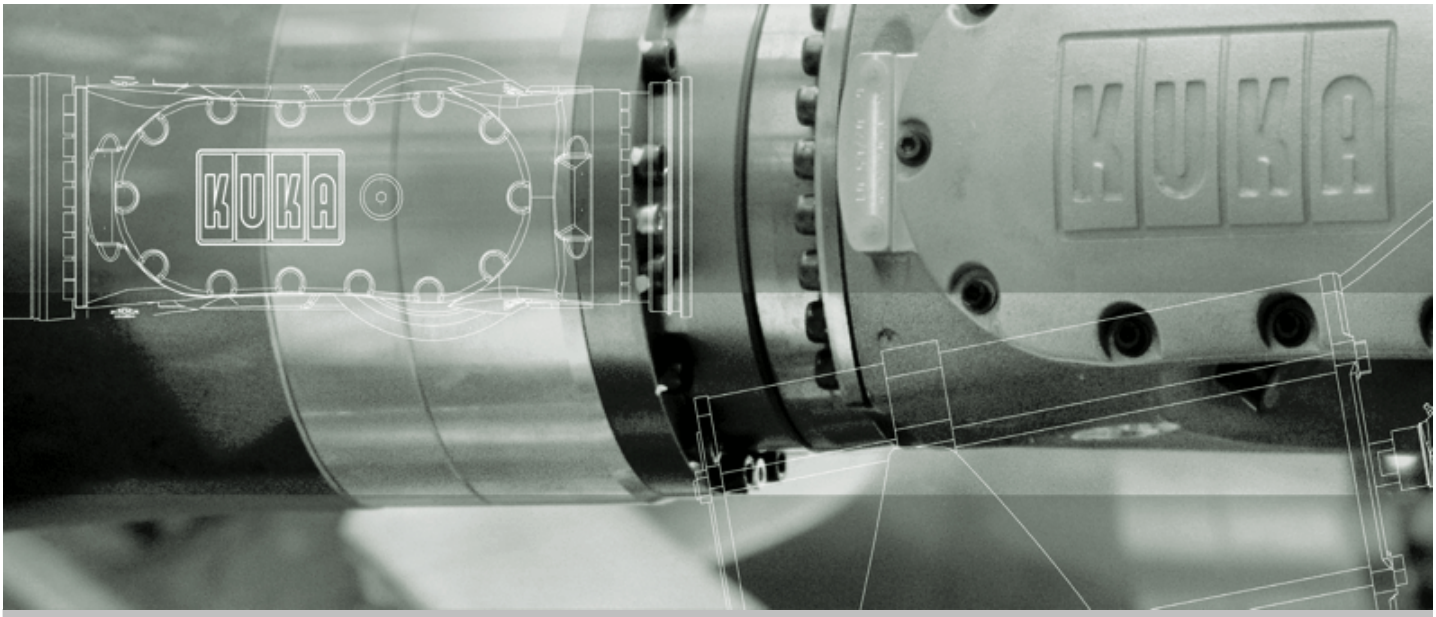


KUKA Robot Group

KUKA System Technology (KST)

KUKA.XRob RCS

Robot Calibration System

For KUKA System Software (KSS) 5.5

Issued: 05.03.2008 Version: LastRecentFinal en

KUKA Roboter GmbH
Zugspitzstraße 140
D-86165 Augsburg
Germany

KIM-PS5-DOC

Publication: Pub XRob RCS en
Book structure: KUKA.XRob RCS V0.1
Label: LastRecentFinal

Contents

1 Introduction

1.1 Target group

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

- Advanced KRL programming skills
- Advanced knowledge of the robot controller system
- Advanced knowledge of measuring technology
- Advanced knowledge of sensor systems
- Advanced knowledge of image processing

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.

1.2 Robot system documentation

The robot system documentation consists of the following parts:

- Operating instructions for the robot
- Operating instructions for the robot controller
- Operating and programming instructions for the KUKA System Software
- Documentation relating to options and accessories

Each of these sets of instructions is a separate document.

1.3 Representation of warnings and notes

Safety

Warnings marked with this pictogram are relevant to safety and **must** be observed.

Danger!
This warning means that death, severe physical injury or substantial material damage **will** occur, if no precautions are taken.

Warning!
This warning means that death, severe physical injury or substantial material damage **may** occur, if no precautions are taken.

Caution!
This warning means that minor physical injuries or minor material damage **may** occur, if no precautions are taken.

Notes

Notes marked with this pictogram contain tips to make your work easier or references to further information.

Tips to make your work easier or references to further information.

1.4 Terms used

Term	Description
Hole pattern	Position of the drilled holes
DB	Database
HD = hard disk	Hard drive
Camera frame	A result file when calibrating with the Krypton system
Krypton computer	PC with Krypton software installed
Krypton strober	Distributor for connecting multiple LEDs to a single output
PID data	Parameter identification file of the robot
RDC	Resolver Digital Converter
RCS	Robot calibration system
Tool LEDs	LEDs that are calibrated by the Krypton camera during every calibration operation.
Tool locating holes	Tool locating holes are required for measuring the tool with the Krypton camera.
X-Rob	XRob stands for a product family.

1.5 Trademarks

Microsoft is a trademark of Microsoft Corporation.

Windows is a trademark of Microsoft Corporation.

2 Product description

2.1 Overview KUKA.XRob RCS

KUKA.XRob RCS is an add-on technology package with the following functions:

Functions

- XRob RCS configuration database for configuration of robot types.
- XRob RCS Wizard for execution of zero mastering and absolute calibration.

2.2 Functional principle

Description

The high-accuracy robot positions the programmed TCP anywhere in the Cartesian workspace with a predefined tolerance. The model parameters of the high-accuracy robot are determined at a calibration station (RCS). They are permanently saved on the robot (RDC).

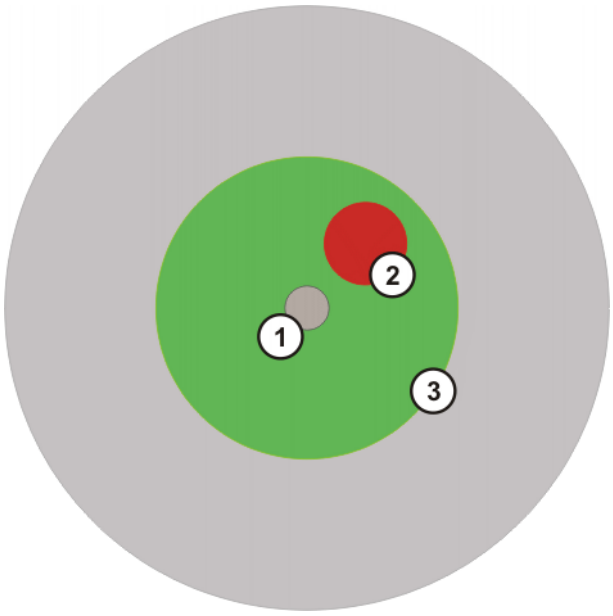


Fig. 2-1: Positional accuracy

1 Setpoint position
2 Repeatability
3 Positioning of the absolutely accurate robot

Robot calibration (calibration process)

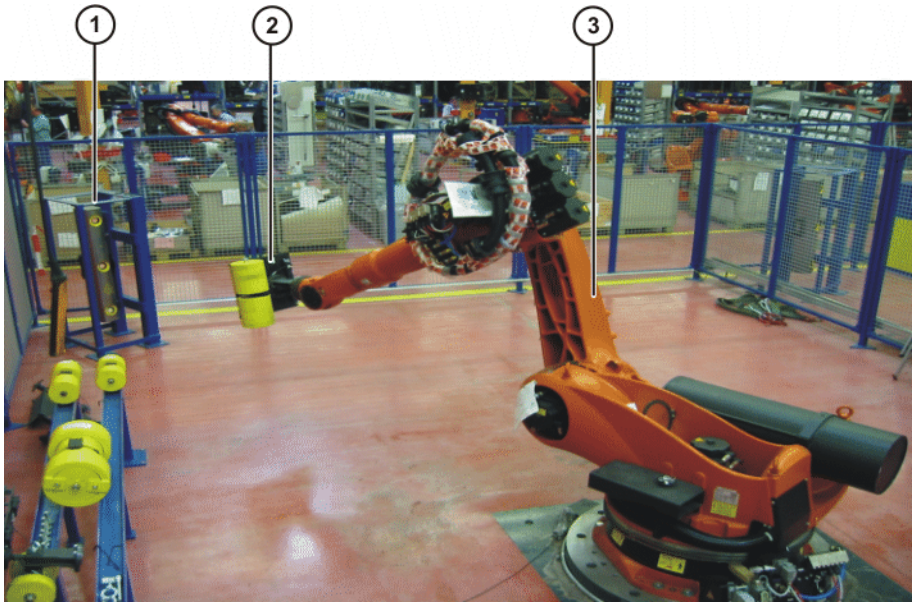
Zero mastering

During zero mastering, the robot is moved to different poses with a calibration panel mounted. The Krypton camera measures the positions in space of the LEDs on the calibration panel. The axis offsets that are saved on the RDC when the new zero mastering is carried out are optimized.

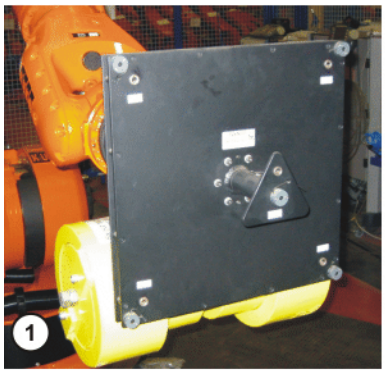
Absolute calibration

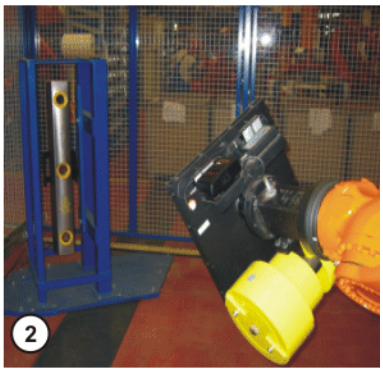
For absolute calibration, the maximum payload is mounted on the robot. Up to 100 axis-specific poses, distributed throughout the workspace of the robot, are measured. These 6D measurements are used to calculate the optimizable parameters of the robot model which are written to the RDC. The quality is

checked in suitable Cartesian poses by means of a verification measurement with the Krypton camera.



1 Krypton camera
2 Calibration panel
3 Robot





1 Calibration panel
2 Krypton camera

3 Safety

- All persons working with the robot system must have read and understood the robot system documentation, including the safety chapter.
- The positionally accurate robot model is only valid for the robot as delivered.

  Following conversion or retrofitting of the robot, e.g. with an arm extension or a new wrist, the robot must be recalibrated.
- The robot system with KUKA.XRob RCS must be operated in accordance with the applicable national laws, regulations and standards.

4 Installation

4.1 Installation overview

Step	Description
1	Check system requirements of the robot controller. (>>> 4.2 "System requirements" page 11)
2	Install Microsoft SQL Server Desktop Engine MSDE. (>>> 4.3 "Installing Microsoft SQL Server Desktop Engine" page 11)
3	Install XRob database. (>>> 4.5 "Installing XRob.RCS database" page 12)
4	Install KUKA.XRob RCS database configurator. (>>> 4.6 "Installing XRob.RCS database configurator" page 12)
5	Install KUKA.XRob RCS Wizard. (>>> 4.8 "Installing XRob.RCS Wizard" page 13)

4.2 System requirements

Hardware

- KR C2ed05
- At least 512 MB RAM

Software

- Windows XP operating system
- KUKA System Software (KSS) 5.5
- KUKA.UserTech 2.2
- Microsoft .NET Framework 2.0

4.3 Installing Microsoft SQL Server Desktop Engine

Precondition

- Windows interface
- Local administrator rights
- All Windows applications are closed

Procedure

1. Start the program **Setup.exe** from the CD-ROM.
2. Reboot the computer. The installation is resumed and completed.

LOG file

LOG files are created in the directory C:\PROGRAM FILES\MICROSOFT SQL SERVER\MSSQL\LOG.

4.4 Uninstalling XRob database

It is advisable to archive all relevant data before updating or uninstalling a software package.

Precondition

- Microsoft SQL Server Desktop Engine is installed.

Procedure

1. In the Windows Start menu, select **Settings** > **Control Panel** > **Software** and uninstall the Microsoft SQL Server Desktop Engine.
2. Delete the folder **MICROSOFT SQL SERVER** in the directory C:\PROGRAM FILES.

4.5 Installing XRob.RCS database

Precondition

- Windows interface
- Local administrator rights
- All Windows applications are closed
- Microsoft SQL Server Desktop Engine is installed.

Procedure

1. Start the program **Setup.exe** from the CD-ROM.
   The **Select Option** window is opened.
2. Select **Configuration database (Config DB)**.
3. Confirm with **Next**.

4.6 Installing XRob.RCS database configurator

Precondition

- Windows XP operating system
- Microsoft .NET Framework 2.0 is installed.
- Windows interface
- Local administrator rights
- All Windows applications are closed

Procedure

1. Start the program **Setup.exe** from the CD-ROM.
   The **Select Option** window is opened.
2. Select **Database configurator**.
3. Confirm with **Next**.
   The program is installed under C:\KUKA\XROB_RCS\CONFIGGUI.

4.7 Uninstalling XRob.RCS database configurator

It is advisable to archive all relevant data before updating or uninstalling a software package.

Precondition

- Windows interface
- KUKA.HMI is switched off.
- KUKA.XRob RCS database configurator is installed.

Procedure

1. Select the folder **Database configurator** in the directory **C:\KUKA\XROB_RCS**.

2. Delete the folder.

4.8 Installing XRob.RCS Wizard

Precondition

- Windows interface
- KSS 5.5
- KUKA UserTech 2.3 is installed
- Local administrator rights
- All Windows applications are closed.
- The network connection is established

Procedure

1. Start the program **Setup.exe** from the CD-ROM.
   The **Select Option** window is opened.
2. Select **Install XRob RcsWizard**.
3. Confirm with **Next**.
   The program is installed under C:\KUKA\KRC\TP\XROB_RCS.

4.9 Uninstalling XRob.RCS Wizard

It is advisable to archive all relevant data before updating or uninstalling a software package.

Precondition

- Windows interface
- KUKA.HMI is switched off.
- KUKA.XRob RCS is installed.

Procedure

1. Start the **UnInstall.exe** program in the directory C:\KRC_OPTION\XROBRCS\UNINST.
2. Reboot the robot controller. Uninstallation is resumed and completed.

4.10 Re-installing XRob.RCS Wizard

Precondition

- Windows interface
- Local administrator rights
- All Windows applications are closed
- KUKA.HMI is switched off
- KUKA.XRob RCS is uninstalled.

Procedure

1. Start the **ReInstall.exe** program in the directory C:\KRC_OPTION\XROBRCS\REINST.
2. Reboot the robot controller. Reinstallation is resumed and completed.

LOG file

A LOG file is created under C:\KRC\ROBOTER\LOG.

5 Configuration

5.1 Configuration overview

Step	Configuration steps
1	Open database configurator (>>> 5.2 "Opening the database configurator" page 15)
2	Enter tool data (>>> 5.3.1 "Entering tool data" page 16)
3	Enter load data (>>> 5.3.2 "Entering load data" page 17)
4	Enter base data (>>> 5.3.3 "Entering base data" page 19)
5	Enter robot type data (>>> 5.3.4 "Entering robot type data" page 20)
6	Enter robot data (>>> 5.3.5 "Entering robot data" page 21)
7	Enter pose data (>>> 5.3.6 "Entering pose data" page 22)
8	Edit tool data (>>> 5.4.1 "Editing tool data" page 23)
9	Edit load data (>>> 5.4.2 "Editing load data" page 23)
10	Edit base data (>>> 5.4.3 "Editing base data" page 24)
11	Edit robot type data (>>> 5.4.4 "Editing robot type data" page 24)
12	Edit robot data (>>> 5.4.5 "Editing robot data" page 24)
13	Edit pose data (>>> 5.4.6 "Editing pose data" page 24)
14	Create new configuration (>>> 5.5.1 "Creating a new configuration" page 25)
15	Edit configuration (>>> 5.5.2.1 "Selecting a configuration" page 26) (>>> 5.5.2.2 "Modifying a configuration" page 27)
16	Configure RCS Wizard (>>> 5.6 "Configuration file XROBCONFIG.XML" page 27)

5.2 Opening the database configurator

Procedure

1. Start **DB Configurator.exe**.
2. The XRob RCS database configurator opens.

3. Select the menu sequence **Database** > **Open**.
   The data linking properties window is opened.
4. Enter server name, user name and password.
5. Select database on the server. Confirm with **OK**.

5.2.1 Saving settings

Description Saving settings of the data linking properties window.

Procedure

1. Open the file **DBKonfigurator.config** in the directory C:\KUKA\XRob_Rcs\ConfigGUI.
2. In this file, carry out the settings for the server, user, password and database.

```
<!-- SQL Server or MSDE configuration -->
<add key="DBHost" value="PCRC..."  />
<add key="DBUser" value="xrob..."  />
<add key="DBPasswd" value="xrob..."  />
<add key="DBName" value="Messplatz..."  />
```

3. Select the menu sequence **File** > **Save** and close the file.

5.3 Entering data in the database configurator

5.3.1 Entering tool data

Description The tool data contain the following information:

- The measurement results of the mechanical calibration of the tool holes.
- The measurement results of the optical calibration of the LEDs with the Krypton system.
- The specification of the mass of the tool, flange adapter and panel, without a supplementary load, relative to the flange.
- The specification of the center of mass of the tool, flange adapter and panel, without a supplementary load, relative to the flange.

Precondition

- The coordinates of the tool LEDs are known and are stored in a file with the extension .tl.
- The coordinates of the tool locating holes are known.
- The mass and center of mass of the tool are known.

Procedure

1. Select the menu sequence **Data** > **New** > **Tool**.
   The input window is opened.
2. Enter an unambiguous designation for the tool in the **Designation** box.
3. Enter a comment in the **Comment** box (optional).
4. Load the coordinates of the tool LEDs by means of the **File** button.
5. Enter the coordinates of the tool locating holes manually. Click into the box under X, Y, Z. <edit> appears. Enter the values for X, Y, Z from the calibration log of the coordinate measuring machine.
6. Enter the mass of the tool in kg in the **Mass** box.
7. Enter the coordinates for X, Y, Z in mm in the boxes for the center of mass.
8. Confirm with **OK**.
   A message window is opened.
9. Confirm the message with **Yes**.

The data are updated in the database.

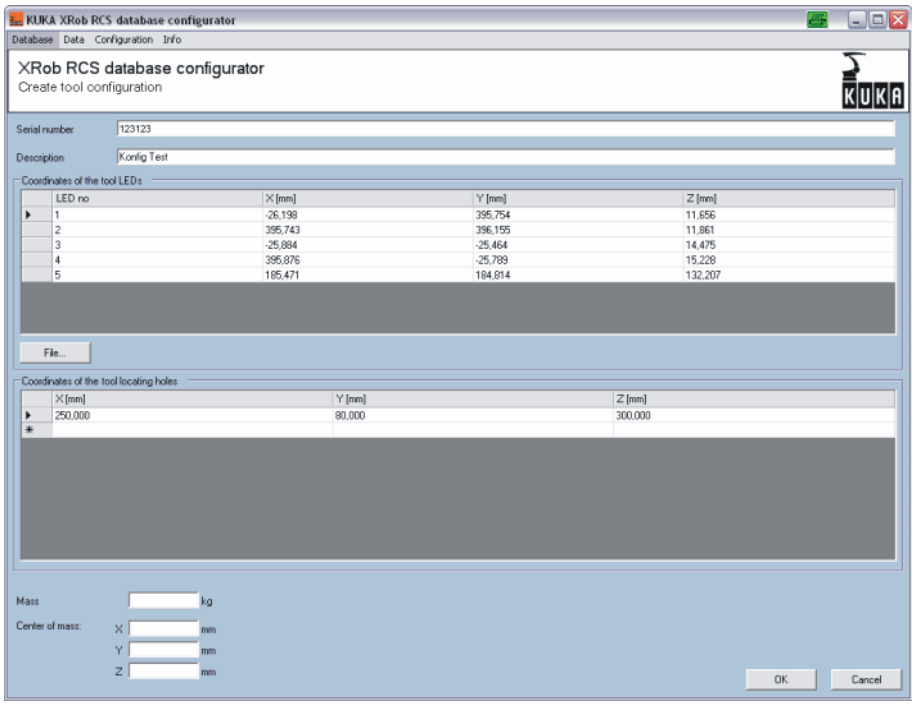


Fig. 5-1: Entering the tool data

5.3.2 Entering load data

Description

The load data are factored into the calculation of the paths and accelerations and help to optimize the cycle times.

Various loads can be mounted on the robot:

- Payload on the flange
- Supplementary load on axis 3
- Supplementary load on axis 2
- Supplementary load on axis 1

All loads added together give the overall load.

There is a payload diagram for every robot. It can be used to check quickly whether the payload could be suitable for the robot. The diagram is not, however, a substitute for checking the payload with KUKA.Load.

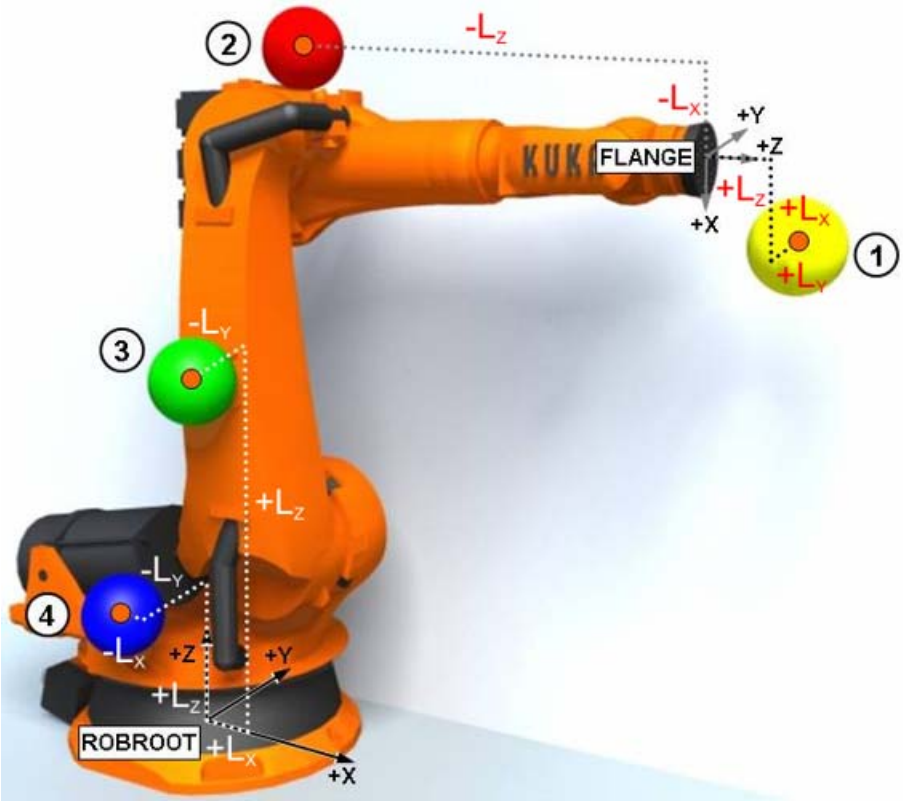


Fig. 5-2: Loads on the robot

1	Payload	3	Supplementary load on axis 2
2	Supplementary load on axis 3	4	Supplementary load on axis 1

Parameters

The load data are defined using the following parameters:

Parameter		Unit
Mass	m	kg
Distance to the center of gravity	L_x, L_y, L_z	mm
Mass moments of inertia at the center of gravity	I_{xx}, I_{yy}, I_{zz}	kg m^2

Reference systems of the X, Y and Z values for each load:

Load	Reference system
Supplementary load A1	ROBROOT coordinate system A1 = 0°
Supplementary load A2	ROBROOT coordinate system A2 = -90°
Supplementary load A3	FLANGE coordinate system A4 = 0°, A5 = 0°, A6 = 0°
Payload	FLANGE coordinate system

Precondition

- The mass and center of mass of the tool are known from the supplementary load data.

Procedure

1. Select the menu sequence **Data** > **New** > **Load**.
   The input window is opened.

2. Enter an unambiguous designation for the load in the **Designation** box.
3. Enter the total mass in kg in the **Mass** box.
4. Enter the coordinates in mm in the boxes for the center of mass.
5. Confirm with **OK**.
   A message window is opened.
6. Confirm the message with **Yes**.
   The data are updated in the database.

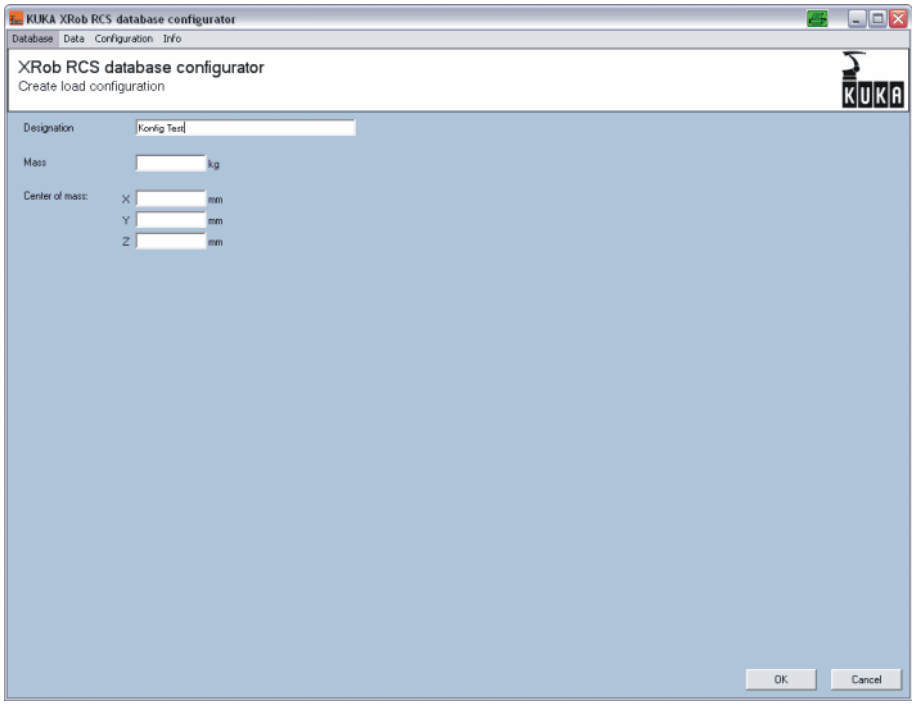


Fig. 5-3: Entering the load data

5.3.3 Entering base data

Description

The base data contain the following:

- The coordinates for the reference LEDs on the baseplate of the calibration station.
- The coordinate transformation between the Krypton camera and the robot base.

Precondition

- The coordinates of the reference LEDs of the baseplate are known and are stored in a file with the extension .prb.
- The camera frame is known and is stored in a file with the extension .txt.

Procedure

1. Select the menu sequence **Data** > **New** > **Base**.
   The input window is opened.
2. Select the suitable hole pattern for the robot.
3. Select the relevant mounting plate in the **Mounting plate** box. If there is no suitable mounting plate, create a new mounting plate. Press the **New** button. Specify a location for the mounting plate. Confirm with **OK**.
4. Select a calibration station in the **Calibration station** box. If there is no suitable calibration station, create a new calibration station. Press the **New** button. Specify a calibration station name. Confirm with **OK**.
5. Load the coordinates of the LEDs, e.g. LEDs.prb, by means of the **File** button.

Load the camera frame, e.g. Camera.txt, by means of the **File** button.

6. Confirm with **OK**.
   A message window is opened.
7. Confirm the message with **Yes**.
   The data are updated in the database.

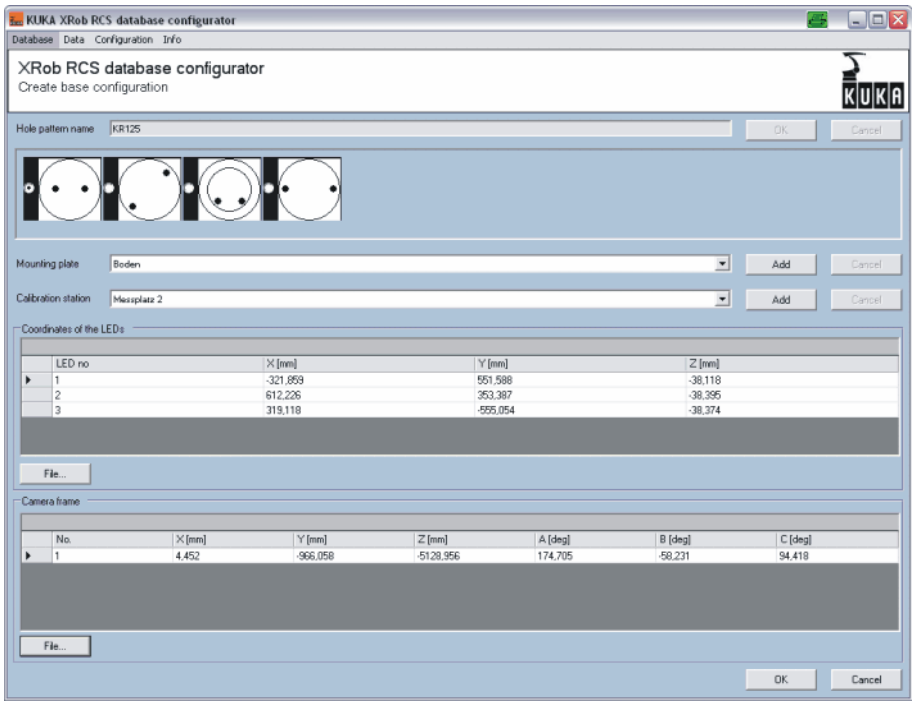


Fig. 5-4: Entering the base data

5.3.4 Entering robot type data

Description

The robot type data consist of the following data sets:

- Robot type
- Payload group
- Hole pattern name

Precondition

- The payload group and the hole pattern name are known.
- The hole pattern is available.

Procedure

1. Select the menu sequence **Data** > **New** > **Robot type**.
2. Enter an unambiguous name in the **Robot type** box.
3. Select the relevant payload group in the **Payload group** box. If there is no suitable payload group, create a new payload group. Press the **New** button. Enter the new payload group name. Confirm with **OK**.
4. Select the relevant hole pattern. The corresponding hole pattern name is displayed in the **Hole pattern name** box.
5. Confirm with **OK**.
   A message window is opened.
6. Confirm the message with **Yes**.
   The data are updated in the database.

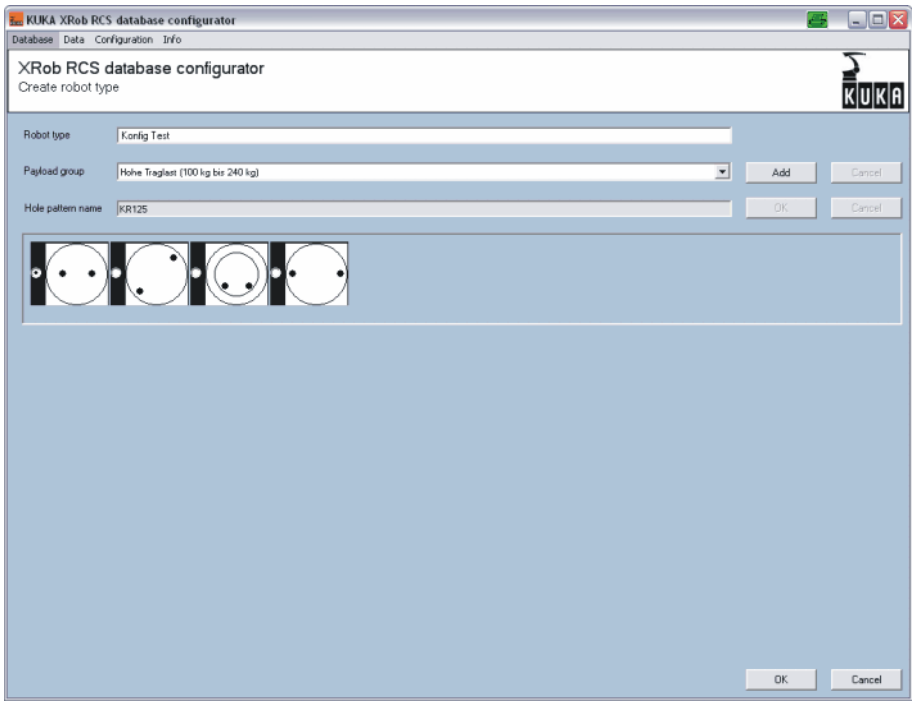


Fig. 5-5: Entering robot type data

5.3.4.1 Creating a new hole pattern

Description If there is no suitable hole pattern available, a new one must be created.

Procedure

1. Create the hole pattern in a graphics program and save it as a bitmap (bmp) with a resolution of 96 dpi and a size of 70x70 pixels.
2. Open the folder **Picture** in the directory C:\KUKA\XROB_RCS\CONFIG-GUI.
3. Copy the hole pattern to the folder.
4. Close the folder.

5.3.5 Entering robot data

Description The robot data consist of the following data sets:

- Payload group
- Robot type

  The robot type designates the basic machine type and payload, without taking an arm extension into consideration.
- Arm extension
- Installation type
- Machine data directory
- Transformation name

Precondition

- The machine data are stored on the computer or network.

Procedure

1. Select the menu sequence **Data** > **New** > **Robot data**.
2. Select the relevant payload group in the **Payload group** box.
3. Select the created robot type in the **Robot type** box.

4. Select the arm extension in the **Arm extension** box. If there is no suitable arm extension, create a new arm extension. Press the **New** button. Specify a name for the arm extension. Confirm with **OK**.
5. Select the relevant installation type in the **Installation type** box. If there is no suitable installation type, create a new installation type. Press the **New** button. Confirm with **OK**.
6. Load the corresponding robcor.dat in the **Directory path: robcor.dat** box. Press the **File** button. Select the corresponding robcor.dat in the machine data and confirm with **Open**.

   The transformation name is displayed.
7. Confirm with **OK**.

   A message window is opened.
8. Confirm the message with **Yes**.

   The data are updated in the database.

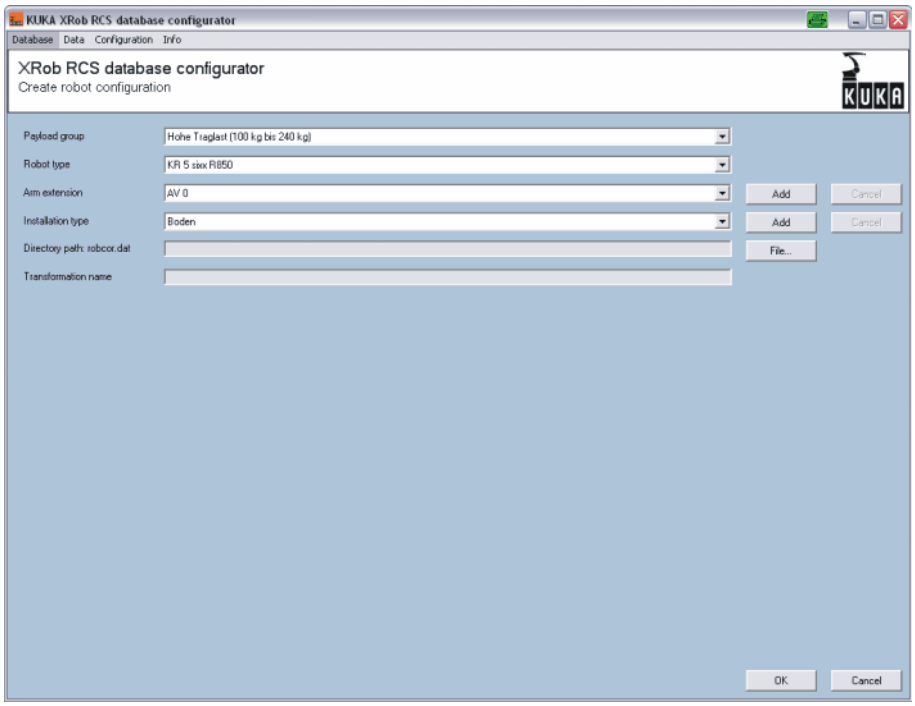


Fig. 5-6: Entering robot data

5.3.6 Entering pose data

Description

A pose set defines all the poses that are used for a calibration type for one robot type.

Precondition

- The system test poses, calibration poses and test poses are known and stored in a KRL.DAT file.
- The poses have been tested for collisions and visibility.

Procedure

1. Select the menu sequence **Data** > **New** > **Poses**.
2. Enter a name in the **Pose set name** box.
3. Load the system test poses, e.g. SPoses.dat, by means of the **File** button.
4. Load the calibration poses by means of the **File** button.
5. Load the test poses by means of the **File** button.
6. Set the measurement tolerance. Select one of the system test poses. Set the value in the **Tolerance sphere radius** box. Press the **Apply** button.

7. Repeat step 6 for the calibration poses and test poses.
8. Confirm with **OK**.
   A message window is opened.
9. Confirm the message with **Yes**.
   The data are updated in the database.

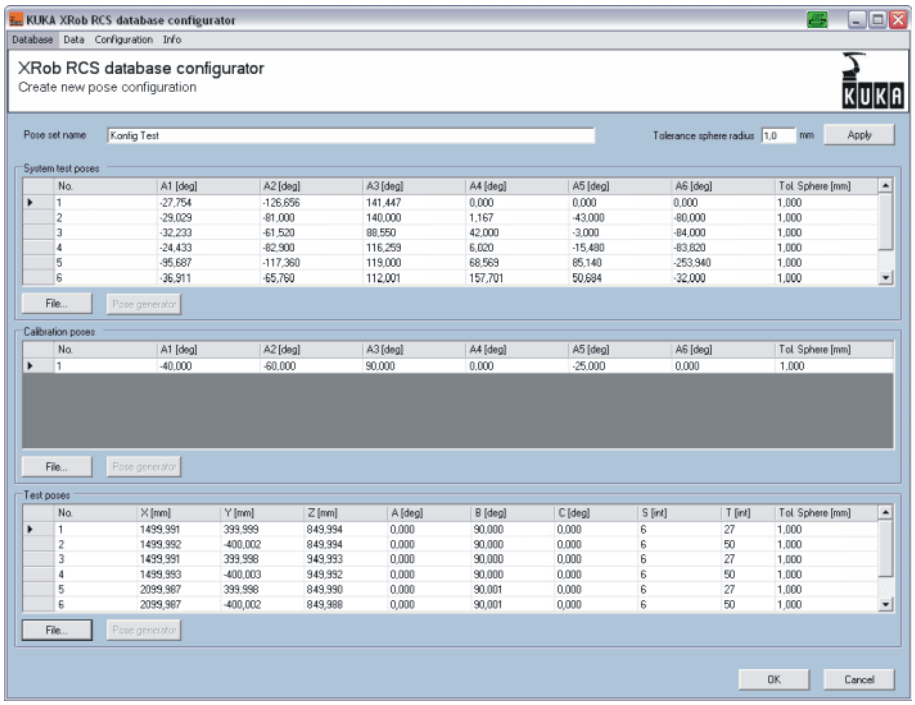


Fig. 5-7: Entering poses

5.4 Editing data

5.4.1 Editing tool data

Precondition

- The tool data have been entered and updated in the database.

Procedure

1. Select the menu sequence **Data** > **Open** > **Tool**.
   The input window is opened.
2. Select the tool to be modified in the **Serial number** box.
3. Modify the desired tool data.
4. Confirm with **OK**.
   A message window is opened.
5. Confirm the message with **Yes**.
   The data are updated in the database.

5.4.2 Editing load data

Precondition

- The load data have been entered and updated in the database.

Procedure

1. Select the menu sequence **Data** > **Open** > **Load**.
   The input window is opened.
2. Select the load to be modified in the **Designation** box.
3. Modify the desired load data.

4. Confirm with **OK**.
   A message window is opened.
5. Confirm the message with **Yes**.
   The data are updated in the database.

5.4.3 Editing base data

Precondition

- The base data have been entered and updated in the database.

Procedure

1. Select the menu sequence **Data** > **Open** > **Base**.
   The input window is opened.
2. Modify the desired base data.
3. Confirm with **OK**.
   A message window is opened.
4. Confirm the message with **Yes**.
   The data are updated in the database.

5.4.4 Editing robot type data

Precondition

- The robot type data have been entered and updated in the database.

Procedure

1. Select the menu sequence **Data** > **Open** > **Robot type**.
   The input window is opened.
2. Select the robot type to be modified in the **Robot type** box.
3. Modify the desired robot type data.
4. Confirm with **OK**.
   A message window is opened.
5. Confirm the message with **Yes**.
   The data are updated in the database.

5.4.5 Editing robot data

Precondition

- The robot data have been entered and updated in the database.

Procedure

1. Select the menu sequence **Data** > **Open** > **Robot data**.
   The input window is opened.
2. Modify the desired robot data.
3. Confirm with **OK**.
   A message window is opened.
4. Confirm the message with **Yes**.
   The data are updated in the database.

5.4.6 Editing pose data

Precondition

- The pose data have been entered and updated in the database.

Procedure

1. Select the menu sequence **Data** > **Open** > **Poses**.
   The input window is opened.
2. Select the pose set to be modified in the **Pose set name** box.
3. Modify the desired pose data.

4. Confirm with **OK**.
   A message window is opened.
5. Confirm the message with **Yes**.
   The data are updated in the database.

5.5 Configuring robot types

5.5.1 Creating a new configuration

Precondition

- All data have been entered and updated in the database.

Procedure

1. Select the menu sequence **Configuration** > **New**.
   The “Robot type and calibration station” tab is opened.
2. Enter an unambiguous name in the **Designation** box.
3. Enter a comment in the **Comment** box (optional).
4. Select the calibration type in the **Calibration type** box.
5. Activate **Configuration active**.
   Active configurations are now available for selection in the RCS Wizard.
6. Select the desired payload group in the **Payload group** box.
7. Select the corresponding robot in the **Robot type** box.
8. Select the desired arm extension in the **Arm extension** box.
9. Select the relevant installation type in the **Installation type** box.
   The corresponding directory path and transformation name are displayed.
10. Select the desired calibration station in the **Calibration station** box.
11. Select the corresponding mounting plate in the **Base** tab.
    The hole pattern name, hole pattern, coordinates of the LEDs and the camera frame are displayed.
12. Select the corresponding load in the **Designation** box on the **Load** tab.
13. Select the corresponding pose in the **Pose set name** box on the **Poses** tab.
14. Select the corresponding tool in the **Serial number** box on the **Tool** tab.
15. Select the relevant model in the **Configuration name** box on the **Model** tab.
16. Confirm with **OK**.
    A message window is opened.
17. Confirm the message with **Yes**.
    The data are updated in the database.

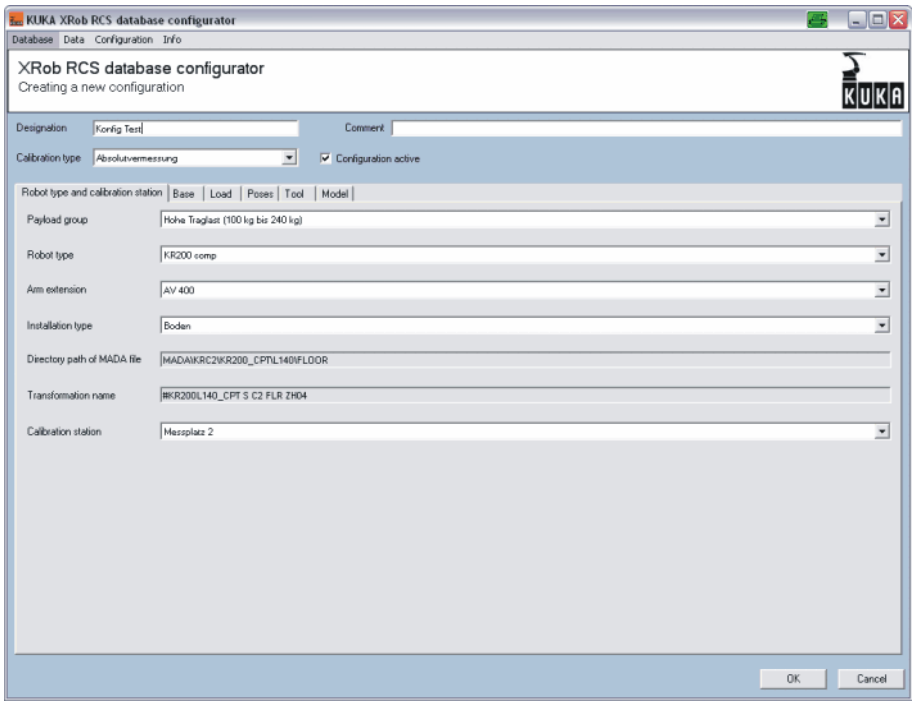


Fig. 5-8: Creating a new configuration

5.5.2 Editing a configuration

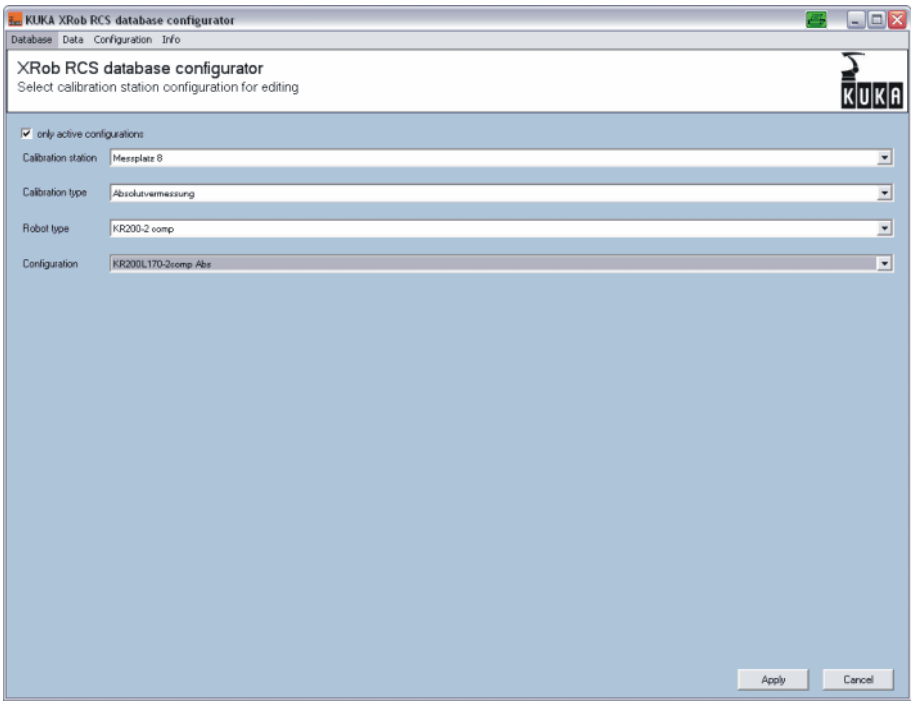
5.5.2.1 Selecting a configuration

Procedure

1. Select the menu sequence **Configuration** > **Open**.
2. **Only active configuration** activated. Only active configurations can be selected.

   Only active configuration not activated. All configurations can be selected.
3. Select the desired calibration station in the **Calibration station** box.
4. Select the desired calibration type in the **Calibration type** box.
5. Select the desired robot type in the **Robot type** box.
6. Select the configuration to be modified in the **Configuration** box.
7. Confirm with **Apply**.

   The “Robot type and calibration station” tab is opened.



5.5.2.2 Modifying a configuration

Precondition

- New data have been entered.
- A configuration for a robot type and calibration station has been selected.

Procedure

1. Modify the load in the **Designation** box on the **Load** tab.
2. Modify the mounting plate in the **Mounting plate** box on the **Base** tab.
3. Modify the poses in the **Pose set name** box on the **Poses** tab.
4. Modify the tool in the **Serial number** box on the **Tool** tab.
5. Modify the model in the **Configuration name** box on the **Model** tab.
6. Confirm with **OK**.
   A message window is opened.
7. Confirm the message with **Yes**.
   The data are updated in the database.

5.6 Configuration file XROBCONFIG.XML

Description

In order to be able to exchange data between the computers, links must be entered in the XRobConfig file.

The configuration file XROBCONFIG.XML is situated, after installation of KUKA.XRob RCS, in the directory ...\KRC\TP\XROB_RCS\UTIL.

To edit XROBCONFIG.XML, the file must be opened in edit mode.

Precondition

- RCS Wizard is installed.
- Windows interface

Procedure

1. Open the file **XRobConfig** in the directory C:\KRC\TP\XROB_RCS\UTIL using the editor.
2. Modify the following entries in the file:

```
<General>
 <StationId>Messplatz 8</StationId>
</General>
...
<RcsAssistent>
 <!-- location of main MADA directory -->
 <MaDaRootDir>\\pcrc40382_3\RCS\MachineData</MaDaRootDir>
 <!-- location of used KRL programs-->
 <KRLProgramDir>KRC:\R1\Program</KRLProgramDir>
 <!-- location for XPId file output -->
 <XPIdOutputDir>C:\KRC\Roboter\IR_Spec</XPIdOutputDir>
</RcsAssistent>
...
<LanguageDatabaseLocation>C:\krc\tp\XRob_Rcs\Data\XRobLang.mdb</Lan-
guageDatabaseLocation>
 <!-- current set language for xrob -->
 <CurrentLanguage>de-DE</CurrentLanguage>
...
<ConfigDB>
 <!--network name or ip adress where database server is hosted, "lo-
calhost"
 is for local system -->
 <DbHost>pc40367</DbHost>
 <!-- name of the database -->
 <DbName>MessplatzDB</DbName>
 <!-- default user name for database acces -->
 <User>xrob_user</User>
 <!-- default password for default database user -->
 <Password>xrob_user</Password>
...
<ResultDB>
 <!-- network name or ip adress where database server is hosted, "lo-
calhost" is for local system-->
 <DbHost>pc40367</DbHost>
 <!-- name of the database -->
 <DbName>resultdb</DbName>
 <!-- default user name for database acces -->
 <User>Name</User>
 <!-- default password for default database user -->
 <Password>testpas</Password>
</ResultDB>
...
<KryptonWorkingDir>\\pc40367\Austausch\rocal\bin</KryptonWorkingDir>
...
<KryptonRemoteHost>pc40367</KryptonRemoteHost>
...
<ShellLocation>C:\Windows\system32\cdm.exe</ShellLocation>
...
<IstFileName>C:\KRC\ROBOTER\IR_SPEC\Messdaten.ist</IstFileName>
```

Entry	Description
<StationId>...</StationId>	Calibration station created in the base data.
<MaDaRootDir>...</MaDaRoot-Dir>	Machine data path.
<XPIdOutputDir>...</XPIdOut-putDir>	Path of the file ErgebnisXRob.pid. The evaluation results are saved here.
<LanguageDatabaseLoca-tion>...</LanguageDatabaseLo-cation>	Path for the language database. This modification is optional.
<CurrentLanguage>...</Current-Language>	Language setting in the language database. This modification is optional.
<DbHost>...</DbHost>	Server name.

Entry	Description
<DbName>...</DbName>	Database name
<User>...</User>	Predefined user name. This modification is optional.
<Password>...</Password>	Predefined password. This modification is optional.
<KryptonWorkingDir>...</KryptonWorkingDir>	Path specification for the working directory of the Krypton software.
<KryptonRemoteHost>...</KryptonRemoteHost>	Name of the Krypton computer.
<ShellLocation>...</ShellLocation>	Path specification of CMD.exe on the Krypton computer. This modification is optional.
<IstFileName>...</IstFileName>	Path for the results database

6 Operation

6.1 Zero mastering with the RCS Wizard

Precondition

- Krypton RemoteControl.exe is started on the Krypton computer.
- The data have been entered and updated in the database.
- A configuration has been created and updated in the database.
- The network connection is established.
- Operating mode T1 or T2.

Procedure

1. Start the KUKA System Software (KSS) 5.5.
2. Select the menu sequence **Monitor** > **XRob RCS** > **Show**.
3. Press the **Next** softkey.
   A prompt window is displayed.
4. Select the calibration type. Press the **Zero mastering** softkey.
   The configuration window is displayed.
5. Select the data from the created configuration in the boxes **Payload group**, **Robot type**, **Arm extension**, **Installation type** and **Mounting platform**.

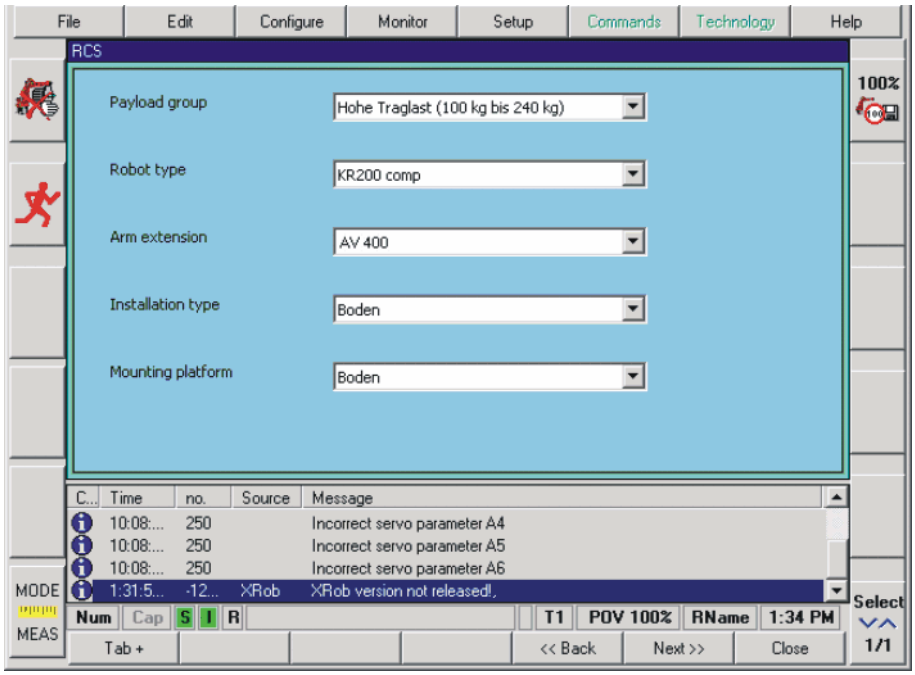


Fig. 6-1: Selecting a configuration

6. Press the **Next** softkey.
7. Enter the robot serial number in the prompt window.
8. Press the **Next** softkey.
   The configuration name, the comment and the robot serial number are displayed.
9. Press the **Next** softkey.
   A message window is displayed.
10. Press the **Next** softkey to confirm the message.
    The “Tool mounting” prompt window is displayed.
11. Follow the prompt.
12. Press the **Next** softkey.

The “Unmaster robot” prompt window is displayed.

13. Unmaster the axes.

Further information is contained in the operating and programming instructions for the KUKA System Software (KSS).

14. Press the **Next** softkey.

    The “Master robot in home position” prompt window is displayed.

15. Master the robot.

Further information is contained in the operating and programming instructions for the KUKA System Software (KSS).

16. Press the **Next** softkey.

    The “Test measurement for robot type check” prompt window is displayed.

17. Press the **Next** softkey.

    The program for checking the robot type is displayed.

18. Set mode selector switch to Automatic mode. Start the program. Once program execution has been completed, the result is displayed.

On completion of the control measurement, a message window is displayed. **System ready for measurement** must be highlighted in green. If this is not the case, an error has occurred. (>>> 8.1 "Causes of errors during the test measurement" page 43)

19. Press the **Next** softkey.

    The “Carry out mastering” prompt window is displayed.

20. Start the program. Once program execution has been completed, the results are displayed.

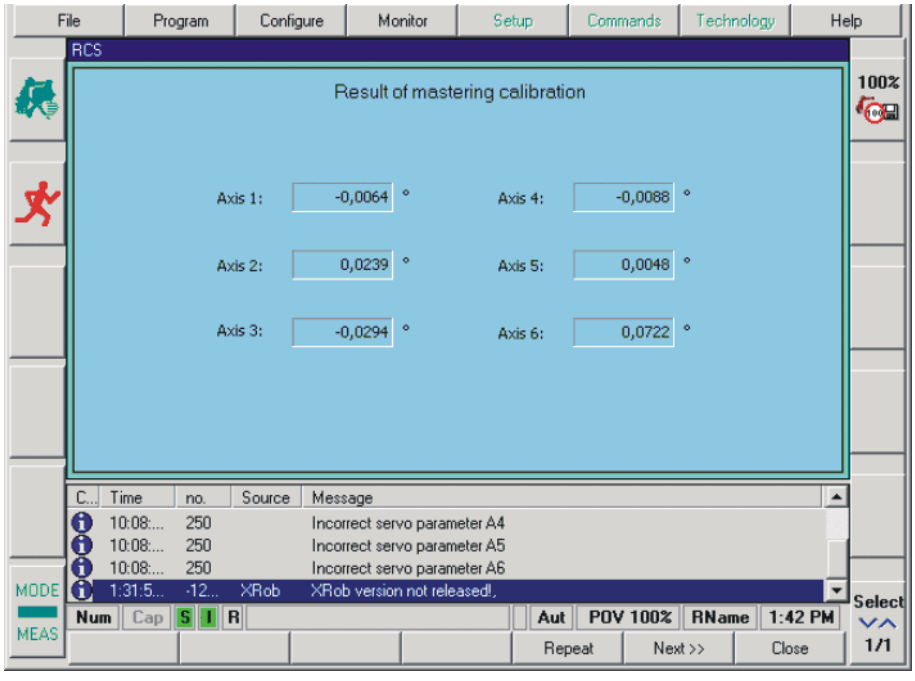


Fig. 6-2: Mastering results

21. Press the **Next** softkey.

    A prompt window is displayed.

22. Follow the prompt. Press the **Next** softkey.

    The “Carry out control measurement” prompt window is displayed.

23. Press the **Next** softkey to confirm the prompt.
    The program for the control measurement is displayed.
24. Start the program. Once program execution has been completed, the results are displayed.

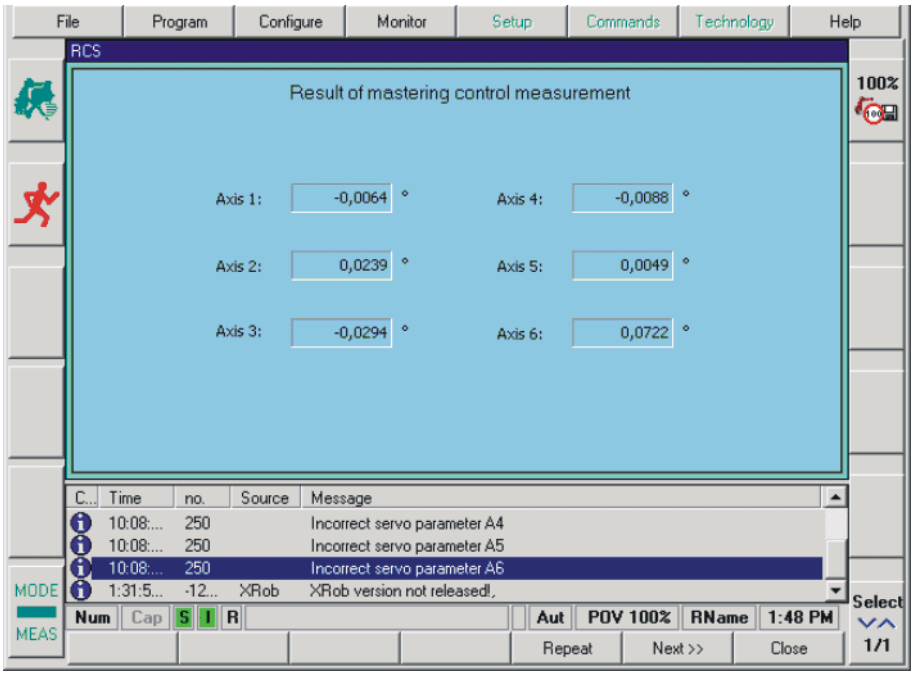


Fig. 6-3: Control measurement result

25. Press the **Next** softkey.
    A prompt window is displayed.
26. Follow the prompt.
27. Press the **Next** softkey.
    A prompt window is displayed. Answer the prompt with the **Yes** or **No** softkey.

If the prompt is answered with Yes, the absolute calibration is started. If the prompt is answered with No, the Wizard can be closed. Press the **Close** softkey.

6.2 Zero mastering for KR spot and KR 5 with the RCS Wizard

Precondition

- Krypton RemoteControl.exe is started on the Krypton computer.
- The data have been entered and updated in the database.
- A configuration has been created and updated in the database.
- The network connection is established.
- Operating mode T1 or T2.

Procedure

1. Start the KUKA System Software (KSS) 5.5.
2. Select the menu sequence **Monitor** > **XRob RCS** > **Show**.
3. Press the **Next** softkey.
   A prompt window is displayed.
4. Select the calibration type. Press the **Zero mastering** softkey.
   The configuration window is displayed.

5. Select the data from the created configuration in the boxes **Payload group**, **Robot type**, **Arm extension**, **Installation type** and **Mounting platform**.
6. Press the **Next** softkey.
7. Enter the robot serial number in the prompt window.
8. Press the **Next** softkey.

   The configuration name, the comment and the robot serial number are displayed.
9. Press the **Next** softkey.

   A message window is displayed.
10. Press the **Next** softkey to confirm the message.

    A prompt window is displayed.
11. Follow the prompt.
12. Press the **Next** softkey.

    The “Unmaster robot” prompt window is displayed.
13. Unmaster the axes.

Further information is contained in the operating and programming instructions for the KUKA System Software (KSS).

14. Press the **Next** softkey.

    The “Master robot in home position” prompt window is displayed.
15. Master the robot.

Further information is contained in the operating and programming instructions for the KUKA System Software (KSS).

16. Press the **Next** softkey.

    The “Test measurement for robot type check” prompt window is displayed.
17. Press the **Next** softkey.

    The program for checking the robot type is displayed.
18. Set mode selector switch to Automatic mode. Start the program. Once program execution has been completed, the result is displayed.
19. Press the **Next** softkey.

    The “Carry out mastering” prompt window is displayed.
20. Start the program. Once program execution has been completed, the results are displayed.
21. Press the **Next** softkey.

    A prompt window is displayed.
22. Follow the prompt.
23. Press the **Next** softkey.

    The “Standard EMT mastering: check mastering” prompt window is displayed.
24. Check mastering.

Further information is contained in the operating and programming instructions for the KUKA System Software (KSS).

25. Press the **Next** softkey.

    The “Save MAMES data” prompt window is displayed.
26. Press the **Save** softkey.

    The data are saved to the HD, RDC and DB.

27. Press the **Next** softkey.
    A prompt window is displayed. Answer the prompt with the **Yes** or **No** softkey.

If the prompt is answered with Yes, the absolute calibration is started. If the prompt is answered with No, the Wizard can be closed. Press the **Close** softkey.

6.3 Absolute calibration with the RCS Wizard

Precondition

- Krypton RemoteControl.exe is started on the Krypton computer.
- The data have been entered and updated in the database.
- A configuration has been created and updated in the database.
- The network connection is established.
- Operating mode T1 or T2.

Procedure

1. Start the KUKA System Software (KSS) 5.5.
2. Select the menu sequence **Monitor** > **XRob RCS** > **Show**.
3. Press the **Next** softkey.
   A prompt window is displayed.
4. Select the calibration type. Press the **AbsoluteC** softkey.
   The prompt is confirmed.
   The configuration window is displayed.
5. Select the data from the created configuration in the boxes **Payload group**, **Robot type**, **Arm extension**, **Installation type** and **Mounting platform**.

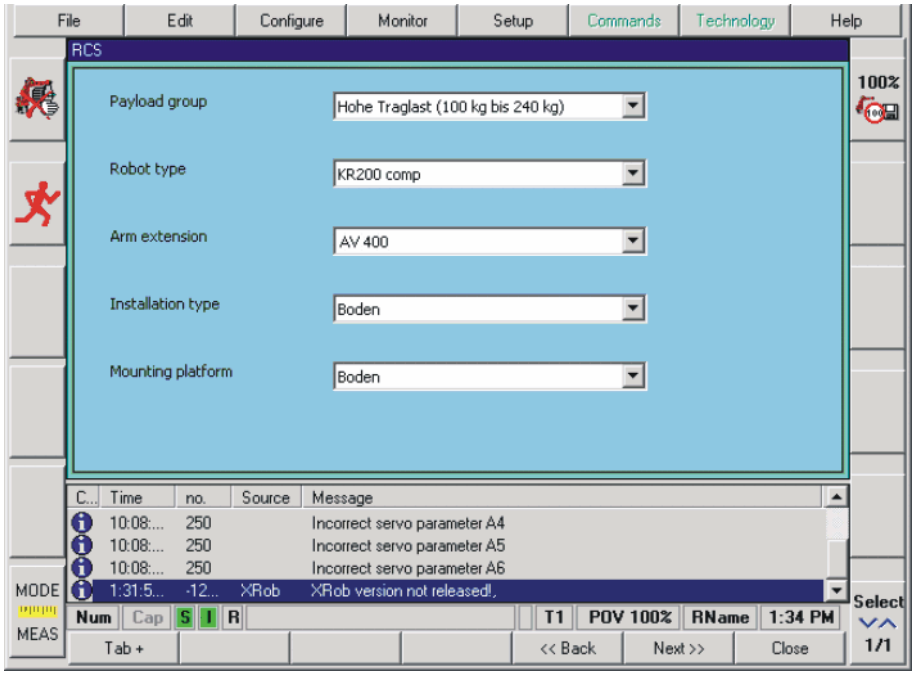


Fig. 6-4: Selecting a configuration

6. Press the **Next** softkey.
7. Enter the robot serial number in the prompt window.
8. Press the **Next** softkey.
   The configuration name, the entered comment and the robot serial number are displayed.

9. Press the **Next** softkey.
   The “Unmaster axes” prompt window is displayed.
10. Unmaster axes.

Further information is contained in the operating and programming instructions for the KUKA System Software (KSS).

11. Press the **Next** softkey.
    The “Master axes” prompt window is displayed.
12. Master the axes.

Further information is contained in the operating and programming instructions for the KUKA System Software (KSS).

13. Press the **Next** softkey.
    A message window is displayed.
14. Press the **Next** softkey to confirm the message.
    A prompt window is displayed.
15. Follow the prompt.
16. Press the **Next** softkey.
    A prompt window is displayed.
17. Press the **Next** softkey to confirm the prompt.
    The program for the control measurement is displayed.
18. Set mode selector switch to Automatic mode. Start the program.

On completion of the control measurement, a message window is displayed. **System ready for measurement** must be highlighted in green. If this is not the case, an error has occurred. (>>> 8.1 "Causes of errors during the test measurement" page 43)

19. Set mode selector switch to T1 mode.
20. Press the **Next** softkey.
    A prompt window is displayed.
21. Press the **Next** softkey to confirm the prompt.
    The program for absolute calibration is displayed.
22. Start the program.
    Once program execution has been completed, the results are displayed.

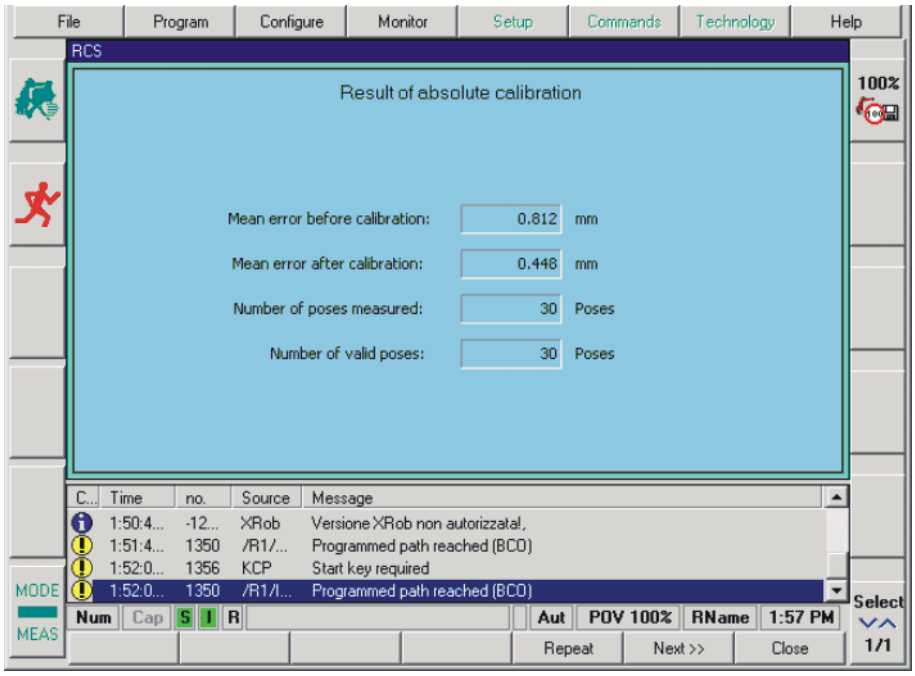


Fig. 6-5: Absolute calibration results

23. Press the **Next** softkey.

    The “Positioning accuracy control measurement run” prompt window is displayed.

24. Press the **Next** softkey.

    The program for the positioning accuracy control measurement run is displayed.

25. Set mode selector switch to Automatic mode. Start the program.

    Once program execution has been completed, the results of the test run are displayed.

26. Press the **Next** softkey.

    The “Save PID data” prompt window is displayed.

27. Press the **Save** softkey.

    The PID data are saved to the HD and RDC.

7 Messages

7.1 Viewing messages in the Event Viewer

Procedure

1. Open **eventvwr.exe** in the directory C:\WINDOWS\SYSTEM32.
2. Select the menu sequence **Action** > **Property** to open the selected message.

Description

All messages are saved in the Event Viewer. The **XRob RCS** Event Viewer displays all messages called by KUKA.XRob RCS.

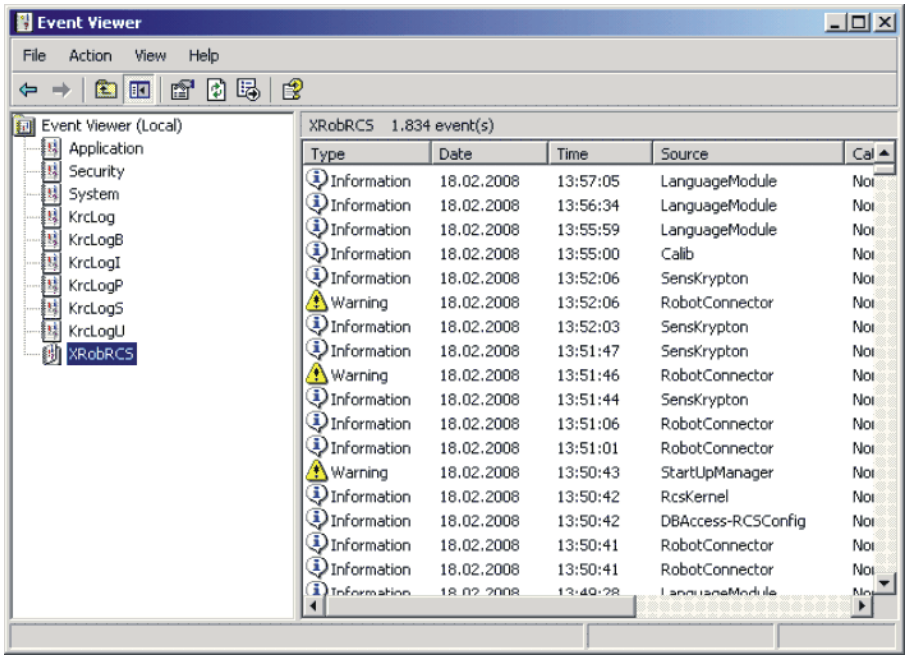


Fig. 7-1: Event Viewer

7.2 Error messages

Description

Configuration or operator errors may result in error messages in an application.

All messages are saved in the Event Viewer.

ID	Message	Cause	Remedy
-61000	Error when saving PID data in the database.	No connection to database.	Establish connection to database.
-25026	Error: saving of PID data on RDC failed	No connection to RDC.	Establish connection to RDC.
-61011	Error when saving MAM data to RDC.	■ No connection to RDC. ■ Incorrect MAM file format on the hard disk.	■ Establish connection to RDC. ■ Repeat mastering.

ID	Message	Cause	Remedy
-25035	Error: saving of MAM data on hard drive failed.	MAM file could not be generated in the directory C:\KRC\ROBOTER\IR_SPEC.	■ Deactivate write protection of directory C:\KRC\ROBOTER\IR_SPEC. ■ Check that you have access rights to write to the directory C:\KRC\ROBOTER\IR_SPEC.
-25030	Error: MAM file could not be found in IR_SPEC directory.	MAM file <Serial_number>.mam could not be found in the directory C:\KRC\ROBOTER\IR_SPEC.	Compare the file name of the MAM file with the programmed serial number of the robot (file name: <Serial_number>.mam)
-25032	Error: MAM file cannot be loaded from hard drive.	MAM file on hard drive faulty.	Repeat mastering.
-25033	Error: MAM file checksum incorrect.	■ Contents of the MAM file have been changed. Check sum check indicates faulty file integrity. ■ Robot serial number or $Mames values have changed.	■ Copy the original MAM file to the directory C:\KRC\ROBOTER\IR_SPEC. ■ Check the programmed robot serial number and the $Mames values in $machine.dat.
-25037	Error: loading of a KRL variable failed.	KRL variable could not be read.	Check whether the KRL variable can be read manually in the variable display of the GUI.
-61005	Error when saving the mastering in the database.	No connection to database.	Establish connection to database.
-61008	Error when saving measured values to the hard drive.	Measurement values file <Serial_number>.ist could not be generated in the specified directory (see XROBCONFIG.XML).	■ Deactivate write protection of specified directory (see XROBCONFIG.XML file). ■ Check that you have access rights to write to the specified directory (see XROBCONFIG.XML file).
-61010	Error when calculating the mastering difference.	An error has occurred in the GUI function “Check mastering”.	Repeat the GUI function “Check mastering”.
-61013	Error when reading $RAT_MOT_AX.	The KRL variable $RAT_MOT_AX[…] could not be read.	Check whether the KRL variable can be read manually in the variable display of the GUI.
-61014	Error when reading $RAT_MOT_ENC.	The KRL variable $RAT_MOT_ENC[…] could not be read.	Check whether the KRL variable can be read manually in the variable display of the GUI.
-61015	Error when reading $AXIS_RESO.	The KRL variable $AXIS_RESO[…] could not be read.	Check whether the KRL variable can be read manually in the variable display of the GUI.

ID	Message	Cause	Remedy
-61016	Error when reading the Mames values.	The KRL variable $mames[…] could not be read.	Check whether the KRL variable can be read manually in the variable display of the GUI.
-61017	Directory not found.	The specified directory path for reading or writing files does not exist.	Check whether all directory paths specified in the file XROBCONFIG.XML exist on the hard drive.
-61019	Access to file denied.	File could not be opened.	Check that you have access rights to read and write to the file.
-61018	File not found	File could not be found in the specified directory.	Check whether the file is present in the specified directory.
-61021	Input/output error.	General error when accessing the storage medium.	Check access to the storage medium.
-61035	Error when copying a file.	An error occurred while a file was being copied.	Check access rights and write protection of source and target directory.
-61029	Error when setting the robot serial number.	Unable to set serial number in robot system.	Check whether the robot serial number can be set manually via the GUI menu item **Setup**.
-24001	Serious system error. Details can be found in XRob log.	Unusual cause.	■ Cold start of the robot controller. ■ If the message is still present following a cold restart, inform KUKA Service.
-24004	Error in XRobConfig.xml file. (Section Command-Handler)	Entries in the Command-Handlers section of XROBCONFIG.XML missing or incorrect.	Use the log to isolate the cause of the error and improve the file XROBCONFIG.XML.
-24010	Feature measurement error (sensor activation failed)	Sensor with configured ID is not ready for measurement.	Make sure that the feature is correctly configured and that the sensor is functional.
-24011	Feature measurement error (sensor deactivation failed)	■ Sensor is not ready for measurement. ■ Communication problems.	Check that the measurement system is ready for operation.
-24012	Feature measurement error (trigger measurement)	Communication problems with the sensor.	Check that the measurement system is ready for operation.
-24013	Feature measurement error (calling measurement data)	Communication problems with the sensor	Check that the measurement system is ready for operation.
-24017	Initialization of calibration failed	An exceptional error has occurred.	■ Analyze XRob log. ■ Cold start of the robot controller. ■ If the message is still present following a cold restart, inform KUKA Service.

8 Troubleshooting

8.1 Causes of errors during the test measurement

Error	Cause	Remedy
The message **System ready** is not highlighted in green.	The battery of the tool LEDs is depleted.	■ Exchange battery. ■ Charge battery.
	The tool LEDs are defective.	Exchange tool LEDs.
	The Krypton strober for the tool LEDs is defective.	Exchange the Krypton strober.
	The Krypton remote control for the tool and reference LEDs is defective.	Exchange the remote control.
	The measured robot type does not match the selected configuration.	■ Select a different robot type in the configuration. ■ Remeasure the robot type.
	The mounted tool does not match the tool in the configuration.	■ Select a different tool in the configuration. ■ Exchange tool.
	The Krypton camera is defective.	Exchange the Krypton camera.
	No network connection between Krypton camera and KUKA KRC.	■ Check the network connections. ■ Connect the network connections. ■ Exchange the network connections.
	The reference LEDs of the base plate are invisible or defective.	■ Make reference LEDs visible. ■ Check reference LEDs. ■ Exchange reference LEDs.
	The Krypton strober for the reference LEDs of the base plate is defective.	Exchange the Krypton strober.

9 KUKA Service

9.1 Requesting support

Introduction

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

Faults leading to production downtime are to be reported to the local KUKA subsidiary within one hour of their occurrence.

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)
- Version of the KUKA System Software
- Optional software or modifications
- Archive of the software
- Application used
- Any external axes used
- Description of the problem, duration and frequency of the fault

9.2 KUKA Customer Support

Availability

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

Argentina

Ruben Costantini S.A. (Agency)
Luis Angel Huergo 13 20
Parque Industrial
2400 San Francisco (CBA)
Argentina
Tel. +54 3564 421033
Fax +54 3564 428877
ventas@costantini-sa.com

Australia

Marand Precision Engineering Pty. Ltd. (Agency)
153 Keys Road
Moorabbin
Victoria 31 89
Australia
Tel. +61 3 8552-0600
Fax +61 3 8552-0605
robotics@marand.com.au

Austria

KUKA Roboter GmbH
Vertriebsbüro Österreich
Regensburger Strasse 9/1
4020 Linz
Austria
Tel. +43 732 784752
Fax +43 732 793880
office@kuka-roboter.at
www.kuka-roboter.at

Belgium

KUKA Automatisering + Robots N.V.
Centrum Zuid 1031
3530 Houthalen
Belgium
Tel. +32 11 516160
Fax +32 11 526794
info@kuka.be
www.kuka.be

Brazil

KUKA Roboter do Brasil Ltda.
Avenida Franz Liszt, 80
Parque Novo Mundo
Jd. Guançã
CEP 02151 900 São Paulo
SP Brazil
Tel. +55 11 69844900
Fax +55 11 62017883
info@kuka-roboter.com.br

Chile

Robotec S.A. (Agency)
Santiago de Chile
Chile
Tel. +56 2 331-5951
Fax +56 2 331-5952
robotec@robotec.cl
www.robotec.cl

China

KUKA Flexible Manufacturing Equipment (Shanghai) Co., Ltd.
Shanghai Qingpu Industrial Zone
No. 502 Tianying Rd.
201712 Shanghai
P.R. China
Tel. +86 21 5922-8652
Fax +86 21 5922-8538
Franz.Poeckl@kuka-sha.com.cn
www.kuka.cn

France

KUKA Automatisme + Robotique SAS
Techvallée
6 Avenue du Parc
91140 Villebon s/Yvette
France
Tel. +33 1 6931-6600
Fax +33 1 6931-6601
commercial@kuka.fr
www.kuka.fr

Germany

KUKA Roboter GmbH
Blücherstr. 144
86165 Augsburg
Germany
Tel. +49 821 797-4000
Fax +49 821 797-1616
info@kuka-roboter.de
www.kuka-roboter.de

Hungary

KUKA Robotics Hungaria Kft.
Fö út 140
2335 Taksony
Hungary
Tel. +36 24 501609
Fax +36 24 477031
info@kuka-robotics.hu

India

KUKA Robotics, Private Limited
621 Galleria Towers
DLF Phase IV
122 002 Gurgaon
Haryana
India
Tel. +91 124 4148574
info@kuka.in
www.kuka.in

Italy

KUKA Roboter Italia S.p.A.
Via Pavia 9/a - int.6
10098 Rivoli (TO)
Italy
Tel. +39 011 959-5013
Fax +39 011 959-5141
kuka@kuka.it
www.kuka.it

Korea

KUKA Robot Automation Korea Co. Ltd.
4 Ba 806 Sihwa Ind. Complex
Sung-Gok Dong, Ansan City
Kyunggi Do
425-110
Korea
Tel. +82 31 496-9937 or -9938
Fax +82 31 496-9939
info@kukakorea.com

Malaysia

KUKA Robot Automation Sdn Bhd
South East Asia Regional Office
No. 24, Jalan TPP 1/10
Taman Industri Puchong
47100 Puchong
Selangor
Malaysia
Tel. +60 3 8061-0613 or -0614
Fax +60 3 8061-7386
info@kuka.com.my

Mexico

KUKA de Mexico S. de R.L. de C.V.
Rio San Joaquin #339, Local 5
Colonia Pensil Sur
C.P. 11490 Mexico D.F.
Mexico
Tel. +52 55 5203-8407
Fax +52 55 5203-8148
info@kuka.com.mx

Norway

KUKA Sveiseanlegg + Roboter
Bryggeveien 9
2821 Gjövik
Norway
Tel. +47 61 133422
Fax +47 61 186200
geir.ulsrud@kuka.no

Portugal

KUKA Sistemas de Automatización S.A.
Rua do Alto da Guerra n° 50
Armazém 04
2910 011 Setúbal
Portugal
Tel. +351 265 729780
Fax +351 265 729782
kuka@mail.telepac.pt

Russia

KUKA-VAZ Engineering
Jushnoje Chaussee, 36 VAZ, PTO
445633 Togliatti
Russia
Tel. +7 8482 391249 or 370564
Fax +7 8482 736730
Y.Klychkov@VAZ.RU

South Africa

Jendamark Automation LTD (Agency)
76a York Road
North End
6000 Port Elizabeth
South Africa
Tel. +27 41 391 4700
Fax +27 41 373 3869
www.jendamark.co.za

Spain

KUKA Sistemas de Automatización S.A.
Pol. Industrial
Torrent de la Pastera
Carrer del Bages s/n
08800 Vilanova i la Geltrú (Barcelona)
Spain
Tel. +34 93 814-2353
Fax +34 93 814-2950
Comercial@kuka-e.com
www.kuka-e.com

Sweden

KUKA Svetsanläggningar + Robotar AB
A. Odhners gata 15
421 30 Västra Frölunda
Sweden
Tel. +46 31 7266-200
Fax +46 31 7266-201
info@kuka.se

Switzerland

KUKA Roboter Schweiz AG
Riedstr. 7
8953 Dietikon
Switzerland
Tel. +41 44 74490-90
Fax +41 44 74490-91
info@kuka-roboter.ch
www.kuka-roboter.ch

Taiwan

KUKA Robot Automation Taiwan Co. Ltd.
136, Section 2, Huanjung E. Road
Jungli City, Taoyuan
Taiwan 320
Tel. +886 3 4371902
Fax +886 3 2830023
info@kuka.com.tw
www.kuka.com.tw

Thailand

KUKA Robot Automation (M)SdnBhd
Thailand Office
c/o Maccall System Co. Ltd.
49/9-10 Soi Kingkaew 30 Kingkaew Road
Tt. Rachatheva, A. Bangpli
Samutprakarn
10540 Thailand
Tel. +66 2 7502737
Fax +66 2 6612355
atika@ji-net.com
www.kuka-roboter.de

UK

KUKA Automation + Robotics
Hereward Rise
Halesowen
B62 8AN
UK
Tel. +44 121 585-0800
Fax +44 121 585-0900
sales@kuka.co.uk

USA

KUKA Robotics Corp.
22500 Key Drive
Clinton Township
48036 Michigan
USA
Tel. +1 866 8735852
Fax +1 586 5692087
info@kukarobotics.com
www.kukarobotics.com

Index

Z