

Project Book for Robot Technology KUKA



Version 2020

Daimler		Powertrain Robotics KUKA
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1 General Information

1.1 Preface

This project book defines the robotics specifications for all production locations and production centers within the Passenger Car/Powertrain (GFP/P) divisions of Daimler AG.

This project book regulates the specific section on the robot technology from **KUKA**. Additional project books on robot manufacturers or specific technologies are also dependent on the technologies used and implemented.

All information in this project book has been compiled based on the current state of knowledge and the current state of technology. Technical modifications in the software and hardware areas, as part of ongoing developments and/or project-specific requirements, remain reserved.

The information makes no claim to completeness and the technical boundary conditions shall be coordinated with Daimler AG in the corresponding project phase in individual cases, if necessary.

1.2 Record of Revisions

Version:	Last revised:		Changed by:
14.0	05.05.2017	New draft	Powertrain
14.0	14.06.2018	Supplemented Chapter 5.	Additional information about connecting safe reference switches
15.0	21.03.2019	LH V15 revised	Powertrain
2020	27.02.2020	Revision LH2020	Powertrain

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1.3 Contacts at Daimler AG

Contact persons are always the particular representatives in the plants/sub-plants/Powertrain center locations.

1.4 Qualification Requirements for the System Supplier

Robotic applications are subject to special technical safety requirements and are very complex in terms of design and programming in combination with the entire system.

These special requirements can only be met with qualified applicators.

In order to maintain robotic applications at a high level in the production plants, we, Daimler AG Powertrain, have certain requirements.

The following qualifications are expected from system suppliers for programming robot systems.

- As a minimum standard, the robot programmer(s) will have qualifications for "**advanced programming, expert programming, or the like**".
- For programming an application with the option "SafeOperation (safe robot)", the qualification "**Safety Commissioner**" or another comparable qualification shall be verified and is mandatory. Without this verification, signing off on the Safe – Acceptance Test Report will not be possible and will not be recognized. Verification does not have to be provided for each robot manufacturer; the qualification for one of the robot manufacturers used (Powertrain manufacturer's approval) is sufficient: ABB, **KUKA**).

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2 General Points (Industrial Robots)

2.1 Release Listing Industrial Robots

The following release listing for industrial robots from Kuka applies for Daimler Powertrain. Use of robot models deviating from this is only possible after consultation between the project partners.

Kuka Industrial Robot	Load capacity (kg)	Range (mm)
KR8 R2010-2 Cybertech	8	2010
KR8 R2100-2 Cybertech arc HW	8	2100
KR12 R1810-2 Cybertech	12	1810
KR16 R1610-2 Cybertech	16	1610
KR16 R2010-2 Cybertech	16	2010
KR20 R1810-2 Cybertech	20	1810
KR22 R1610-2 Cybertech	22	1610
KR8 R1420-2 Cybertech Nano arc HW	8	1420
KR30 HA (can be ordered before 31.10.2020)	30	2033
KR30 L16 HA (can be ordered before 31.10.2020)	16	3102
KR60 HA (can be ordered before 31.10.2020)	60	2033
KR60 L45 HA (can be ordered before 31.10.2020)	45	2230
KR60 L30 HA (can be ordered before 31.10.2020)	30	2429
KR20 R3100 Iontec (can be ordered as of 01.11.2020)	20	3100
KR30 R2100 Iontec (can be ordered as of 01.07.2020)	30	2100
KR50 R2100 Iontec (can be ordered as of 01.07.2020)	50	2100
KR50 R2500 Iontec (can be ordered as of 01.07.2020)	50	2500
KR70 R2100 Iontec (can be ordered as of 01.07.2020)	70	2100
KR90 R2700 Pro (can be ordered before 01.07.2021)	90	2700
KR120 R2500 Pro (can be ordered before 01.07.2021)	120	2500
KR150 R3100 Quantec Prime (can be ordered before 01.07.2021)	150	3100
KR180 R2900 Quantec Prime (can be ordered before 01.07.2021)	180	2900
KR210 R2700 Quantec Prime (can be ordered before 01.07.2021)	210	2700
KR240 R2700 Quantec Prime (can be ordered before 01.07.2021)	240	2700
KR210 R3100 Quantec Ultra (can be ordered before 01.07.2021)	210	3100
KR240 R2900 Quantec Ultra (can be ordered before 01.07.2021)	240	2900
KR270 R2700 Quantec Ultra (can be ordered before 01.07.2021)	270	2700
KR300 R2500 Quantec Ultra (can be ordered before 01.07.2021)	300	2500

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Quantec-2		
KR150 R3100-2 (can be ordered as of 01.07.2020)	150	3100
KR180 R2900-2 (can be ordered as of 01.07.2020)	180	2900
KR210 R2700-2 (can be ordered as of 01.07.2020)	210	2700
KR210 R3100-2 (can be ordered as of 01.07.2020)	210	3100
KR250 R2700-2 (can be ordered as of 01.07.2020)	250	2700
KR240 R2900-2 (can be ordered as of 01.07.2020)	240	2900
KR300 R2700-2 (can be ordered as of 01.07.2020)	300	2700
KR360 R2830 Fortec	360	2826
KR280 R3080 Fortec	280	3076
KR240 R3330 Fortec	240	3326
KR500 R2830 Fortec	500	2826
KR420 R3080 Fortec	420	3076
KR340 R3330 Fortec	340	3326
KR600 R2830 Fortec	600	2826
KR510 R3080 Fortec	510	3076
KR420 R3330 Fortec	420	3326
KR1000 Titan	1,000	3,200
KR120 R2100 nano Foundry Exclusive	120	2100
KR180 R2100 nano Foundry Exclusive	180	2100

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Kuka Small Robotics "Agilus"	Load capacity (kg)	Range (mm)
KR 6 R 700-2	6	700
KR 6 R 900-2	6	900
KR 10 R 900-2	10	900
KR 10 R 1100-2	10	1100

Note:

In the Powertrain it is not permitted to use the internal pneumatic valves of the "Agilus" series located in the upper arm.

2.2 Robot Calibration

Robot calibration/adjustment can only be carried out using the adjustment kit (EMD or Micro EMD) available from Kuka. Calibration procedures deviating from this will not be accepted.

Daimler Powertrain will not supply the system supplier with an adjustment set. The system supplier is obliged to have one available for the duration of the commissioning work in order to ensure the robot is correctly adjusted at all times.



EMD Adjustment Kit (Kuka)

2.3 Approval for Robot Control System

Well-defined model types for Kuka KRC4 control are approved for Daimler Powertrain. Control configurations deviating from this are not supported and cannot be used.

Provision of robotic products by Daimler Powertrain additionally ensures the use of approved model types. Documentation about this can be found in the **Appendix to the Chapter**.

Current Model Types for Daimler Powertrain:

- KRC4 Standard Cabinet TDA4.1 (discontinued as of 31.12.2018)
- KRC4 Standard Cabinet TDA4.6 (**current Powertrain**)
- KRC4 SmallSize-2 TDA4.6 **current Powertrain** (only available upon delivery of the "Agilus" and "Cybertech Nano" robot series)

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3 Software Equipment (Standard for Powertrain)

The software equipment for Kuka robot control systems is firmly set for Daimler Powertrain. The robot control system will be equipped with technology packages that will be installed in the robot control system during a basic installation.

Technology packages that deviate from or are not included in the Powertrain standard will not be accepted.

At the start of the project the system supplier is obligated to request the latest versions of the technology packages from the representative and to install them on the robot control system at the start of the project. By agreement it is possible to have the Daimler technology package installed by KUKA.

3.1 Technology Packages for Daimler Powertrain

Technology Package	Description
KUKA.UserTech	Basic package KUKA – Creating inline forms
KUKA.LoadDataDetermination	Basic package KUKA – Determining load data
KUKA.SafeOperation	Basic package KUKA – Safety option
KUKA.Profinet M/S	Basic package KUKA – Profinet field bus
KUKA.RobotSetupManager	Basic package KUKA – Configuring the KRC4 controller
KUKA.CustomView	Basic package KUKA – User-defined interfaces
KUKA.PrismaInterface	Basic package KUKA – Connecting to the Prisma server
KUKA.MaintenanceMSG	Basic package KUKA – Configurable screen savers
KUKA.RemoteSupportView	Basic package KUKA – Remote access KRC4
KUKA.GripperSpotTech	Basic package KUKA – Option for gripper applications
KUKA.CPC	Basic package KUKA – Virus protection (white listing)
KUKA.UserkeyActivator	Basic package KUKA – EKS connection
KUKA.OptionalNetworkInterface	Basic package KUKA – Additional network interface
DAI_Powertrain	Basic package Daimler – Installation of the Powertrain standard
OrangeApps.DAGToolBaseCalib	Basic package Daimler – Tool & base measurement and testing
DAI_UserkeyCommissioning	Basic package Daimler – Configuring fall-back time and operating mode switchover for user changes
DAI_ConfigUserNetshare	Basic package Daimler – Configuring Auvesy and the possibility to change the password

For Daimler Powertrain, only "iKOP" versions are available for installing technology packages. Setups that are executed directly on the control unit are no longer available and can no longer be used.

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3.2 Commissioning According to Powertrain Specifications

The objective in Powertrain is that all Kuka robot control systems are operated with an identical sample program and technology packages. There could be differences in the basic software (KSS version), since the delivery periods within Powertrain sometimes differ greatly. Harmonizing the KSS versions would then be a decision for the representative to make on his/her own.

An installation routine is available for Powertrain that does just that. Using the installation routine ensures that the technology packages and the sample program are located in the robot control system after they have been executed.

During commissioning, parameters and settings for operating the robot control system in Powertrain are also adapted.

After the robot control system has been commissioned successfully, the actual programming phase would be able to begin.

The basic installation of the Powertrain standard is the task of the system supplier. By default it is not part of the commissioning of robotic system by the robot manufacturer. By agreement it is possible to have the Daimler technology package installed by KUKA.

Installation of the Powertrain standard is mandatory.

3.3 Work Visual (Programming Environment)

The programming environment WorkVisual is available for programming the Kuka robots. One version of the programming environment is always stipulated for projects at Daimler Powertrain. The system supplier is obliged at the beginning of the project to use the latest version of the technology packages and to work with the Work Visual version specified for the project start. Powertrain will provide this version to the system supplier upon request.

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3.4 Approved Software Options

In addition to the technologies integrated in the software package, additional Kuka software packages can be used in Powertrain. These can be ordered as an option and shall be coordinated during the project phase between the system supplier and the representative along with the involvement of the specialist department. The following overview provides a brief summary of the approved technologies. Information about this can be found in the **Appendix to the Chapter**.

Technology Package	Description
KUKA.Vision Tech	Package for image processing (not combinable with KUKA.OptionalNetworkInterface)
KUKA.Robo Team	Package for logical and geometric coupling
KUKA.ForceTorqueControl	Package for force/torque control
KUKA.ConveyorTech	Package for synchronizing robot movements
KUKA.Gluetech	Package for gluing
KUKA.Lasertech	Package for laser welding
KUKA.RoboterSensorInterface	Robot communication with a sensor system (joining applications)
KUKA.EthernetKRL	Package for data transfer via Ethernet TCP/IP
KUKA.ArcTech Basic	Package for gas-shielded welding
KUKA.ArcTech Advanced	Package for gas-shielded welding in the RoboTeam
KUKA.ExpertTech	Package for options in inline forms (e.g. switching collision detection on/off)
KUKA.SeamTech Finding	Package for seam finding
KUKA.SeamTech Tracking	Package for seam tracking
KUKA.PointCorrectionOnline	Package for online point of a path
KUKA.DIRLoader	Package for loading external KRL modules
KUKA.PLC ProConOS	Package for executing MultiProg PLC applications

3.5 Programming Specifications

Sample programs are loaded onto the robot control system when the robot control system is installed. The use of and adherence to the programming specifications as well as the sample programs are mandatory.

If failure to comply with the sample programs leads to errors while updating the KSS system software, any additional expenses shall be borne by the system supplier. Kuka system updates are adapted to the sample programs in Powertrain.

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4 Robot Control Cabinet

4.1 Power Switch

The power switch is supplied by default as a range switch. This shall be explicitly stated when ordering when it is designed as a main switch.

4.2 Power Supply (Europe)

Power supply voltage (according to DIN/IEC 38) AC 3x400 V \pm 10%

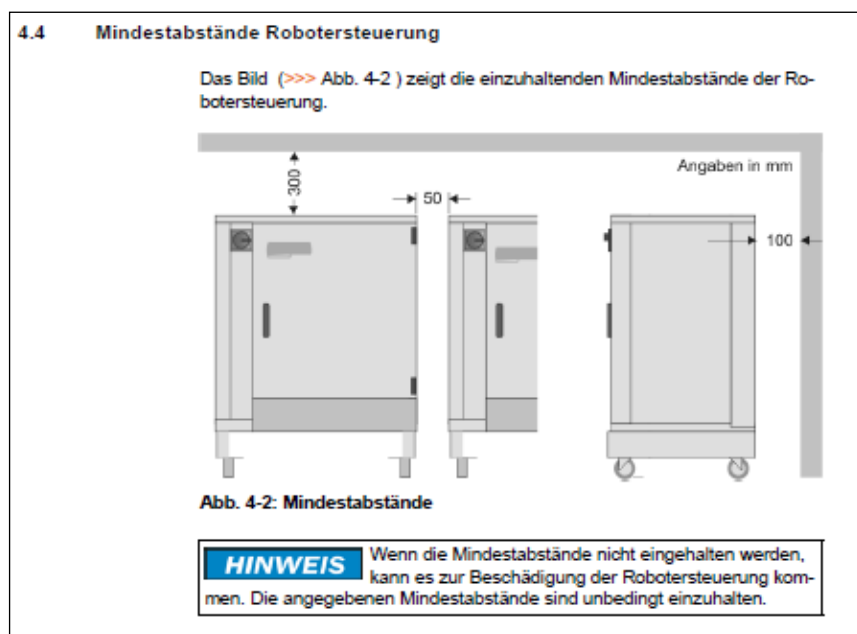
The power line frequency is 49-61 Hz

The nominal load is 8 kVA (max. 13.5 kVA)

4.3 Setting Up the Control Cabinets

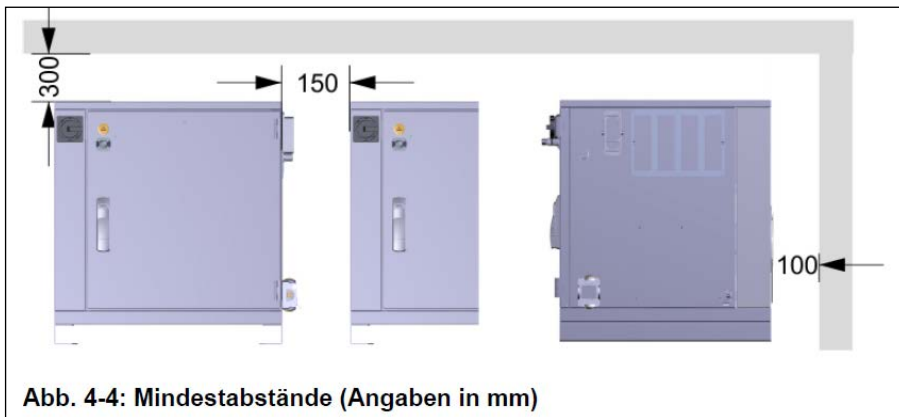
Setting up the robot control cabinets requires certain minimum requirements that are regulated in the Kuka product documentation. The following is an excerpt from this documentation on the topic of minimum distances when setting up the KRC4 control cabinets. At this point, it is again expressly noted that the regulations shall be adhered to, as damage can be caused by thermal defects and, in the event of non-compliance, responsibility for this and any damage remediation are transferred to the system supplier.

KRC4 control cabinets are supplied by default with spacer plates that shall not be removed by the system supplier.



Standard KRC4 control cabinet

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Small Size 2 control cabinet

4.4 Switch in the KUKA Robot Control Cabinet

The KUKA control cabinet for the KRC4 controller is equipped with a network switch as standard. This switch is to be treated by the supplier of the installations in the same way as switches in the entire installation network and must therefore be parameterized.

The "**Profinet specifications, Appendix 30**" of the Powertrain specifications apply. For wording see below.

The removable C-Plug medium must be installed and parameterized in the switch by the supplier of the installations.

Only SCALANCE type managed switches from Siemens may be used in the PROFINET network (see MDM). If settings in the switch are carried out via the WEB server, the C-PLUG removable medium shall be used for rapid device exchange. The web servers shall be integrated in the system's user interface.

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5 KUKA.SafeOperation

5.1 General

Kuka robots are equipped by default with the KUKA.SafeOperation option, but this is not activated. The system supplier decides whether or not to use this option by means of a risk analysis of the system to be delivered. Kuka is not primarily responsible for implementing the safety function. Additional details on how to handle this safety function can be found in the General Requirement Specifications for Robotics.

5.2 Description

The KUKA.SafeOperation 3.5.x option offers a combination of the latest safety-relevant software and hardware components for restricting and monitoring work and protection areas. KUKA.SafeOperation can be used with the KUKA standard robot and offers a range of options for personnel and cell safety.

5.3 Fields of Application (Examples)

- Replacement of conventional axis-range monitoring systems
- Direct insertion of workpieces without a clipboard
- Cooperation between humans and robots
- Innovative safety and system concepts

5.4 Functioning

The robot system components move within the configured and activated limits. The actual positions are continuously calculated and monitored as per the set safe parameters.

KUKA.SafeOperation monitors the robotic system with the set safe parameters. If a component within the robot system violates a monitored limit or a safe parameter, the robots and additional axes (optional) stop.

5.5 Referencing the Safe System

A 2-channel, non-contact proximity switch is used to reference the robot system. This reference switch is available within the Daimler Powertrain scope of delivery together with the robot control system incl. the associated connection line.

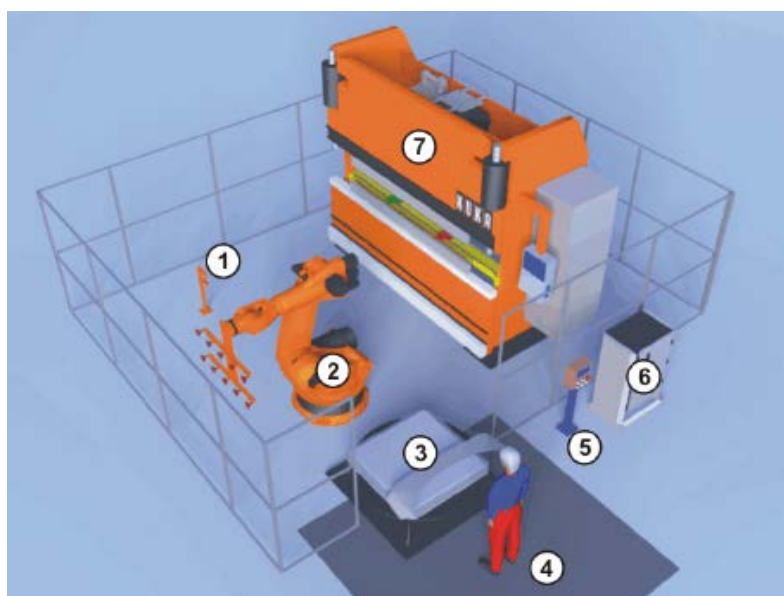
In the case of the Kuka robot control system, the robot control system plug field is connected with the plug provided for this (designation XG242).

Connecting the reference switch to the machine control unit for the system is not planned when using a Kuka robot control system in Powertrain.

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5.6 Provided Functions

- Reference switch and associated attenuation plate (attenuation plate shall be mounted close to the flange)
- Connection to an external safety logic
- Activatable monitoring via safe inputs
- Activatable safe outputs for status messages from the monitors
- Monitoring of up to 16 freely-definable monitored areas
- Cell area
- Monitored Area 1...16: Axis-specific or Cartesian monitored areas
- Safe monitoring of axis-specific speeds and accelerations
- Safe monitoring of area-specific speeds
- Safe monitoring of Cartesian speeds on the activated tool
- Modeling of up to 16 tools with special TCP
- Safe standstill monitoring
- Safe stop via the safety control system with safe drive shutdown
- Monitoring of adjustment
- Support of asynchronous additional axes
- Brake test
- Braking before brake limits (BBRA)



- | | |
|----------------------------|------------------------|
| 1 Mounted reference button | 2 Robot |
| 3 Insertion station | 4 Safety mats |
| 5 System control panel | 6 Robot control system |
| 7 Bending machine | |