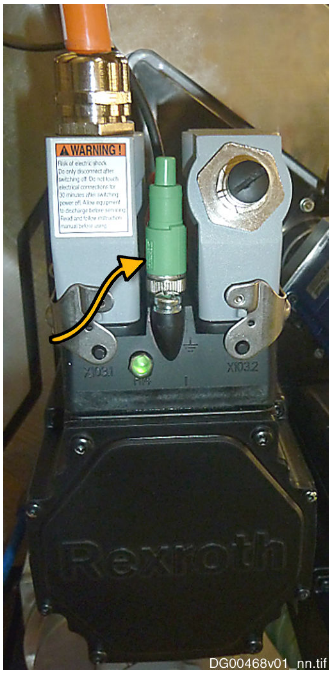


Tab. 10-15: Parts RKS0010

10.15 RBS0023, connector for safety zone node

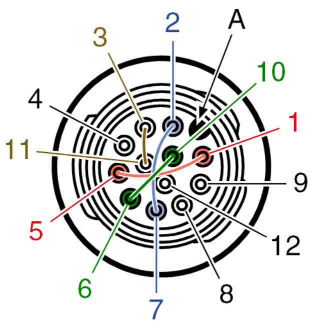


DG000461v01_nn.fh11



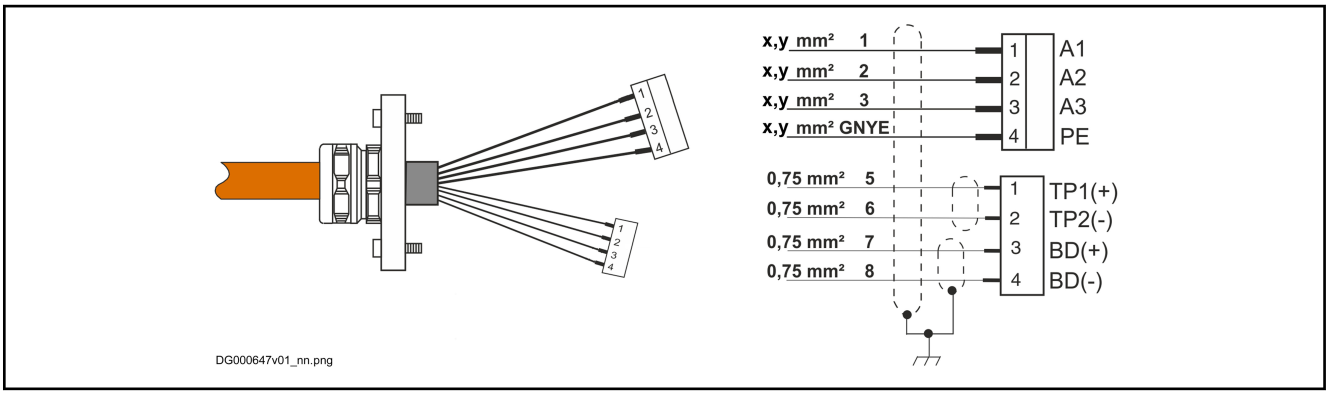
DG00468v01_nn.tif

Tab. 10-16: Connector RBS0023

RBS0023 Connector M12, 12-pin, A-coded; mat. no.: R911335348	Connec-tion	Connected to connection	Function
 DA000437v01_nn.fh11 A: Coding	1	5	When a KSM/KMS with optional safety technology is to be a safety zone node within a safety zone, the connection point X141 must be equipped with the connector RBS0023. The connector RBS0023 jumpers the following connections: • 5 ↔ 1 • 7 ↔ 2 • 6 ↔ 10 • 11 ↔ 3 KSM/KMS without optional safety technology can be operated within a safety zone without the connector RBS0023, because the signals are directly transmitted to the next safety zone node via X103.1 and X103.2.
	2	7	
	3	11	
	4	n. c.	
	5	1	
	6	10	
	7	2	
	8	n. c.	
	9	n. c.	
	10	6	
	11	3	
	12	n. c.	

Tab. 10-17: Function, pin assignment, properties

10.16 RLS0725, KMS03 motor power cable connector



RLS0725/K01 x,y = 1.0
RLS0725/K02 x,y = 1.5

Fig. 10-16: RLS0725

10.17 RGS0725, KMS03 encoder cable connector

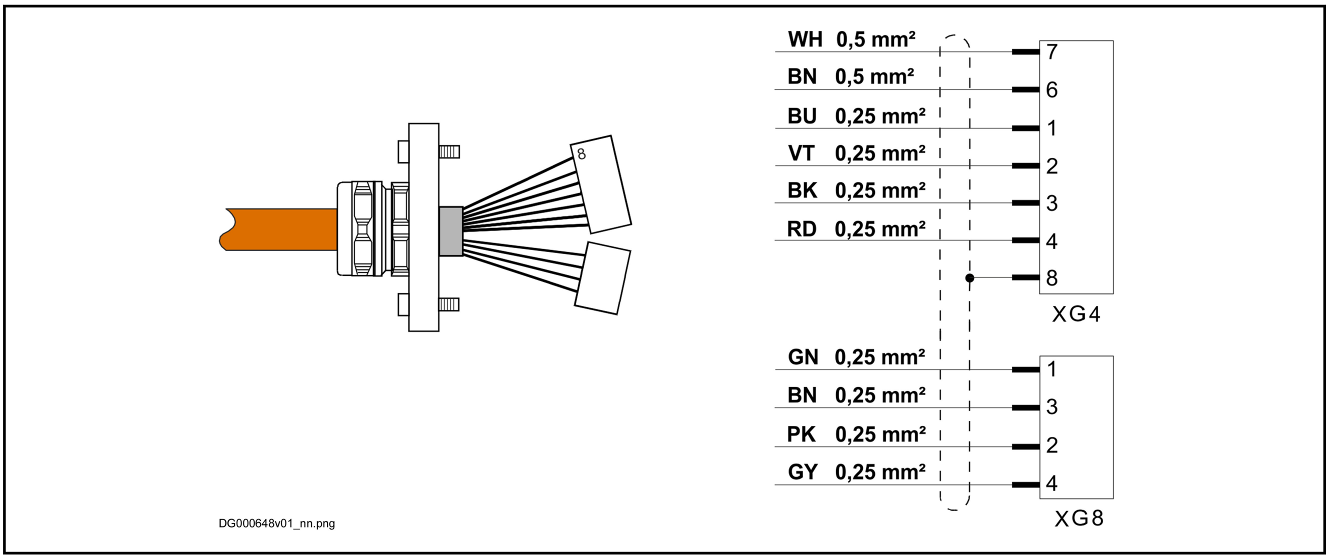


Fig. 10-17: RGS0725/K02

10.18 RHS0725, KMS03 motor cable connector

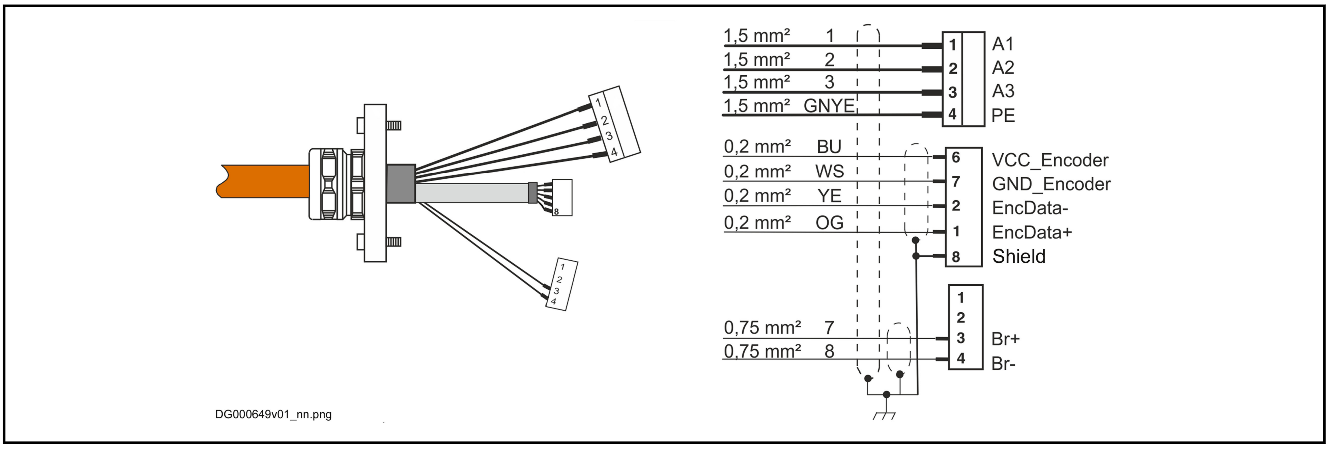
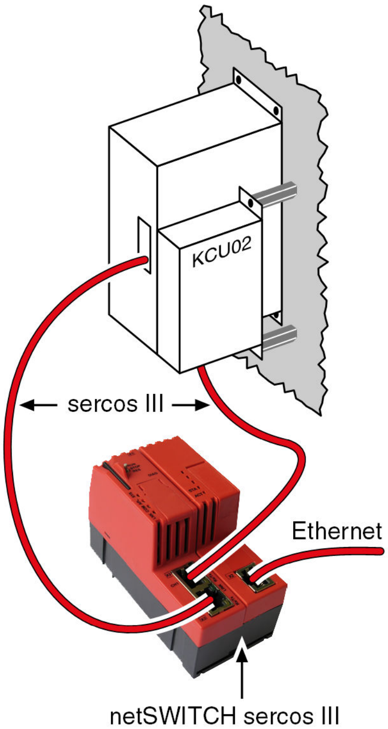


Fig. 10-18: RHS0725/K02

10.19 netSWITCH sercos III

	The accessory "netSWITCH sercos III" (mat. no.: R911328254) connects a sercos III network into a standard Ethernet network. The netSwitch can be used to loop TCP/IP components (e.g. visualization devices) into the sercos III ring. See documentation of the accessory for detailed information. Engineering: The accessory "netSWITCH sercos III" can be looped into the sercos III ring for drive system engineering. Drive system engineering is also possible via a connected control unit (MLC) or via a drive with an open sercos ring (can be connected at terminal connector RHS0014).

Tab. 10-18: netSWITCH sercos III

11 Commissioning, operation, diagnostics and maintenance

11.1 Notes on commissioning

11.1.1 General information

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

Read and observe the detailed safety instructions contained in this documentation in chapter "Safety instructions for electric drives and controls".

11.1.2 Preparation

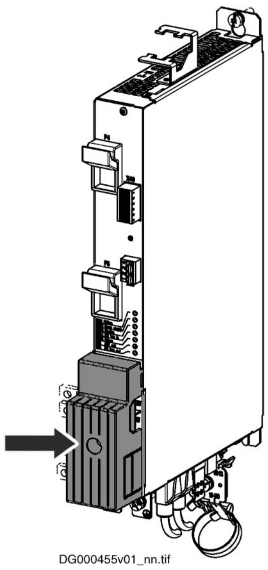
1. Keep the documentation of all used products ready.
2. Check the products for damage.
3. Check all mechanical and electrical connections.
4. Activate safety devices and monitoring systems of the installation.

11.1.3 Procedure

Commission the drive system according to the instructions contained in the corresponding product documentation. See the Functional Description of the firmware for the corresponding information.

The commissioning of drive controllers and control unit can require additional steps. The functionality and performance check of the installations is not part of motor commissioning; instead, it is carried out within the scope of the commissioning of the machine as a whole. Observe the information and regulations of the machine manufacturer.

11.2 Notes on operation

 DG000455v01_nn.tif	**WARNING!** Lethal electric shock from live parts with more than 50 V! Never operate the KCU02 drive connection box without the touch guard mounted. See also chapter 9.4.2 "Touch Guard" on page 255.

Tab. 11-1:

Make sure that the ambient conditions described are complied with during operation.

11.3 Diagnostic functions

11.3.1 KMV diagnostic display

LED H14

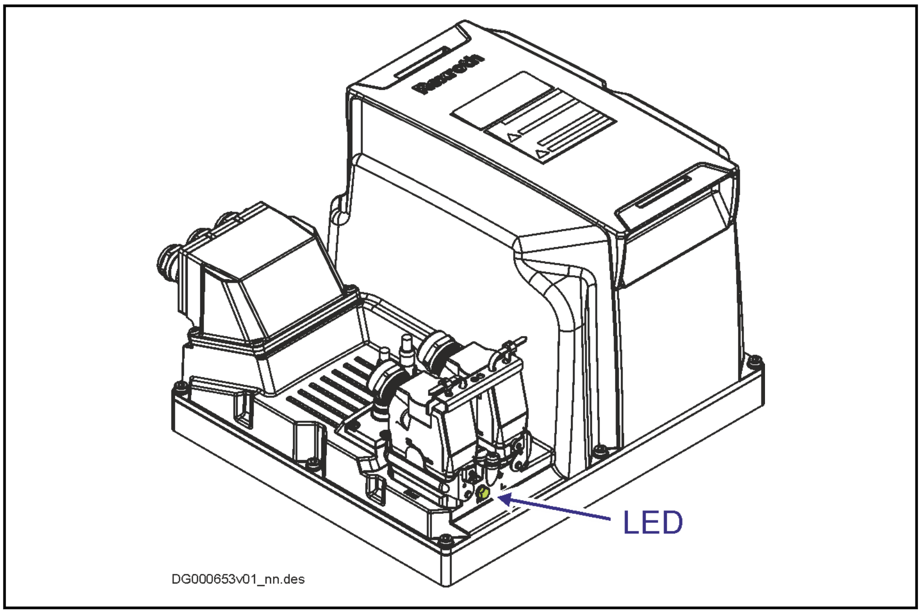


Fig. 11-1: LED H14

At the device, there is a bicolor LED which displays the drive status.

H14 Color / flashing pattern 1)		Significance	Measures
	Off --	Supply unit not switched on	Check 24V supply and switch it on, if not yet done
		Cable interrupted	Check cable and connector
		Hardware defective	Replace hardware
	Flashing green GN --	Firmware update active	-
	GN -- -- -- -- -- --	• Transition command active • PM (parameter mode)	-
	GN -- GN -- -- -- -- -- --	• **bb** (control section ready for oper., mains voltage not available) • **ZKS** (DC bus short circuit)	-
	GN -- GN -- GN -- -- -- -- -- --	• **Ab** (drive ready for operation, power on) • **Bb** (control section and power section ready for operation, mains voltage available) • **charg** (DC bus charging active)	-

H14 Color / flashing pattern 1)	Significance	Measures
Green GN	• **AH** (Drive Halt) • **AF** (Drive in control) • **Lb** (supply unit in rectifier mode) • **LB** (supply unit in voltage control) • **I LB** (supply unit in current control)	-
Flashing red-green GN -- RD -- -- -- -- -- --	Bus state (e.g., not active, pre-operational, …)	-
GN RD	Loader active	-
Flashing red RD --	Firmware update error	Repeat firmware update
RD -- -- -- -- -- --	• All warnings • Command errors	Read detailed state via "S-0-0095, Diagnostic message"
RD -- RD -- -- -- -- -- --	All errors (except F4xxx)	Read detailed state via "S-0-0095, Diagnostic message" and carry out service function
RD -- RD -- RD -- -- -- -- -- --	Communication error (F4xxx)	If necessary, read detailed state via "S-0-0095, Diagnostic message"
Red RD	Booting phase	Wait until booting phase is over (approx. 2 minutes)
	System error (F9xxx)	• Switch off and on; replace hardware, if necessary • Check whether programming module has been plugged

1) Flashing pattern: One square corresponds to a duration of 250 ms; the arrow marks the end of a cycle; abbreviations on the squares: GN = LED permanently lit green, RD = LED permanently lit red, -- = LED is off

Tab. 11-2: H14 LED displays

11.3.2 KCU02 Diagnostic Display

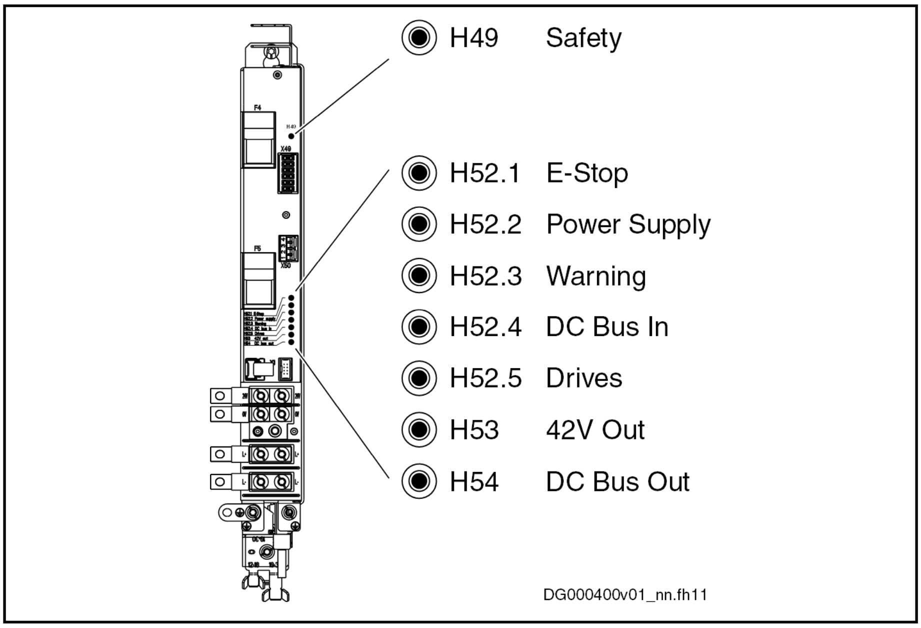


Fig. 11-2: LEDs of KCU02

LED	Color / status		Significance	Measures
H49 Safety		Green	Safety technology signals without errors	None
		Red	Safety technology signals without errors (Error is stored until the device is turned off.)	Check the safety technology wiring for short-circuits.
H52.1 E-Stop		Off	E-Stop not activated	Deactivate E-Stop, if necessary
		Red	E-Stop active (/E_Stop)	Activate E-Stop, if necessary (see connection point X50)
H52.2 Power Supply		Green	Supply unit without error, regular status	None
		Red	Supply unit signals errors (/Bb_V)	Check power supply, see also "F2086 Error supply module"
H52.3 Warning		Green	Supply unit without warning (/Warn), regular status	None
		Red	Supply unit signals warning	Check supply unit, see also "E2086 Prewarning supply module overload"
H52.4 DC Bus In		Off	DC bus voltage (L+; L-) too low	Switch power on at supply unit
			Module bus is not connected (if H54 green)	Connect the module bus (connection point X1)
		Green	DC bus voltage (L+; L-) without error (Ud), regular status	None

LED	Color / status	Significance	Measures
H52.5 Drives	Green	No error at module bus, regular status	None
	Red	Module bus error (/Bb_A)	• Check module bus wiring • Check control voltage supply of the devices; see also "F2087 Module group communication error"
	Red/ green Flashing	Drive system carries out error reaction (Bb_A)	Bring device at module bus to readiness for operation; see also diagnostic message "E2810 Drive system not ready for operation"
H53 42V Out	Green	Control voltage for KSM at output X53 okay	None
	Red	The control voltage for KSM at output X53 is faulty or control voltage is out of limits Error is stored until the device is turned off	Overload at output: • Check the control voltage supply • Check voltage at X53 • Reduce load • Remove short circuit
H54 DC Bus Out	Off	DC bus (L+, L-) not ready for power output	None
	Green	Intermediate circuit (L+, L-) ready for power output	None
	Red	DC bus voltage (L+; L-) at output X54 not okay	Check fuses F4, F5 and replace them, if necessary

Tab. 11-3: KCU02 LED Displays

11.3.3 KSM/KMS diagnostic display

H14 LED

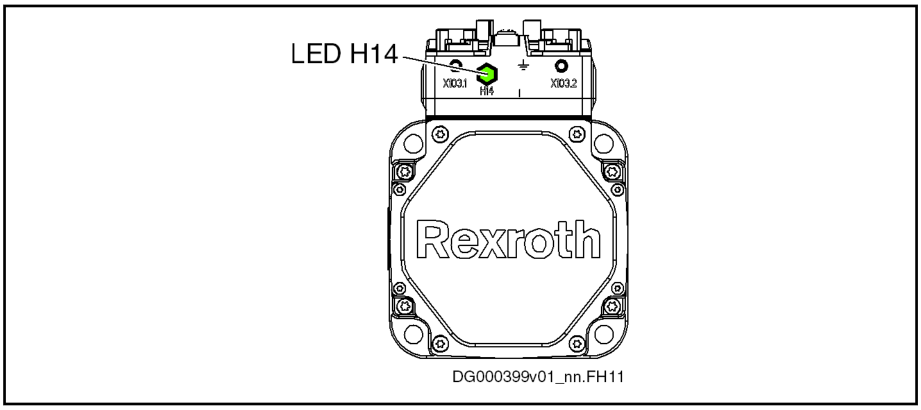


Fig. 11-3: H14 LED (KSM example)

At the device, there is a tricolor LED which displays the drive status.

H14 Color / flashing pattern [1)]		Significance (drive status)	Measures
	Off -- -- -- --	Supply unit not switched on	Check and, if necessary, switch on the 24-V supply
		Cable interrupted	Check cable and connector X18
		Hardware defective	Replace hardware
	Flashing green GN GN -- --	Drive is error-free (phases 2, 3 and 4); in phase 4, drive is ready for drive enable ("Bb")	If necessary, read exact status via "S-0-0095, Diagnostic message"
	Green GN GN GN GN	Power on and DC bus voltage available ("Ab")	Drive is error-free in operation and runs according to inputs
		Drive in control ["AF", "AH" or drive command active (Cxxxs)]	
	Flashing green-yellow GN GN YE YE	Switching command active (C01xx/C02xx) Switching command error (C01xx/C02xx)	If necessary, read exact status via "S-0-0095, Diagnostic message"
		Firmware update running Loader active	Do not interrupt the 24-V supply and do not unplug connectors while the firmware is being updated
	YE -- -- GN	Drive command error (Cxxxx)	
	Flashing yellow YE -- -- --	Drive warning (E2xxx … E3xxx)	Read exact status via "S-0-0095, Diagnostic message" and execute service function
	YE YE -- --	Communication warning (E4xxx)	
	YE YE YE --	Travel range warning (E6xxx … E7xxx)	
	YE -- YE --	Drive controller identification	

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

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

Tab. 11-4: LED Displays H14

H25 H26 LED

Use

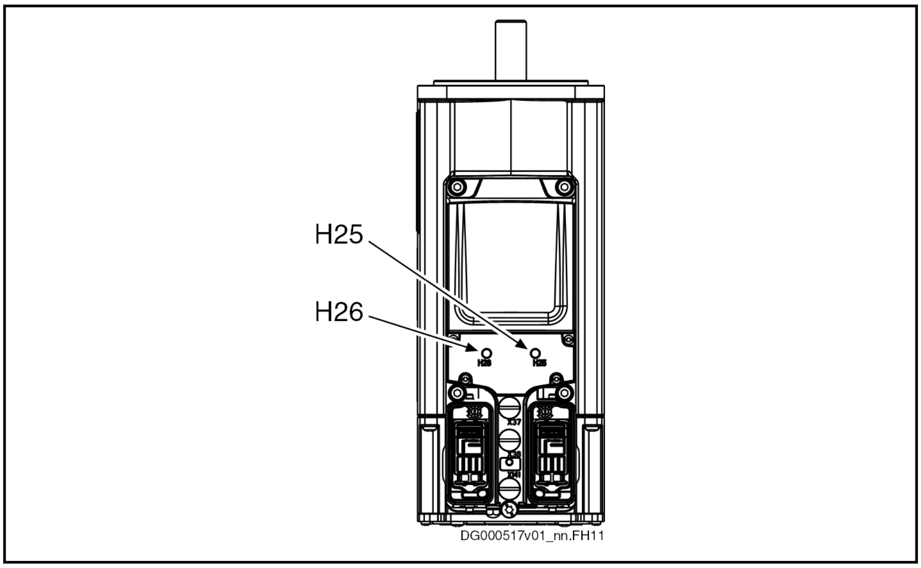


Fig. 11-4: H25 H26 LED (KSM example)

- H25 → safety technology
- H26 → network

  The significance of the network displays depends on the field bus system.

☞ The LEDs do not provide any reliable information on the internal state of the device! The LEDs only provide general diagnostic information for commissioning or troubleshooting.

H25 LED, displays

Color / flashing pattern [1]	Safety technology status [3] (Safety Supervisor State / Event)	Connection status [3]
-- Off	• Not active • Safety bus communication not configured	• Not ready • Safety bus communication not configured
GN GN -- -- Flashing green	Active, no connection (safety default)	Ready and no active connection
GN Permanently lit green	Active, at least one safe connection	Ready and at least one active connection
RD GN GN RD Flashing red-green	• Waiting for TUNID [2] • Self test and initialization • Identifying the axis identifier	• Waiting for TUNID [2] • Self test and initialization • Identifying the axis identifier
RD -- RD -- GN -- GN -- Flashing red-green	Indentifying the safety technology	-
RD -- GN -- RD -- GN -- Flashing red-green	TUNID [2] not yet set	-
RD RD -- -- Flashing red	Abortion of connections	Faulty abortion of at least one active connection
RD Permanently lit red	Critical error	Critical connection error

1) Flashing pattern: One square corresponds to a duration of 250 ms; the arrow marks the end of a cycle; abbreviations on the squares: GN = LED permanently lit green, RD = LED permanently lit red, -- = LED is off
2) TUNID = Target Unique Network Identifier
3) The LED display is only active with safety bus communication via the master communication

Tab. 11-5: LED display

H26 LED, displays

Ethernet/IP

LED: Color / flashing pattern	Significance
Off	The device does not have a valid IP address or has been switched off.
Flashing green	The device has run up with a valid IP address, but does not have a cyclic connection.
Permanently lit green	The I/O connection has been established without error.
Flashing red	The existing I/O connection was unexpectedly aborted (e.g., watchdog).
Permanently lit red	The "Duplicate-IP-Adress-Check" showed that the IP address which was set already exists in the network.
Flashing red-green	The device is running up and carries out a self test.

Tab. 11-6: Diagnostic LED

EtherCAT

LED: Color / flashing pattern [1)]	Significance	Description
-- Off	Status INIT	• Cyclic process data and acyclic data channel are not transmitted • No error
GN -- Flashing green	Status PRE-OPERATIONAL	Acyclic data channel is transmitted
GN -- -- -- -- -- Green, one LED lighting up	Status SAFE-OPERATIONAL	Acyclic data channel is transmitted
GN Permanently lit green	Status OPERATIONAL	Cyclic process data and acyclic data channel are transmitted
RD -- Flashing red	Configuration error	General EtherCAT configuration error
RD -- -- -- -- -- Red, one LED lighting up	Synchronization error	• The drive controller has not been synchronized to the EtherCAT master • Communication error of the drive controller
RD -- RD -- -- -- -- -- Red, two LEDs lighting up	Timeout - watchdog	• Timeout while cyclic process data are monitored • Watchdog of the EtherCAT master

1) Flashing pattern: One square corresponds to a duration of 200 ms; the arrow marks the end of a cycle; abbreviations on the squares: GN = LED permanently lit green, RD = LED permanently lit red, -- = LED is off

Tab. 11-7: Diagnostic LED

sercos III

LED: Color / flashing pattern [1]	Description	Prio [2]
-- Off	NRT mode (no sercos communication) [3]	6
OG Permanently lit orange	CP0 (communication phase 0 active)	6
GN OG OG OG OG OG OG OG OG OG OG OG Flashing orange-green	CP1 (communication phase 1 active)	6
GN OG GN OG OG OG OG OG OG OG OG OG Flashing orange-green	CP2 (communication phase 2 active)	6
GN OG GN OG GN OG OG OG OG OG OG OG Flashing orange-green	CP3 (communication phase 3 active)	6
GN Permanently lit green	CP4 (communication phase 4 active)	6
GN -- GN -- GN -- GN -- GN -- GN -- Flashing green	Transition from Fast forward to Loopback	5
RD OG RD OG RD OG RD OG RD OG RD OG Flashing red-orange	Application error (Sub-device/device error [C1D])	4
RD GN RD GN RD GN RD GN RD GN RD GN Flashing red-green	MST warning [4] (S-0-1045, sercos: Device Status [S-Dev], bit15)	3
RD Permanently lit red	Communication error (Sub-device/device error [C1D])	2
OG -- OG -- OG -- OG -- OG -- OG -- Flashing orange	Identification (S-0-1044, sercos: Device Control [C-Dev], bit15)	1
RD -- RD -- RD -- RD -- RD -- RD -- Flashing red	Internal watchdog	0

1) Flashing pattern: One square corresponds to a duration of 250 ms; the arrow marks the end of a cycle; abbreviations on the squares: GN = LED permanently lit green, OG = LED permanently lit orange, RD = LED permanently lit red, -- = LED is off

2) Display priority (1 = highest priority); the state of the highest priority is displayed

3) NRT = None Real Time

4) MST = Master synchronization telegram

Tab. 11-8: Diagnostic LED

PROFINET IO

LED: Color / flashing pattern	Significance
Off	The device does not have a valid IP address or has been switched off.
Flashing green	The device has run up with a valid IP address, but does not have a cyclic connection.
Permanently lit green	The I/O connection has been established without error.
Flashing red	The existing I/O connection was unexpectedly aborted (e.g., watchdog).
Permanently lit red	The "Duplicate-IP-Adress-Check" showed that the IP address which was set already exists in the network.
Flashing red-green	The device is running up and carries out a self test.

Tab. 11-9: Diagnostic LED

11.3.4 Diagnostic messages via parameters

The usual diagnostic parameters are used:

- S-0-0095
- S-0-0390
- P-0-0009
- …

See also parameter description of firmware.

11.3.5 Firmware functions

Easy startup mode

The easy startup mode is intended for initial commissioning. Easy startup can be carried out with the "Rexroth IndraWorks D" commissioning software.

For easy startup, the digital inputs have been preset as follows:

- E1 (X37.4): +24 V to activate positive direction of rotation
- E2 (X37.2): +24 V to activate negative direction of rotation
- E3 (X38.4): +24 V to activate drive enable

📖 See Functional Description of firmware → "Easy startup mode".

Analog outputs

KSM/KMS have **no** analog outputs!

Oscilloscope function

It is possible to use the oscilloscope function integrated in the drive and described in the Functional Description of the firmware!

🕮 See Functional Description of firmware → "Oscilloscope function".

Patch function

With the patch function you can read or write controller-internal memory cells.

🕮 See Functional Description of firmware → "Patch function".

Monitoring function

The monitoring function provides extended diagnostic possibilities.

🕮 See Functional Description of firmware → "Monitoring function".

Logbook function

With the logbook function you can reproduce the internal firmware sequence.

🕮 See Functional Description of firmware → "Logbook function".

11.4 Service functions/troubleshooting

11.4.1 General information

⚠ WARNING **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.

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

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

The following section explains the tasks required to eliminate errors or malfunction.

We distinguish the following actions:

- Replacing fuses F4 and F5
- Deactivation
- Dismounting
- Replacing the component

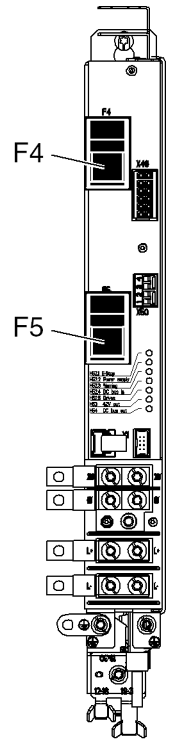
11.4.2 Replacing Fuses F4 and F5

⚠ WARNING	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.

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

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



DG000401v01_nn.FH11

Fig. 11-5: Fuses F4 and F5

Replacing fuses F4 and F5

1. Switch off power voltage to drive system.
2. Wait at least 30 minutes until discharge time has elapsed.
3. Open fuse carriers F4 and F5.
4. Remove fuses F4 and F5.

   Note: Always replace both fuses, even if only one of them is defective. Probably, the intact fuse is already damaged.
5. Insert new **FWP-30A14Fa** fuses by BUSSMANN.
6. Close fuse carriers F4 and F5.

11.4.3 Deactivating and Dismounting the Drive

Deactivation

In the case of malfunction, maintenance measures or to deactivate the motors, proceed as follows:

1. Observe the instructions contained in the machine documentation.
2. Use the machine-side control commands to bring the drive to a controlled standstill.
3. Switch off the power voltage and control voltage of the controller.
4. Switch off the main switch of the machine.
5. Secure the machine against accidental movements and against unauthorized operation.
6. Wait to allow the electric systems to discharge and then disconnect all electrical connections.
7. Before dismounting them, secure the motor and, if necessary, the fan unit against falling or movements, before unfastening the mechanical connections.

Dismounting

⚠ WARNING **Lethal injury caused by errors when controlling motors and working at moving parts!**

- Do not work at running or unsecured installations.
- Before starting to dismount, secure the machine against accidental movements and unauthorized operation.
- Before dismounting them, secure the motor and the supply lines unit against falling or movements, before unfastening the mechanical connections.

⚠ CAUTION **Burns caused by hot surfaces with temperatures of more than 100 °C!**

- Before beginning to work, let the motors cool down. The thermal time constant specified in the Technical Data is a measure for the time required for cooling down. Cooling down can require up to 140 minutes!
- Do not work at hot surfaces.
- Wear safety gloves.

1. Observe the instructions contained in the machine documentation.
2. Observe the Safety Instructions and carry out all steps according to the instructions for "deactivation".
3. Before dismounting them, secure the motor and the supply lines unit against falling or movements, before unfastening the mechanical connections.
4. Dismount the motor from the machine.
5. Store the motor appropriately.

11.4.4 Replacing the component

☞ Always replace a defective component with a new component of the same type.

1. De-energize the machine (switch off 24V supply, too!)
2. Make sure main switch cannot be switched on again
3. **WARNING!** High electrical voltage! Danger to life by electric shock!

Wait 30 minutes to allow discharging before you start replacing the component.

4. Verify zero potential
5. Dismount defective component
6. If available: Write down address selector switch positions of the defective component
7. If available: Remove cover from slot X107 of defective component and take out programming module
8. If available: Set address selector switch of new component like the one of defective component
9. If housing of new component is dirty: Clean housing
10. When carrying out the next step, take care that dirt and moisture are prevented from penetrating the inside of the housing.

    If available: Remove cover from slot X107, plug programming module of defective component in slot X107 of new component, check sealing ring of cover for damage (if sealing ring damaged: provide new sealing ring), mount cover (screw tightening torque: 1 Nm)
11. Mount new component
12. Connect new component according to machine circuit diagram
13. Switch on 24V supply
14. Put machine into ready-for-operation state again according to machine manufacturer's instructions
15. Check functions of drive

11.4.5 "Release holding brake" service function

⚠ WARNING **Lethal injury caused by errors when controlling motors and working at moving parts!**

- Do not work at running or unsecured installations.
- Before starting to dismount, secure the machine against accidental movements and unauthorized operation.
- Before dismounting them, secure the motor and the supply lines unit against falling or movements, before unfastening the mechanical connections.

Via the X141 interface, it is possible to "release" the integrated holding brake:

- A voltage of 30 … 46 V has to be applied at X103.1 (pins 11 and 12).
- Short-circuit pin 3 with pin 9 at X141.
- The holding brake is released after the system has been booted up (H14 LED flashing).

☞ The "release holding brake" service function may only be used provided that communication with other drive components or with an Engineering tool has not been established.

With operational communication established, the holding system check command can be used to release the holding brake (parameter "P-0-0541, C2100 Holding system check command").

11.4.6 Saving Parameters

For servicing, the drive parameters must be saved and archived on initial commissioning (e.g. with software Rexroth IndraWorks D) because it must be expected that the parameters of the defective drive cannot be read any longer.

Parameters can be managed in the control unit or saved and loaded with the "Rexroth IndraWorks D" software.

11.4.7 Firmware Update

See Functional Description of firmware → "Firmware Replacement".

11.4.8 Replacing the programming module

The programming module sits underneath a cover of the housing (see chapter 6.3.4 "X107, programming module" on page 149).

The programming module contains the firmware and parameters so that the drive can be easily programmed during commissioning. Use the "Rexroth IndraWorks D" software to configure the data transfer from the programming module after the control voltage has been switched on.

11.5 Maintenance

11.5.1 Maintenance of the Motor Component

General Information

The **motors** operate in a maintenance-free way within the given operating conditions and service life. However, operation under unfavorable conditions can lead to limitations in availability.

- Increase the availability with regular preventive maintenance measures. Observe the information in the maintenance schedule of the machine manufacturer and the maintenance measures described below.

⚠ CAUTION **Risk of burns by hot surfaces with temperatures of more than 100 °C!**

Before beginning to work, let the motors cool down. The thermal time constant specified in the Technical Data is a measure for the time required for cooling down. Cooling down can require up to 140 minutes!

Do not work at hot surfaces.

Wear safety gloves.

Cleaning

Excessive dirt, dust or shavings may affect the function of the motors adversely, may in extreme cases even cause a failure of the motors. For that reason, you should clean the cooling ribs of the motors in regular intervals (at the latest, after one year is over).

Bearings

The nominal service life of the bearings is L10h > 30000 h (according to DIN ISO 281, ed. 1990), if the permissible radial and axial forces are not exceeded.

The motor bearings should be replaced, if

- the nominal bearing service life has been reached
- running noise can be heard

☞ We recommend that you have the bearings replaced by Rexroth.

Connection Cables

Check connection cables for damage in regular intervals and replace them, if necessary.

Check any optionally present flexible cable tracks for damage and replace them, if necessary.

⚠ WARNING **Danger to life by live parts with more than 50 V!**

Do not repair any connection cables provisionally. If the slightest damage is detected in the cable sheath, you must immediately put the installation out of operation and replace the connection cable.

Check the equipment grounding conductor for proper connection and tight fit in regular intervals.

Holding Brake – Commissioning and Maintenance Instructions

In order to ensure proper functioning of the holding brake, it must be checked before the motors are commissioned. The test as well as the resurfacing may be carried out "mechanically by hand" **or** "automatically by means of the software function".

Checking and resurfacing of holding brakes by hand

Measure the holding torque (M4) of the holding brake. If necessary, resurface the holding brake.

Measuring the Holding Torque (M4) of the Holding Brake

1. De-energize the motor and secure it against re-energization.
2. Measure the transferable holding torque of the holding brake with a torque wrench. For holding torque (M4) refer to the technical data.

   If the holding torque (M4) is achieved, the motor is ready for assembly. If the holding torque (M4) **is not achieved**, the subsequent resurfacing-process can be used to reconstitute the holding torque.

Resurfacing the Holding Brake

1. At closed holding brake, turn the output shaft by hand, e.g. with the help of a torque wrench, by about 5 revolutions.
2. Measure the holding torque (M4).

   If the holding torque (M4) is achieved, the motor is ready for assembly. If the specified holding torque (M4) is not attained after several grinding-in processes, the holding brake is not operable. Please, contact the Rexroth Service.

Checking and resurfacing of holding brakes by means of the software function

Checking the Holding Torque (M4) via P-0-0541, C2100 Command Holding system check

1. The efficiency of the holding brake and the opened state are checked by the control device by starting the routine "P-0-0541, C2100 Command Holding system check".

   If the holding brake is operational, the drive is in an operational state after the routine was run through. If the braking torque is too low, the control device outputs a corresponding message.

☞ The brake test can also be carried out cyclically in the framework of a preventive maintenance.

Restoring the Holding Torque (M4) by means of the Software Function

The following possibilities are available:

1. Realization of the resurfacing routine IndraDrive "Restoring the holding torque "(see"P-0-0544, C3900 Command Resurfacing of motor holding brake"). A repeated realization of the resurfacing routine is possible.

   Upon the execution of the command C3900 it is not checked whether the resurfacing of the holding brake was successful. It is recommended to execute the command C2100 (Command Holding system check) once again.
2. Resurfacing routine by superior control. Here, special control programs adapted to the machine and system concepts are required. If necessary, please contact your Bosch Rexroth distribution partner and discuss the resurfacing routine parameters for your application.

For further information on software functions, see Functional Description of firmware.

11.5.2 Maintenance of the Electronic System of the Drive

The electronic system of the drive (power section and control section) operates without wear within the given operating conditions and service life. However, operation under unfavorable conditions (e.g. increased ambient temperature) can lead to limitations in availability.

⚠ CAUTION **Risk of burns by hot surfaces with temperatures of more than 60 °C!**

After switching the devices off, wait 15 minutes to allow them to cool down before touching them. Do not work at hot surfaces.

In regular intervals (at the latest, after one year is over), check the heat sink of the electronic system of the drive for accumulated dirt (e.g. dust deposits). Remove accumulated dirt.

12 Environmental protection and disposal

12.1 Environmental protection

Production processes

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

No release of hazardous substances

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

Significant components

Basically, our products contain the following components:

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

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

12.2 Disposal

Return of products

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

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

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

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

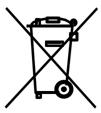
Packaging

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

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

Batteries and accumulators

Batteries and accumulators can be labeled with this symbol.



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

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

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

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

Recycling

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

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

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

13 Service and support

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

Service Germany

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

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

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

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

Service worldwide

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

Preparing information

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

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

14 Appendix

14.1 Digital inputs

14.1.1 Digital Inputs Type A (Standard)

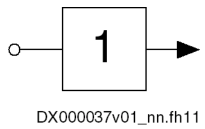


Fig. 14-1: Symbol

Data	Unit	Min.	Max.
Allowed input voltage	V	-3	30
High	V	15	30
Low	V	-3	5
Current consumption	mA	2	5
Control delay	µs		1000 + position controller clock 200 + position controller clock [1)]

1) Applies to optional I/O extension DA

Tab. 14-1: Digital Inputs Type A

14.1.2 Digital inputs (safety technology L options)

The digital inputs correspond to IEC 61131, type 2.

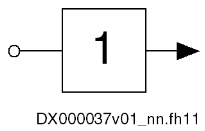


Fig. 14-2: Symbol

Data	Unit	Min.	Max.
Allowed input voltage	V	-3	30
High	V	11	30
Low	V	-3	5
Current consumption [1)]	mA	7	15

1) For KCU02, the specified values must be multiplied with the number of zone nodes of the drive line.

Tab. 14-2: Digital inputs (safety technology L options)

Appendix

14.1.3 Digital inputs (safety technology S options)

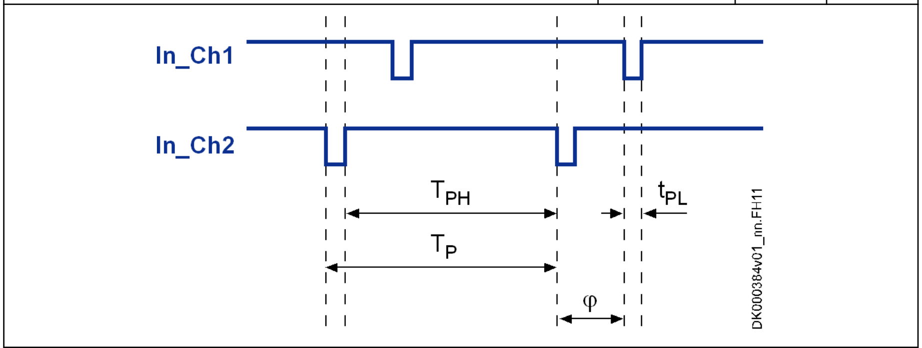
The digital inputs correspond to IEC 61131, type 1.

Data	Unit	min.	max.
Allowed input voltage	V	-3	30
High	V	15	30
Low	V	-3	5
Current consumption	mA	2	5

Tab. 14-3: Digital inputs (safety technology S options)

Time behavior

Description	Unit	min.	max.
Test pulse width (t_{PL})	µs	0	1000
Percentage of High time ($T_{PH}/T_P \times 100\%$)	%	90	100
Phase shift between two test pulses on both channels (φ)	ms	-	-



Tab. 14-4: Time behavior

14.2 Digital outputs

14.2.1 Digital Outputs (Safety Technology L Options)

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

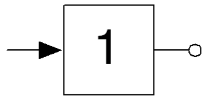


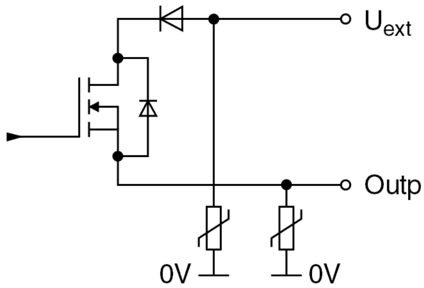
Fig. 14-3: Symbol

Data	Unit	Min.	Max.
Supply voltage (U_{ext})	V	19,2	30
Current consumption (I_{ext})	mA		700
Output voltage ON	V	18,2	30
Output voltage OFF	V		5
Output current ON	mA		350
Allowed energy content of connected inductive loads, e.g. relay coils; only allowed as single pulse	mJ		400
Short circuit protection		Available	
Overload protection		Available	

Tab. 14-5: Digital Outputs (Safety Technology L Options)

14.2.2 Digital outputs (safety technology S options)

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

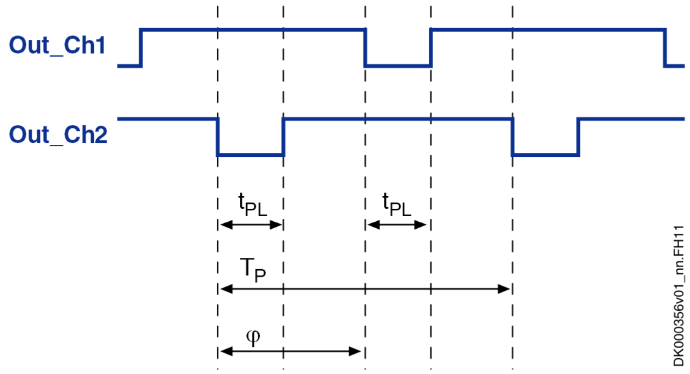
Data	Unit	min.	max.
Output voltage ON	V	U_{ext} - 1	U_{ext}
Output voltage OFF	V		2
Allowed output current per output	mA		350
Allowed energy content of connected inductive loads, e.g. relay coils	mJ		400 [1) 2)]
Capacitive load	nF		320
Short circuit protection		Present	
Overload protection		Present	
Block diagram output:	 DA000462v02_nn.FH11		
Error detection	The following errors are detected: • Wiring error with short circuit to high • Wiring error with short circuit to low • Wiring error with short circuit between the two channels • Internal errors In the case of an error, the control panel shows the corresponding error message: F83xx		

1) At a maximum switching frequency of 1 Hz
2) In the case of inductive loads with currents > 200 mA or in the case of inductive loads with a greater energy content, an external free-wheeling arm has to be installed. The effective terminal voltage has to be < 25 V.

Tab. 14-6: Digital outputs

Time behavior

Description	Unit	min.	max.
Test pulse width (t_{PL})	µs	100	200
Periodic time (T_P)	ms	500	1000
Phase shift between two test pulses on both channels (φ)	ms	50	-



Tab. 14-7: Time behavior

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The Drive & Control Company

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Bosch Group

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