

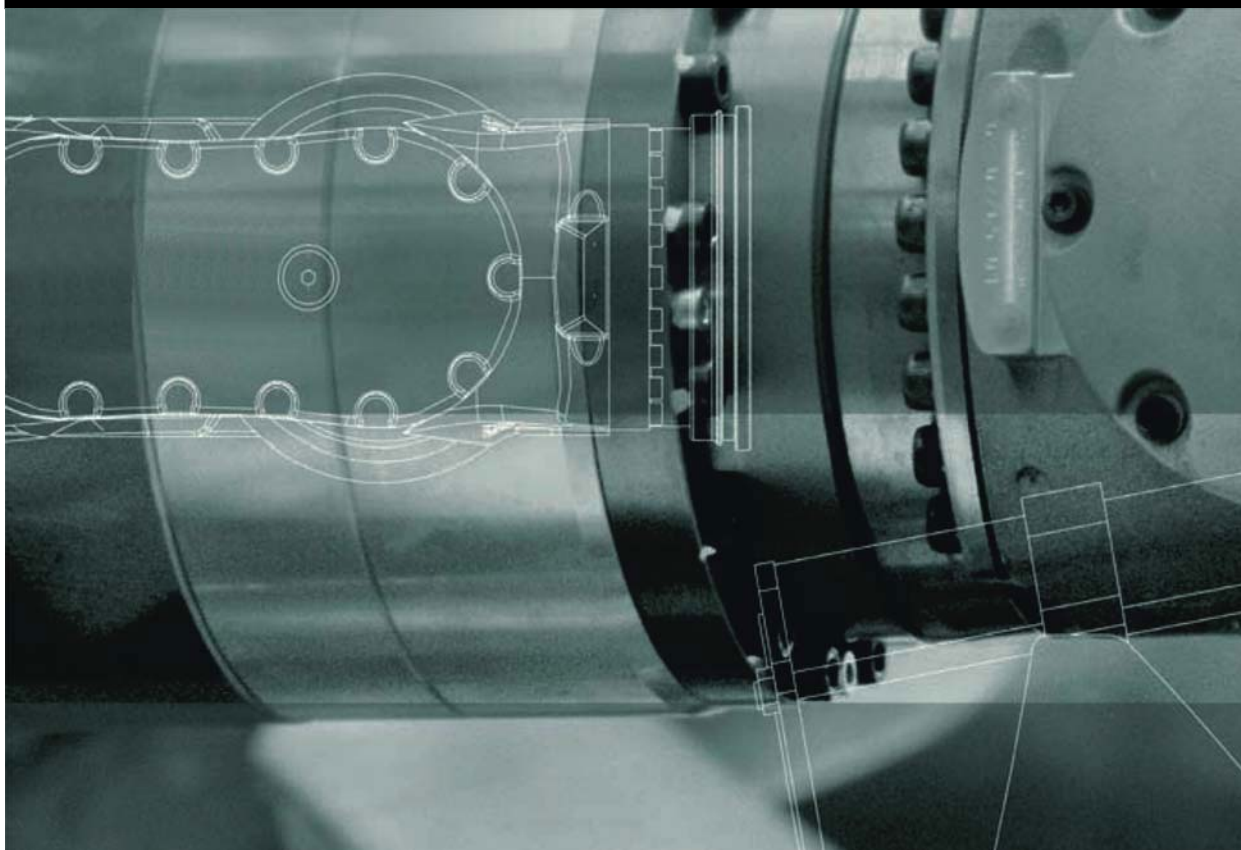
Controller Option

KUKA Roboter GmbH

External Cabling

For KR C4 Robot Controllers

Assembly and Operating Instructions



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Other functions not described in this documentation may be operable in the controller. The user has no claims to these functions, however, in the case of a replacement or service work.

We have checked the content of this documentation for conformity with the hardware and software described. Nevertheless, discrepancies cannot be precluded, for which reason we are not able to guarantee total conformity. The information in this documentation is checked on a regular basis, however, and necessary corrections will be incorporated in the subsequent edition.

Subject to technical alterations without an effect on the function.

Translation of the original documentation

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1 Introduction

1.1 Industrial robot documentation

The industrial robot documentation consists of the following parts:


- Documentation for the manipulator
- Documentation for the robot controller
- Operating and programming instructions for the KUKA System Software
- Documentation relating to options and accessories
- Parts catalog on storage medium


Each of these sets of instructions is a separate document.


1.2 Representation of warnings and notes

Safety


These warnings are relevant to safety and **must** be observed.

 DANGER	These warnings mean that it is certain or highly probable that death or severe injuries will occur, if no precautions are taken.
---	---

 WARNING	These warnings mean that death or severe injuries may occur, if no precautions are taken.
--	--

 CAUTION	These warnings mean that minor injuries may occur, if no precautions are taken.
--	--

NOTICE	These warnings mean that damage to property may occur, if no precautions are taken.
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	These warnings contain references to safety-relevant information or general safety measures. These warnings do not refer to individual hazards or individual precautionary measures.
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This warning draws attention to procedures which serve to prevent or remedy emergencies or malfunctions:

SAFETY INSTRUCTIONS	Procedures marked with this warning must be followed exactly.
----------------------------	--

Notes

These hints serve to make your work easier or contain references to further information.

	Tip to make your work easier or reference to further information.
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1.3 Terms used

Term	Description
CK	Customer-built Kinematics
EDS	Electronic Data Storage (memory card)
RDC	Resolver Digital Converter
EA	External axis (linear unit, Posiflex)

2 Purpose

2.1 Target group

This documentation is aimed at users with the following knowledge and skills:

- Advanced knowledge of electrical and electronic systems
- Advanced knowledge of the robot controller



For optimal use of our products, we recommend that our customers take part in a course of training at KUKA College. Information about the training program can be found at www.kuka.com or can be obtained directly from our subsidiaries.

2.2 Intended use

Use

The external cabling is valid for the following robot controllers:

- KR C4
- KR C4 CK
- KR C4 midsize
- KR C4 midsize CK
- KR C4 extended
- KR C4 extended CK
- KR C4 NA
- KR C4 CK NA
- KR C4 extended NA
- KR C4 extended CK NA

The external cabling for the KR C4 robot controllers must only be used for the following connections:

- Motor cables for multiple motors
 - Connection of a KR C4 with a manipulator
 - Connection of a KR C4 with a CK
 - Connection of a KR C4 with an EA
 - Connection of a KR C4 with a motor box
- Motor cables for single motors
 - Connection of a motor box with a motor
 - Connection of a KR C4 with a motor
- Data cables
 - Connection of a KR C4 with an RDC box
 - Connection of an RDC box with an RDC box
- Resolver cables
 - Connection of an RDC with the resolver of a motor

Misuse

Any use or application deviating from the intended use is deemed to be impermissible misuse. This includes e.g.:

- Operation outside the permissible operating parameters

3 Product description

3.1 Motor box and RDC box connection examples

Description

The diagram (>>> Fig. 3-1) shows a system with a manipulator with 6 axes and 8 single axes. The RDC boxes are connected in series (cascade).

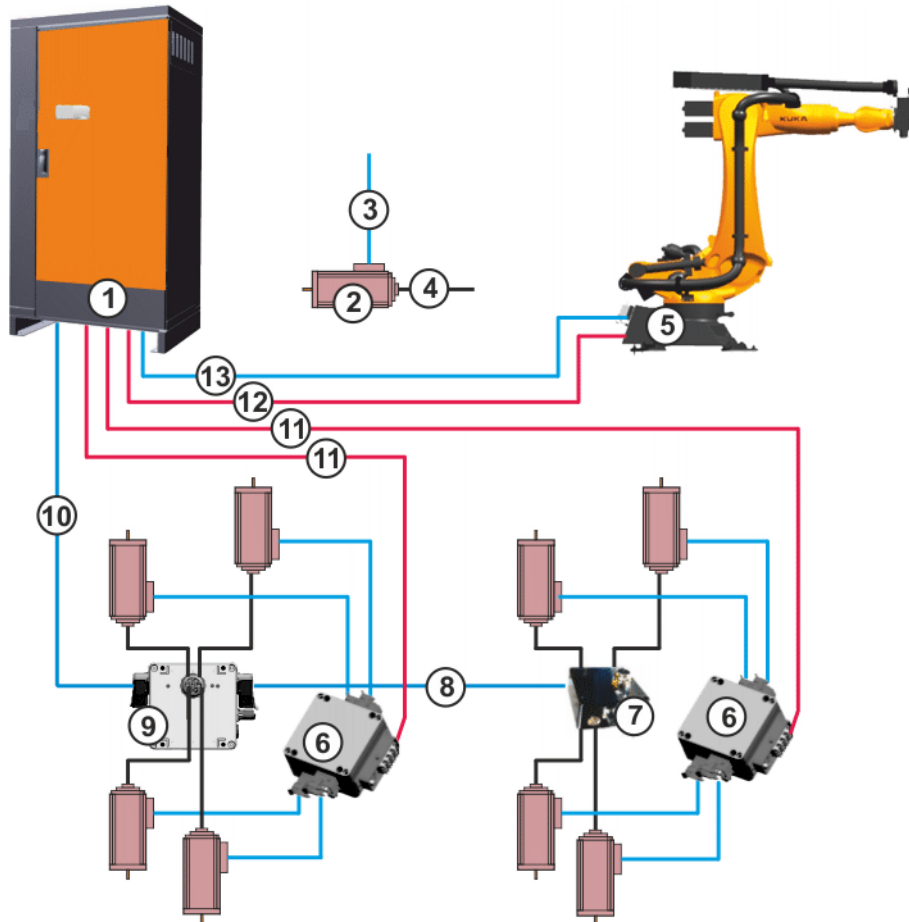


Fig. 3-1: Example: 14 axes

- 1 Connection panel on KR C4 extended robot controller
- 2 Motor
- 3 Motor cable for single axis
- 4 Resolver cable to RDC box
- 5 Manipulator
- 6 Motor box for 4 axes
- 7 RDC box
- 8 Data cable between the RDC boxes
- 9 RDC box (cascadable)
- 10 Data cable between RDC box (cascadable) and robot controller, X21.1
- 11 Motor cable between motor box and robot controller
- 12 Motor cable between manipulator and robot controller
- 13 Data cable between manipulator and robot controller, X21

Description

The diagram (>>> Fig. 3-2) shows a system with 16 single axes. The RDC boxes are connected in series.

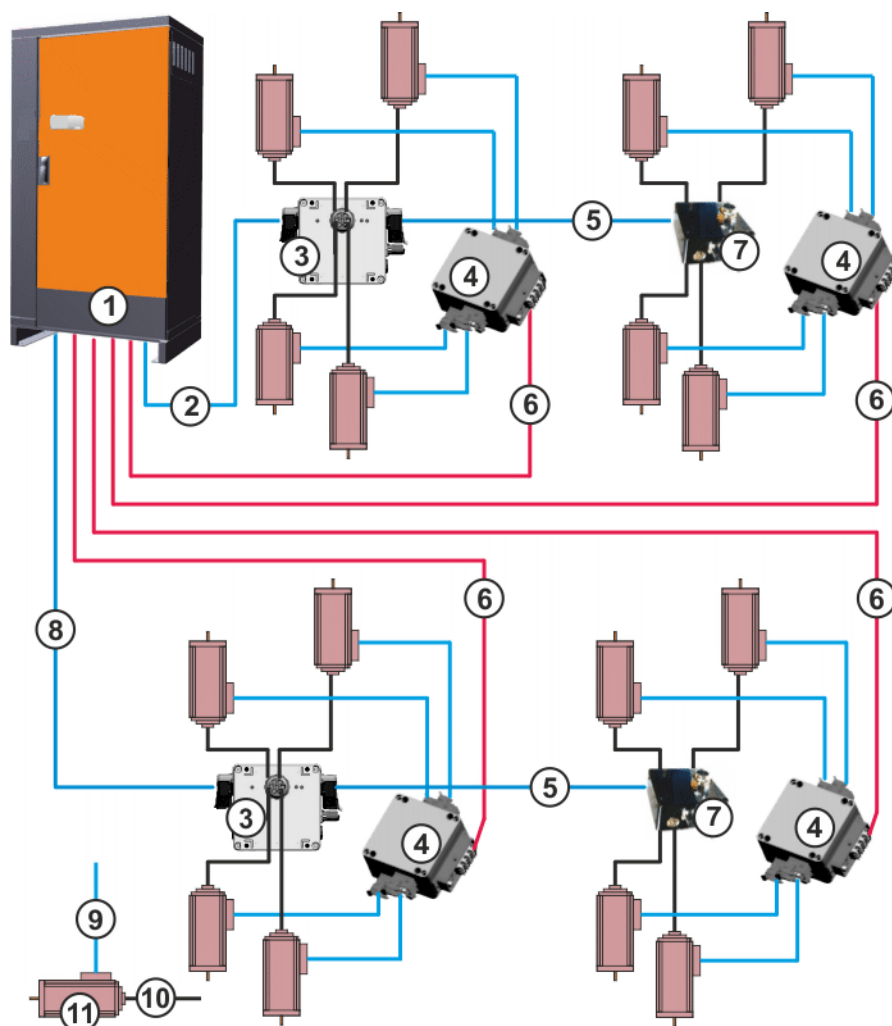


Fig. 3-2: Example: 16 axes

- 1 Connection panel on KR C4 extended robot controller
- 2 Data cable between RDC box (cascadable) and robot controller, X21
- 3 RDC box (cascadable)
- 4 Motor box for 4 axes
- 5 Data cable between the RDC boxes
- 6 Motor cable between motor box and robot controller
- 7 RDC box
- 8 Data cable between RDC box (cascadable) and robot controller, X21.1
- 9 Motor cable for single axis
- 10 Resolver cable to RDC box
- 11 Motor

3.1.1 Motor box for 4 axes

Description

The motor box is a connection adapter between a motor cable for 4 motors and 4 motor cables for one motor each. The motor box is connected at the robot controller with a multiple connector. 4 motor cables can be connected via single-axis connectors. The motor box is available in the following versions:

- with rear wall inlet
- with side wall inlet

- closed

The motor cables of the individual axes must be connected directly to the HAN modules of the multiple connector. For this, the corresponding holes for the cable inlets must be drilled in the housing.

Overview

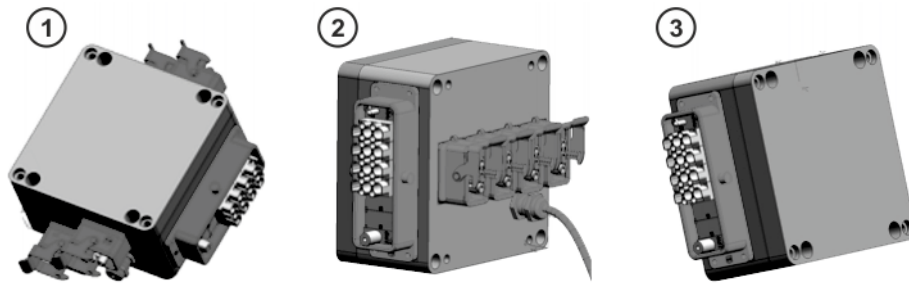


Fig. 3-3: Motor box for 4 axes

- 1 Motor box with side wall inlet
- 2 Motor box with rear wall inlet
- 3 Motor box (closed)

3.1.2 Motor box for 6 axes

Description

The motor box is a connection adapter between a motor cable for 6 motors and 6 motor cables for one motor each. The motor box is connected at the robot controller with a multiple connector. 6 single-axis motor cables with size 1 circular connectors can be connected. The motor box is available in the following versions:

- with rear wall inlet
- closed

The motor cables of the individual axes must be connected directly to the HAN modules of the multiple connector. For this, the corresponding holes for the cable inlets must be drilled in the housing.

Overview

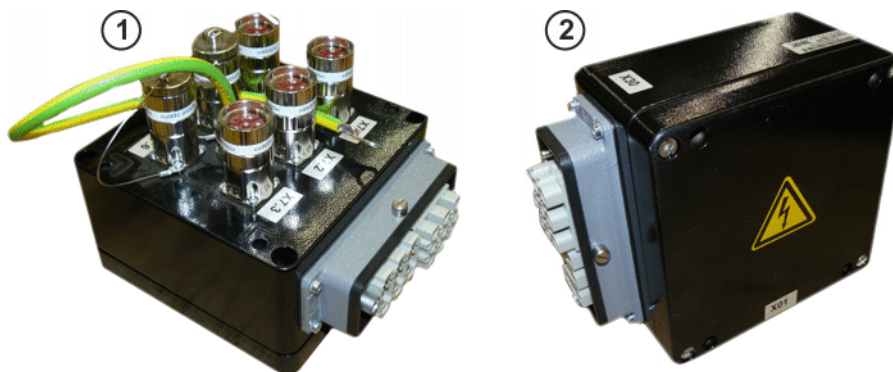


Fig. 3-4: Motor box for 6 axes

- 1 Motor box with rear connector outlet
- 2 Motor box (closed)

3.1.3 RDC box

Description

The Resolver Digital Converter (RDC) is used to detect the motor position data. 8 resolvers can be connected to the RDC. In addition, the motor tempera-

tures are measured and evaluated. For non-volatile data storage, the EDS is located in the RDC box.

RDC box

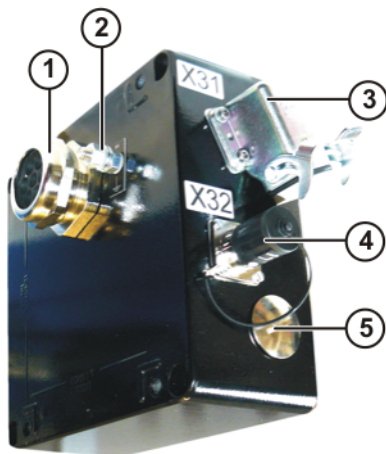


Fig. 3-5: RDC box connections

- 1 Union for 2 external axis control cables X1 ... X6
- 2 Bolt for ground conductor connection
- 3 Data cable X31
- 4 EMD connection X32
- 5 Cable inlet for resolver connections X7 and X8

3.1.4 RDC box (cascadable)

Description

The Resolver Digital Converter (RDC) is used to detect the motor position data. 8 resolvers can be connected to the RDC. In addition, the motor temperatures are measured and evaluated. For non-volatile data storage, the EDS is located in the RDC box.

The RDC box is cascadable. 2 RDC boxes per RDC interface (X21 and X21.1) can be connected in series.

RDC box (cascadable)

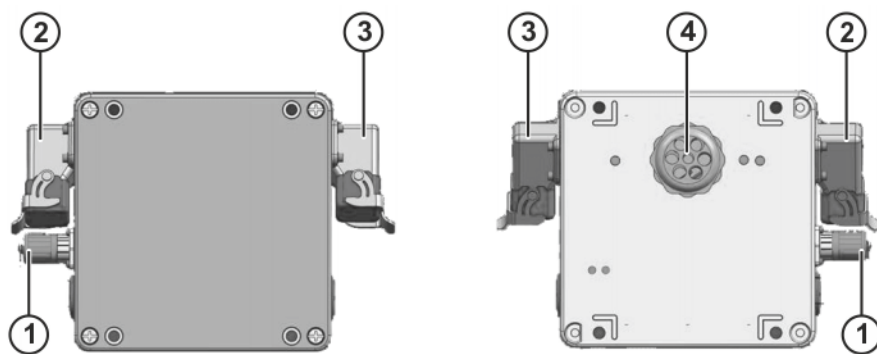


Fig. 3-6

- 1 EMD connection X32
- 2 Data cable X31
- 3 Data cable X21 (cascadable)
- 4 Cable inlet for resolver connections

3.2 Motor cables for multiple motors

- Description** The motor cables for multiple motors are used for the following connections:
- KUKA robot and robot controller
 - CK and robot controller
 - Motor box and robot controller

3.3 Motor cables for single motors

- Description** The motor cables for single motors are used for the following connections:
- 2.5 mm² and 4 mm² between motor box for 6 axes and motor
 - 6 mm² between motor box for 4 axes and motor, or between robot controller and motor

The dimensioning of the cross-section and lengths must be carried out in accordance with the relevant VDE and EN guidelines and other regulations applicable to the application and is the responsibility of the system builder.

- Extension** The motor cable extension for single motors is used for the following connection:
- Motor cable for single motors and motor

3.4 Data cable

- Description** The data cables are used for the following connections:

- Robot controller and RDC box
- Robot controller and RDC box (cascadable)

The data cable extensions are used for the following connections:

- Data cable and RDC box
- Data cable and manipulator

3.5 Resolver cable

- Description** The resolver cables are used for the following connections:

- RDC box and motors

The resolver cable extensions are used for the following connections:

- Resolver cable and motors

4 Technical data

4.1 Motor cables for multiple motors

4.1.1 Motor cable for 3 motors

Interface connector	X20.1; X20.2; X20.3
Lengths	7 m, 15 m, 25 m, 35 m, 50 m
Cross-section	3x 10 mm ²
Bending radius	100 mm for single bending
Suitable for use in a cable carrier	No
Load max.	3x 64 A
Connector type	HAN Modular
Outside diameter	27.5 mm, ±0.5 mm

4.1.2 Motor cable for 4 motors

Interface connector	X8; X81; X82; X83; X84
Lengths	3 m, 7 m, 10 m, 15 m, 20 m, 25 m, 30 m, 35 m, 50 m
Cross-section	3x 10 mm ² , 1x 6 mm ²
Bending radius	100 mm for single bending
Suitable for use in a cable carrier	No
Load max.	3x 64 A, 1x 40 A
Connector type	HAN Modular
Outside diameter	29.9 mm ±0.5 mm

4.1.3 Motor cable for 6 motors

Interface connector	X20
Lengths	3 m, 7 m, 10 m, 15 m, 20 m, 25 m, 30 m, 35 m, 50 m
Cross-section	3x 6 mm ² , 3x 2.5 mm ²
Bending radius	100 mm for single bending
Suitable for use in a cable carrier	No
Load max.	3x 40 A, 3x 20 A
Connector type	HAN Modular
Outside diameter	30 mm ±0.5 mm

4.1.4 Extensions

Interface connector	X30.1 flexible
Lengths	1.6 m, 2 m, 3 m, 4 m, 5 m, 6 m, 7 m, 8 m, 9 m, 10 m, 11 m, 12 m, 13 m, 14 m, 15 m, 16 m, 17 m, 18 m, 19 m, 20 m, 25 m, 30 m, 35 m
Cross-section	3x 6 mm ² , 3x 2.5 mm ²

Bending radius	250 mm for continuous bending
Suitable for use in a cable carrier	Yes
Load max.	3x 40 A, 3x 20 A
Connector type	HAN Modular
Outside diameter	30 mm ±0.5 mm

4.2 Motor cable for single motors

Interface connector	X7.1...X7.12
Cross-section	2.5 mm ² , 4 mm ² , 6 mm ²
Bending radius for 2.5 mm ²	120 mm for continuous bending
Bending radius for 4 mm ²	140 mm for continuous bending
Bending radius for 6 mm ²	160 mm for continuous bending
Suitable for use in a cable carrier	Yes
Load max. for 2.5 mm ²	20 A
Load max. for 4 mm ²	40 A
Load max. for 6 mm ²	64 A
Connector type	H-J1, H-J1.5
Outside diameter for 2.5 mm ²	10 mm
Outside diameter for 4 mm ²	12 mm
Outside diameter for 6 mm ²	16 mm

4.2.1 Extensions

Motor connector type 1 2.5 mm²

1.6 m, 2 m, 3 m, 4 m, 5 m, 6 m, 7 m, 8 m, 9 m, 10 m, 11 m, 12 m, 13 m
14 m, 15 m, 16 m, 17 m, 18 m, 19 m, 20 m, 25 m, 30 m, 35 m

4 mm²

1 m, 1.6 m, 2 m, 3 m, 4 m, 5 m, 6 m, 7 m, 8 m, 9 m, 10 m, 11 m, 12 m, 13 m
14 m, 15 m, 16 m, 17 m, 18 m, 19 m, 20 m, 25 m, 30 m, 35 m

Motor connector type 1.5 6 mm²

1 m, 1.6 m, 2 m, 3 m, 4 m, 5 m, 6 m, 7 m, 8 m, 9 m, 10 m, 11 m, 12 m, 13 m
14 m, 15 m, 16 m, 17 m, 18 m, 19 m, 20 m, 25 m, 30 m, 35 m

4.3 Data cable

Interface connector	X21 - X31
Cross-section	2 x 2 AWG24, 2x 1.5 mm ²
Lengths	1 m, 3 m, 7 m, 10 m, 15 m, 20 m, 25 m, 30 m, 35 m, 50 m
Bending radius	30 mm for single bending
Suitable for use in a cable carrier	No

Connector type	HAN Q12
Outside diameter	9 mm \pm 0.5 mm

4.3.1 2nd data cable

Interface connector	X21.1
Cross-section	2 x 2 AWG24, 2x 1.5 mm ²
Lengths	1 m, 3 m, 7 m, 10 m, 15 m, 20 m, 25 m, 30 m, 35 m, 50 m
Bending radius	30 mm for single bending
Suitable for use in a cable carrier	No
Connector type	HAN Q12
Outside diameter	9 mm \pm 0.5 mm

4.3.2 Extensions

Interface connector	X31.1
Cross-section	2 x 2 AWG24, 2x 1.5 mm ²
Lengths	1.6 m, 2 m, 3 m, 4 m, 5 m, 6 m, 7 m, 8 m, 9 m, 10 m, 11 m, 12 m, 13 m, 14 m, 15 m, 16 m, 17 m, 18 m, 19 m, 20 m, 25 m, 30 m, 35 m
Bending radius	100 mm for continuous bending
Suitable for use in a cable carrier	Yes
Connector type	HAN Q12
Outside diameter	10.6 mm \pm 0.3 mm

4.4 Resolver cable

Interface connector	XP
Cross-section	4 x 2 x 0.25 mm ²
Lengths	1.3 m, 2 m, 3 m, 4 m, 5 m, 6 m, 7 m, 8 m, 9 m, 10 m, 11 m, 12 m, 13 m, 14 m, 15 m, 16 m, 17 m, 18 m, 19 m, 20 m, 25 m, 30 m
Bending radius	80 mm for continuous bending
Suitable for use in a cable carrier	Yes
Connector type	M23, 12 contacts
Outside diameter	8 mm \pm 0.5 mm



The max. difference in cable length between the individual channels of the RDC box must not exceed 10 m.


4.4.1 Extensions

Interface connector	XPx.1
Cross-section	4 x 2 x 0.25 mm ²

Lengths	0.7 m, 1.4 m, 1.6 m, 2 m, 3 m, 4 m, 4.5 m, 5 m, 5.5 m, 6 m, 7 m, 7.5 m, 8 m, 9 m, 9.5 m, 10 m, 11 m, 11.5 m, 12 m, 13 m, 14 m, 15 m, 16 m, 17 m, 18 m, 19 m, 20 m
Bending radius	80 mm for continuous bending
Suitable for use in a cable carrier	Yes
Connector type	M23, 12 contacts
Outside diameter	8 mm \pm 0.5 mm

5 Safety

This documentation contains safety instructions which refer specifically to the product described here. The fundamental safety information for the industrial robot can be found in the “Safety” chapter of the operating or assembly instructions for the robot controller.

 **WARNING** The “Safety” chapter in the operating instructions or assembly instructions of the robot controller must be observed. Death to persons, severe injuries or considerable damage to property may otherwise result.

6 KUKA Service

6.1 Requesting support

Introduction The KUKA Roboter GmbH documentation offers information on operation and provides assistance with troubleshooting. For further assistance, please contact your local KUKA subsidiary.

Information The following information is required for processing a support request:

- Model and serial number of the robot
- Model and serial number of the controller
- Model and serial number of the linear unit (if applicable)
- Model and serial number of the energy supply system (if applicable)
- Version of the KUKA System Software
- Optional software or modifications
- Archive of the software
 - For KUKA System Software V8: instead of a conventional archive, generate the special data package for fault analysis (via **KrcDiag**).
- Application used
- Any external axes used
- Description of the problem, duration and frequency of the fault

6.2 KUKA Customer Support

Availability KUKA Customer Support is available in many countries. Please do not hesitate to contact us if you have any questions.

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