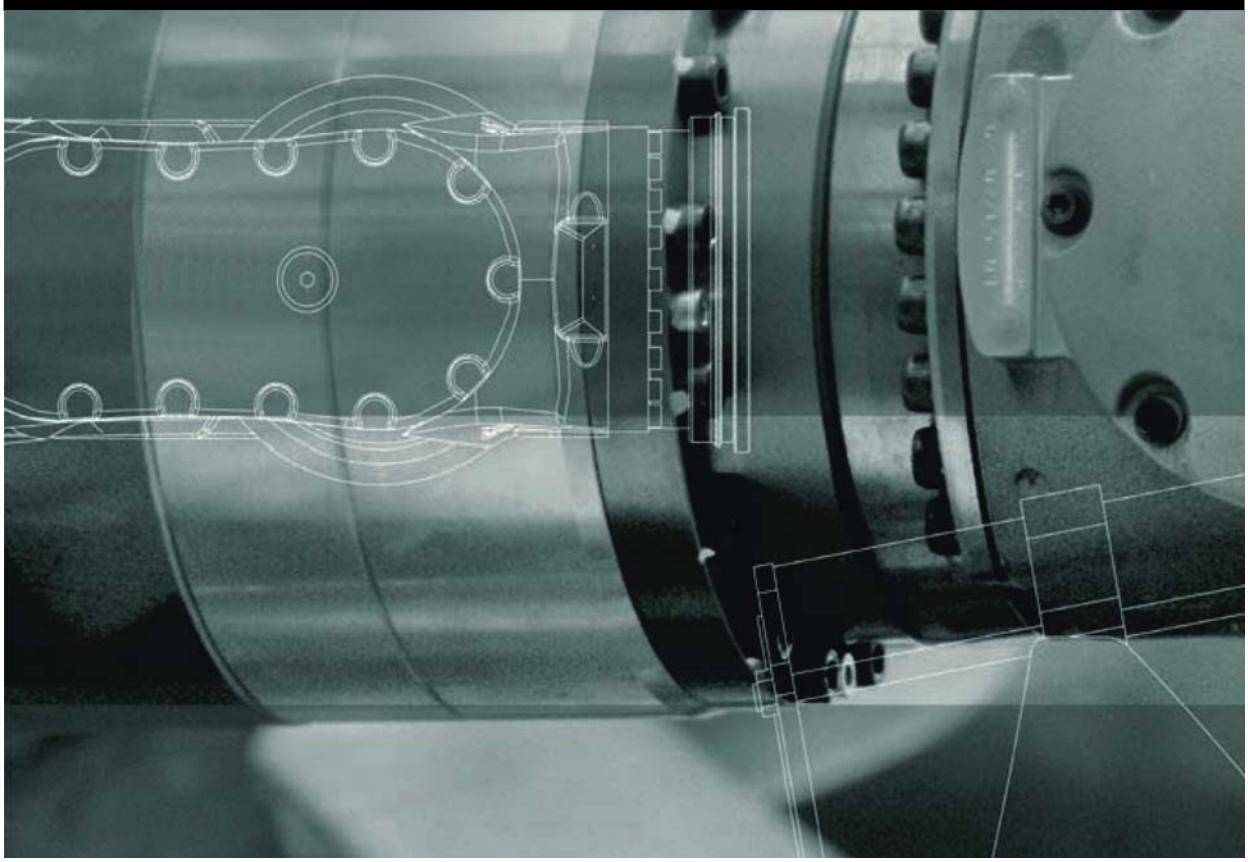
KUKA

Controller Option

KUKA Roboter GmbH

KR C4 EtherNet/IP 2.0

For KUKA System Software 8.3



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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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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 field buses
- Knowledge of WorkVisual
- Knowledge of the software RSLogix 5000

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 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.

1.3 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.

These warnings contain references to safety-relevant information or general safety measures.
These warnings do not refer to individual hazards or individual precautionary measures.

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.

1.4 Trademarks

Windows is a trademark of Microsoft Corporation.

RSLogix is a trademark of Rockwell Automation Inc.

1.5 Terms used

Term	Description
EDS file	Device description file for EtherNet/IP
Industrial Ethernet	Ethernet is a data network technology for local area networks (LANs). It allows data to be exchanged between the connected devices in the form of data frames.
PLC	Programmable logic controller
Subnet	Subnetwork in the Internet Protocol (IP)
Subnet mask	Defines which IP addresses a device looks for in its own network and which addresses can be reached in other networks.

2 Product description

EtherNet/IP is an Ethernet-based field bus. Data exchange is carried out on a client-server basis.

EtherNet/IP is installed on the robot controller.

Compatibility

KR C4 EtherNet/IP 2.0 is compatible with the following field buses:

- KR C4 DeviceNet
- KR C4 EtherCAT

Functions

The following functions are supported:

- EtherNet/IP IO (cyclical communication)
- Explicit Messaging (acyclic communication)
- Quick Connect
- CIP Safety

Limitations

The Explicit Messaging function can only be used in conjunction with the EtherNet/IP IO function.

Configuration software

EtherNet/IP is configured on a laptop or PC. The following software is required for configuration:

- WorkVisual 3.0 or higher
- Depending on the selected procedure, additional configuration software may be required:
  - RSLogix 5000 from Rockwell Automation

For configuration of a higher-level controller, the corresponding configuration software from the manufacturer is also required, e.g. RSLogix 5000 from Rockwell Automation.

Device types

The following device types are used with EtherNet/IP:

- Scanner: a higher-level controller that controls all the components of a system.
- Adapter: a field device subordinated to a scanner. Adapters are also referred to as devices in this document.

The 2 device types have relationships for transferring configuration data and process data.

A physical device, e.g. the robot controller, can be a scanner and/or an adapter. The configuration of communication relationships is carried out solely in the scanner.

3 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.

4 Installation

4.1 System requirements

Robot controller

Hardware:

- KR C4
- Or KR C4 compact

Software:

- KUKA System Software 8.3

Laptop/PC

Software:

- WorkVisual 3.0 or higher

  The requirements for installation of WorkVisual are contained in the WorkVisual documentation.
- RSLogix 5000

  The requirements for installation of RSLogix are contained in the documentation of this software.
- Rockwell BOOTP-DHCP server

  The Rockwell BOOTP-DHCP server allows dynamic IP addresses to be assigned. The software can be found on the WorkVisual CD, in the directory Tools\BOOTP-DHCP. To install the software, start the program **Setup.exe** from the CD.

4.2 Routing the data cables

- The Industrial Ethernet cables are routed to the adapters from the scanner or from the switch using a star or ring topology.

4.3 Installing or updating EtherNet/IP

If a version of EtherNet/IP is already installed, its configuration is carried over automatically. If this is not desired, the existing version must first be uninstalled.

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

Preparation

- Copy software from CD to KUKA USB stick.

  The software must be copied onto the stick with the file Setup.exe at the highest level (i.e. not in a folder).

NOTICE Recommendation: Use a KUKA stick. Data may be lost if any other stick is used.

Precondition

- “Expert” user group

Procedure

1. Connect the USB stick to the robot controller or smartPAD.
2. In the main menu, select **Start-up** > **Additional software**.
3. Press **New software**. The entry **KRC4 EthernetIP** must be displayed in the **Name** column and drive **E:** or **K:** in the **Path** column.

   If not, press **Refresh**.
4. If the specified entries are now displayed, continue with step 5.

If not, the drive from which the software is being installed must be configured first:

- Click on the **Configuration** button. A new window opens.
- Select a line in the **Installation paths for options** area.

  Note: If the line already contains a path, this path will be overwritten.
- Press **Path selection**. The available drives are displayed.
- Select **E:**. (If stick connected to the robot controller.)

  Or select **K:**. (If stick connected to the smartPAD.)
- Press **Save**. The window closes again.

The drive only needs to be configured once and then remains saved for further installations.

5. Select the entry **KRC4 EthernetIP** and press **Install**. Answer the request for confirmation with **Yes**.
6. Confirm the reboot prompt with **OK**.
7. Remove the stick.
8. Reboot the robot controller.

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

4.4 Uninstalling EtherNet/IP

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

Precondition

- "Expert" user group

Procedure

1. In the main menu, select **Start-up** > **Additional software**.
2. Select the entry **KRC4 EthernetIP** and press **Uninstall**. Reply to the request for confirmation with **Yes**. Uninstallation is prepared.
3. Reboot the robot controller. Uninstallation is resumed and completed.

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

5 Configuration

5.1 Overview

Step	Description
1	Configure the higher-level controller with the configuration software provided by the manufacturer of the higher-level controller. **Note:** This step only needs to be carried out if a higher-level controller is being used.
2	Make EDS files available (optional). (>>> 5.2 "Making EDS files available" Page 13) (>>> 5.3 "Making EDS files available for configuration of the PLC with third-party engineering software" Page 14)
3	Configure Ethernet/IP. (>>> 5.4 "Configuring the bus with WorkVisual" Page 14)
4	Map the inputs and outputs in WorkVisual. (>>> 5.5 "Mapping inputs/outputs in WorkVisual" Page 22)
5	Transfer the bus configuration from WorkVisual to the robot controller.
6	Reboot the robot controller.
7	Configure bus device ports (optional). (>>> 5.6 "Configuring bus device ports" Page 23)
8	Export EDS files (optional). (>>> 5.7 "Exporting EDS files" Page 24)
9	Configure acyclic communication (optional). (>>> 5.8 "Acyclic communication" Page 25)
10	Safety interface via CIP Safety (optional) (>>> 5.9 "Safety interface via CIP Safety (optional)" Page 29)

Information about procedures in WorkVisual is contained in the WorkVisual documentation. Information about procedures in the configuration software from the manufacturer of the higher-level controller can be found in the documentation for this configuration software.

If the higher-level controller is configured with the RSLogix software, the module type **Generic Ethernet Module** must be used.

5.2 Making EDS files available

An EDS file can be used for the configuration of a device. It is also possible to configure a device without an EDS file. In the case of modular devices, an EDS file is required for each module. EDS files must be obtained from the manufacturer of the device.

Precondition

- A robot controller has been added and set as active.

Procedure

1. Expand the tree structure of the robot controller on the **Hardware** tab in the **Project structure** window.

2. Right-click on **Bus structure** and select **Add…** from the context menu.
3. A window opens. Select the entry **EtherNet/IP** and confirm with **OK**. The entry is inserted in the tree structure.
4. Right-click on the entry **EtherNet/IP** and select the menu sequence **Functions** > **Add EDS to library**.
5. A wizard is opened. Click on **Next >**.
6. Click on **Browse…** and specify a directory.
7. Confirm with **Next>**.

   A list of the EDS files to be added to the library is displayed.
8. Confirm with **Next>**.
9. Click on **Finish**.

   The EDS files are added to the library.
10. Close and save the project with **File** > **Close**.
11. Select the menu sequence **Extras** > **DTM Catalog Management...**.
12. Click on **Search for installed DTMs**. The catalog scan is started
13. Under **Known DTMs**, select the required files and click on the **Right arrow** button. The selected files are displayed under **Current DTM Catalog**.
14. Click on **OK** to end the catalog scan.

> If there is already a different version of an EDS file present on the hard drive, the user is asked to confirm whether the file on the hard drive should be overwritten. If the file to be added is required for a project, overwriting the file on the hard drive with this file is recommended. Otherwise, the project may be impossible to open.

5.3 Making EDS files available for configuration of the PLC with third-party engineering software

Description

If a KUKA robot controller is added as a device on the PLC with third-party engineering software, this software requires the EDS file for the KUKA robot controller.

Procedure

1. Copy the EDS file of the KUKA robot controller.

   The file can be found on the WorkVisual CD-ROM, in the following directory: DeviceDescriptions\EDS
   - For the EtherNet/IP adapter: **KCR4ScannerAdapter.eds**
   - For the safety interface via CIP Safety: **KCR4SafeAdapter.eds**
2. Add the file in the third-party engineering software.

5.4 Configuring the bus with WorkVisual

> With certain EtherNet/IP devices, the full range of functions can only be used if the manufacturer's software (e.g. Web Server or RSPLogix) is used for configuration.

5.4.1 Configuring Ethernet/IP scanners

Precondition

- A robot controller has been added and set as active.
- The **EtherNet/IP** node is inserted into the bus structure.

Procedure

1. Expand the tree structure of the robot controller on the **Hardware** tab in the **Project Structure** window.
2. Right-click on **EtherNet/IP** and select **Add…** from the context menu.

3. A window opens with a list of devices. Select the device used and confirm with **OK**. The device is inserted in the tree structure.

NOTICE The inserted device must correspond to the actual device used in reality. Substantial damage to property may otherwise result.

4. Right-click on the device in the tree structure and select **Settings…** from the context menu. A window with the device data is opened.
5. Enter the IP address of the device on the **Address Setting** tab.
   (>>> 5.4.1.1 "Address setting" Page 15)
6. On the **Device Properties** tab, fill out the following boxes:
   - **Number**; **Is Active**; **Device name**

   (>>> 5.4.1.2 "Device properties" Page 16)

Steps 7 and 8 are only relevant for modular devices. In the case of non-modular devices or configuration without an EDS file, the **Chassis/Modules** tab is not available.

7. Select the chassis type used on the **Chassis/Modules** tab and assign the modules used to the slots.
   (>>> 5.4.1.3 "Chassis/Modules" Page 16)
8. Configure the modules.
   (>>> 5.4.1.4 "Setting parameters" Page 17)
9. Save the device data with **OK**.
10. If necessary, repeat steps 4 to 9 for further devices.

5.4.1.1 Address setting

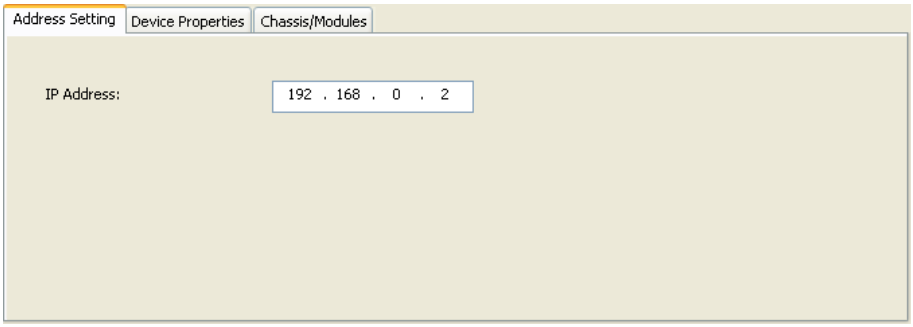

Fig. 5-1: "Address Setting" tab

Box	Description
IP address	Enter the IP address of the device.

5.4.1.2 Device properties

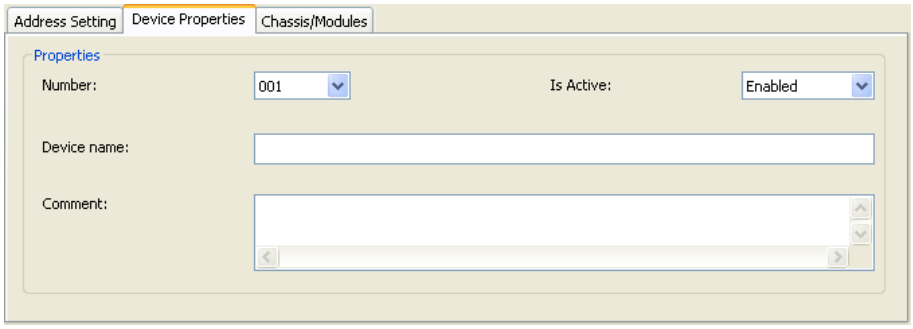

Fig. 5-2: "Device Properties" tab

Box	Description
Number	Select the number of the device.
Is Active	■ **Enabled**: The robot controller expects the device to be active when the controller boots up. If the device is not active, the robot controller issues an error message. ■ **Disabled**: The robot controller does not check whether the device is active when the controller boots up.
Device name	Enter the name of the device (optional). **Note:** If a name is entered, it is displayed in the diagnostic monitor of smartHMI. If nothing is entered, the default name is displayed.

5.4.1.3 Chassis/Modules

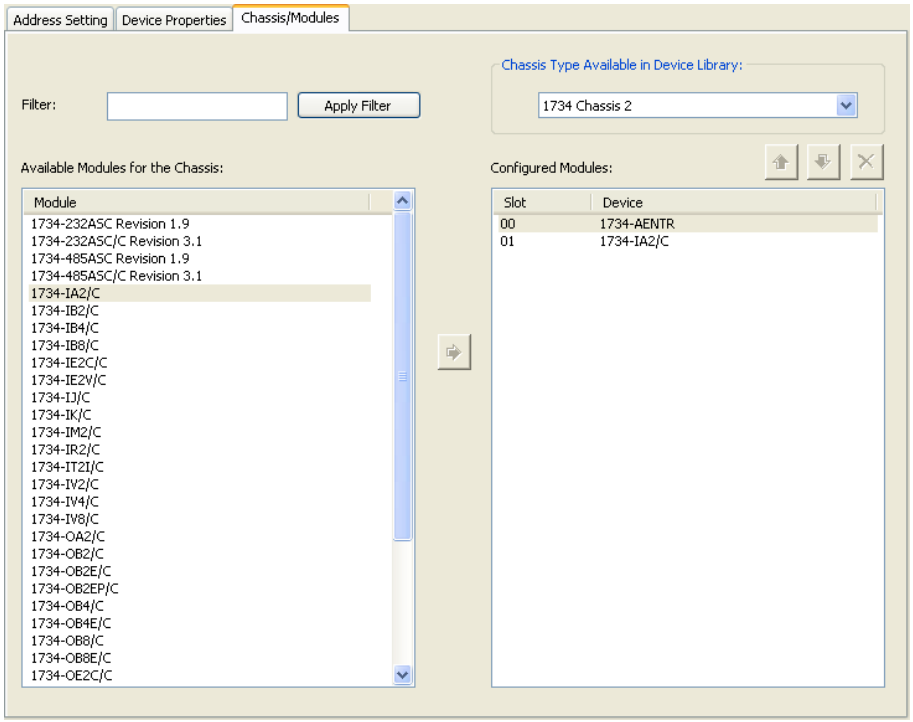

Fig. 5-3: "Chassis/Modules" tab

Box	Description
Chassis type available in device library	Select the type of chassis used. **Example:** A bus coupler with 6 slots has 7 chassis.
Module	Assign the modules used to the slots by means of the right arrow.

5.4.1.4 Setting parameters

Precondition

- A robot controller has been added and set as active.
- The **EtherNet/IP** node is inserted into the bus structure.
- A device is added to the bus and the modules of the device are assigned to the slots.

Procedure

1. Right-click on the device in the tree structure and select **Settings…** from the context menu. A window with the device data is opened. The modules are displayed in the box to the left of the tabs.
   (>>> 5.4.1.5 "Module configuration" Page 17)
2. Click on the connection type under the module, e.g. **Rack Optimization**. The tabs **General**, **Identity Check** and **Configuration Settings** are displayed.

> Information about the parameters that can be set in these tabs is displayed in the **Description** box by clicking on the parameter.

> The connection type can be changed.
> (>>> 5.4.1.6 "Changing the connection type" Page 18)

3. Make the desired settings and save them by pressing **OK**.

5.4.1.5 Module configuration

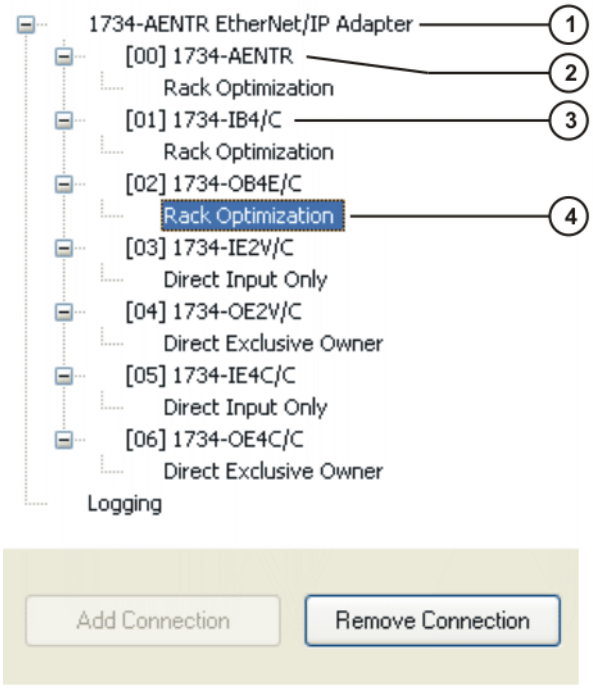

Fig. 5-4: Module configuration, example

Description

Item	Description
1	Device
2	Bus coupler
3	Module
4	Connection type ■ **Rack Optimization:** Connection type for digital input and output modules This connection type can be used to group several modules together. ■ **Direct Input Only:** Connection type for analog and digital input modules ■ **Direct Exclusive Owner:** Connection type for analog and digital output modules

5.4.1.6 Changing the connection type

Precondition

- A robot controller has been added and set as active.
- The **EtherNet/IP** node is inserted into the bus structure.
- A device is added to the bus and the modules of the device are assigned to the slots.

Procedure

1. Right-click on the device in the tree structure and select **Settings…** from the context menu. A window with the device data is opened. The modules are displayed in the box to the left of the tabs.
   (>>> 5.4.1.5 "Module configuration" Page 17)
2. Select the module and click on **Remove Connection**.
3. Click on **Add Connection**.
4. Select the connection type and confirm with **OK**.

5.4.2 Configuring Ethernet/IP adapters

Precondition

- A robot controller has been added and set as active.
- The **EtherNet/IP** node is inserted into the bus structure.

Procedure

1. Expand the tree structure of the robot controller on the **Hardware** tab in the **Project structure** window.
2. Right-click on **EtherNet/IP** in the tree structure and select **Settings** from the context menu.
3. A window opens. Fill out the following boxes on the **Communication settings** tab:
   - **Begin detection range address**; **End detection range address**; **Bus timeout**; **Scanner IP address**

   (>>> 5.4.2.1 ""Communication settings" tab" Page 19)
4. Save the setting with **Apply**.
5. The local slaves can be configured in the tabs **Local Slave 1** to **Local Slave 5**.
   (>>> 5.4.2.2 ""Local Slave" tab" Page 20)
6. Only if the safety interface via CIP Safety is used: Configure the local safety slave on the **Local Safety Slave** tab.
   (>>> 5.4.2.3 ""Local Safety Slave" tab" Page 21)
7. Save the settings by selecting **OK**.

5.4.2.1 “Communication settings” tab

Fig. 5-5: “Communication settings” tab

Box	Description
EtherNet/IP network detection	
Begin detection range address:	If a start address is entered, the system only looks for IP addresses that are greater than or equal to the entered IP address.
End detection range address:	If an end address is entered, the system only looks for IP addresses that are less than or equal to the entered IP address.
Adapter	
Bus timeout:	If the robot controller cannot establish the connection to the PLC within this time, it generates an error message. (If the connection is then established subsequently, the message changes to an acknowledgement message.) Unit: ms
Scanner	
Scanner IP address:	Enter the IP address of the EtherNet/IP scanner. **Note:** The IP address of the scanner is required for diagnosis.
Bus timeout:	If the robot controller cannot establish the connection to the device within this time, it generates an error message. (If the connection is then established subsequently, the message changes to an acknowledgement message.) Unit: ms

5.4.2.2 “Local Slave” tab

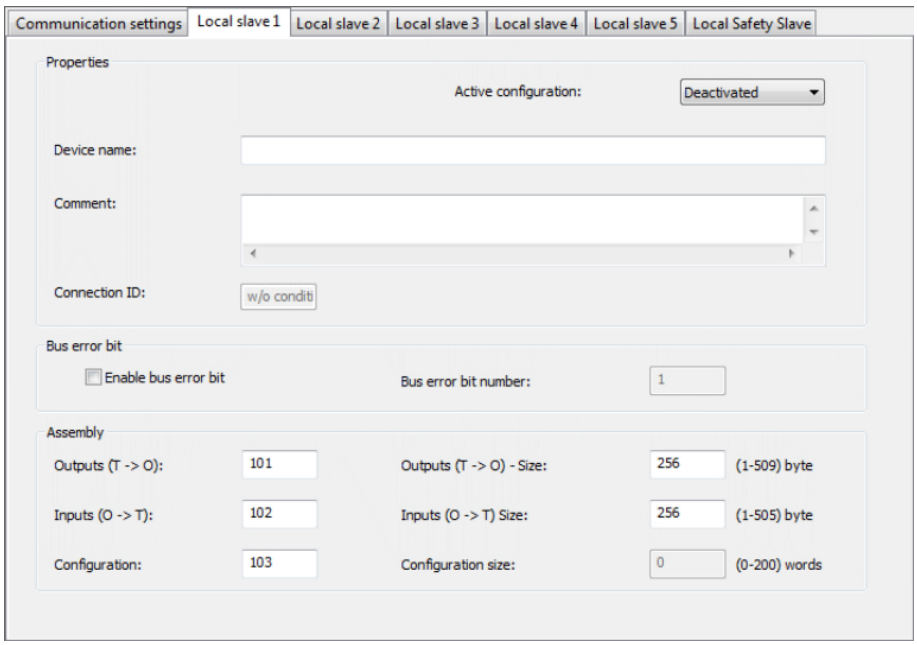

Fig. 5-6: “Local Slave” tab

The default settings (>>> Fig. 5-6) can be retained for those boxes which are not described here.

Box	Description
Properties	
Active configuration:	■ **Activated**: Local slave is used. ■ **Deactivated**: Local slave is not used. **Deactivated** is selected by default. **Note:** This function is not the same as the **Is Active** function. If **Activated** is selected, the local slave is saved to the configuration; until then, it is not available in the configuration.
Device name:	Enter the name of the local slave (optional). **Note:** If a name is entered, it is displayed in the diagnostic monitor of smartHMI. If nothing is entered, the default name is displayed.
Bus error bit	
Enable bus error bit	■ **Activated:** In the case of a bus error, a status bit is sent to the PLC. ■ **Deactivated:** No status bit is sent to the PLC. By default, the check box is deactivated.
Bus error bit number:	Enter the number of the status bit in the address range of the local slave. **0 … 4071 bits** Default value: 1 bit
Assembly	

Box	Description
Outputs (T -> O) - Size:	Number of outputs of the local slave **1 … 509 bytes** Default value: 256 bytes
Inputs (O -> T) Size:	Number of inputs of the local slave **1 … 505 bytes** Default value: 256 bytes

5.4.2.3 “Local Safety Slave” tab

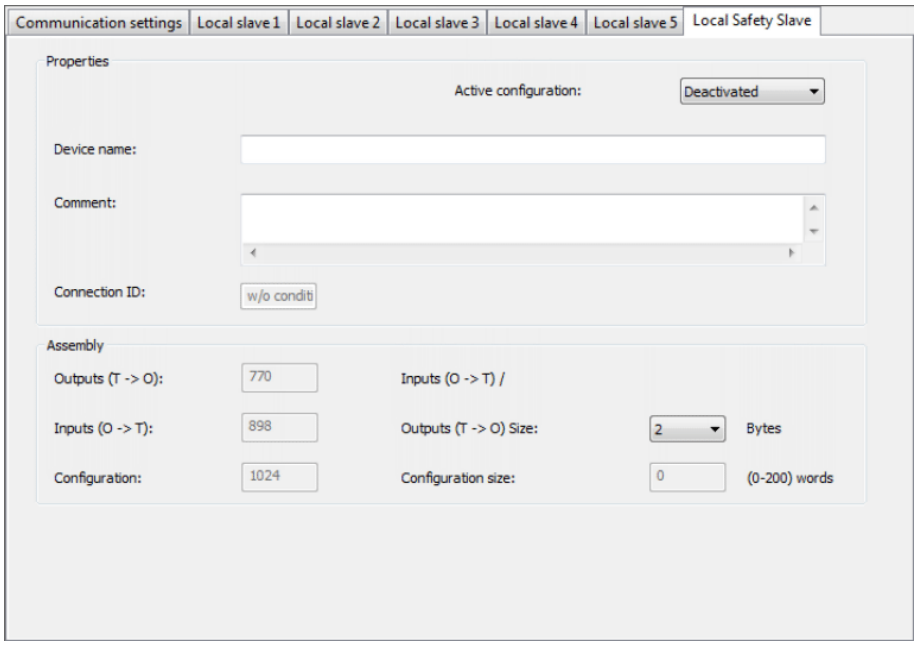

Fig. 5-7: “Local Safety Slave” tab

Box	Description
Properties	
Active configuration:	■ **Activated**: Local safety slave is used. ■ **Deactivated**: Local safety slave is not used. **Deactivated** is selected by default. **Note:** This function is not the same as the **Is Active** function. If **Activated** is selected, the local slave is saved to the configuration; until then, it is not available in the configuration.
Device name:	Enter the name of the local safety slave (optional). **Note:** If a name is entered, it is displayed in the diagnostic monitor of smartHMI. If nothing is entered, the default name is displayed.

Box	Description
Assembly	
Outputs (T -> O) / Inputs (O -> T) - Size	Number of inputs and outputs of the local safety slave ■ **2 bytes**: For standard safety functions without SafeOperation, SafeRangeMonitoring and SafeSingleBrake ■ **8 bytes**: For standard safety functions with SafeOperation, SafeRangeMonitoring and SafeSingleBrake Default value: 2 bytes

5.5 Mapping inputs/outputs in WorkVisual

Procedure

- Map the inputs/outputs in WorkVisual.

Signal names of local slaves

The EtherNet/IP signal names of the local slaves have the following structure in WorkVisual:

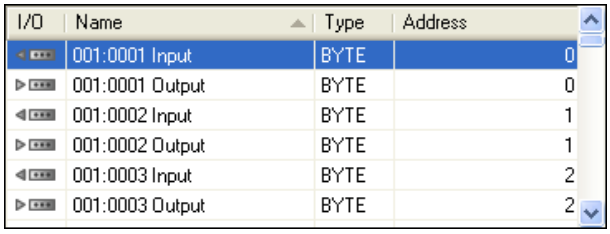

Fig. 5-8: EtherNet/IP signal names of the local slaves in WorkVisual

Example: **001:0001 Input**

Name	Meaning	In the example
1st value from left	Number of the device	001
2nd value from left	Index number (consecutive ascending numbering of the individual inputs/outputs)	0001
Input/Output	Direction of processing	Input

Signal names of devices

The EtherNet/IP signal names of the EtherNet/IP devices have the following structure in WorkVisual:

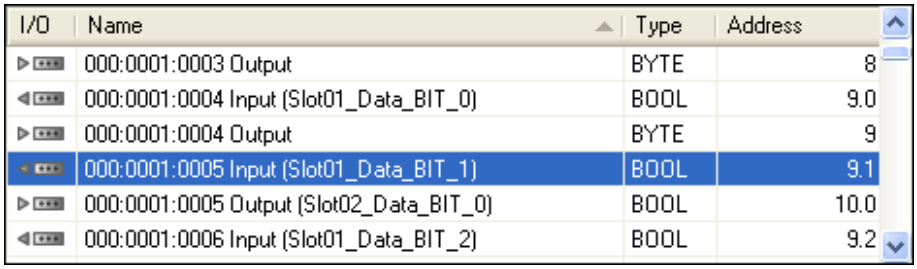

Fig. 5-9: EtherNet/IP signal names of the devices in WorkVisual

Example: **000:0001:0005 Input (Slot01_Data_BIT_1)**

Name	Meaning	In the example
1st value from left	Number of the module **Note:** If the connection type **Rack Optimization** is used, multiple modules can be grouped together as a single module.	000
2nd value from left	Index for every connection in the module (in the case of modular devices) or in the device (in the case of non-modular devices).	0001
3rd value from left	Index number (consecutive ascending numbering of the individual inputs/outputs)	0005
Input/Output	Direction of processing	Input
Text in brackets	Comment by the manufacturer The comment indicates which inputs/outputs belong to a module.	(Slot01_Data_BIT_1)

5.6 Configuring bus device ports

Description

For error-free operation of EtherNet/IP, it is recommended that all Ethernet connections between the bus devices have the configuration 100 MB Full Duplex. For this, 2 ports that are connected to one another must have the same configuration: either 100 MB Full Duplex or Autonegotiation. In the following figure, for example, these are the KLI on the robot controller and port 1 on the switch.

By default, the KLI has the configuration Autonegotiation. The port connected to it should thus have the same configuration.

Configuration of the ports can be carried out in WorkVisual by means of explicit messaging.

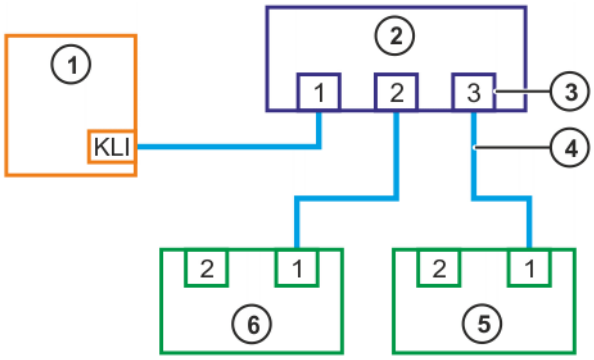

Fig. 5-10: Example of a bus structure

1 Robot controller
2 Switch
3 Port
4 Connecting cable with 100 MB Full Duplex
5 Device 2
6 Device 1

If Quick Connect is used, the configuration 100 MB Full Duplex is recommended for the connected ports.

Precondition

- The robot controller has been set as the active controller.
- The bus devices to be configured are connected and can be accessed via the network.

Procedure

1. Expand the tree structure of the robot controller on the **Hardware** tab in the **Project structure** window.
2. Right-click on **EtherNet/IP** in the tree structure and select **Connect** from the context menu.
3. Right-click on **EtherNet/IP** and select **Functions** > **Extended mode**.
4. Right-click on **EtherNet/IP** and select **Functions** > **Explicit Ethernet/IP messaging**.
5. Fill out the following boxes:
   - **IP address**: IP address of the device
   - **Class**: 0xF6
   - **Instance**: Port number
   - **Attribute**: 6
   - **Service**: Set_Attribute_Single
   - **Data**: Settings in hexadecimal notation, Intel format
6. Save the settings with **Close**.

Example

Example for configuration of 100 MB Full Duplex for port 1 of a device:

- **Class**: 0xF6
- **Instance**: 1
- **Attribute**: 6
- **Service**: Set_Attribute_Single
- **Data**: 02 00 64 00

5.7 Exporting EDS files

In order, for example, to be able to use a project on a different computer, the EDS files used must be exported.

In the case of modular devices, multiple EDS files must be exported. For non-modular devices, a single EDS file is exported.

Precondition

- A robot controller has been added and set as active.
- The **EtherNet/IP** node is inserted into the bus structure.
- A device is added to the bus.

Procedure for modular device

1. Right-click on the device in the tree structure and select **Functions** > **Export EDS** in the context menu.
2. A window opens. Select the directory to which the EDS files are to be exported.
3. Confirm the selection with **OK**.

   The files are exported to the specified directory.

Procedure for non-modular device

1. Right-click on the device in the tree structure and select **Functions** > **Export EDS** in the context menu.
2. A window opens. Select the directory to which the EDS file is to be exported. The name of the EDS file can be changed.
3. Click on **Save**.

The file is exported to the specified directory.

5.8 Acyclic communication

> Acyclic communication can only be used in conjunction with cyclical communication.

Description

A PLC can exchange acyclic data with the applications on the robot controller (e.g. KRL). For this, various parameters must be configured in the corresponding PLC module and in the KRL program.

The maximum length of the data that can be received by the PLC is 1406 bytes. The maximum length of the data that can be sent to the PLC is 1410 bytes. The communication device with the lowest maximum length is decisive, however.

> The data format is not predefined. The interpretation of the data is the responsibility of the PLC and KRL programmers.

PLC program

The following parameters must be configured in the corresponding PLC module:

- Class ID = 0x64
- Instance Number = 1
- Attribute Number = 1
- Service Read = 0x32
- Service Write = 0x33

The PLC configuration is described in the following section, taking a Rockwell PLC by way of example:

(>>> 5.8.2 "Configuring the PLC (example)" Page 26)

KRL program

The following parameters must be configured in the KRL program:

Parameter	Description
CmdID	Command ID ■ **1**: Read data ■ **2**: Write data
CmdLen	Length of command
UserData	User data ■ **0 … 255**

5.8.1 Configuring the robot controller

In order to enable acyclic communication, the robot controller must be configured accordingly.

Precondition

- The EtherNet/IP adapter has been mapped to KRL inputs and outputs in WorkVisual.
- “Expert” user group

Procedure

1. Open the file AsyncDataToKrl.xml in the directory C:\KRC\ROBOTER\Config\User\Common.
2. Adapt the entry <IODriver IODrvName="PNIO-DEV" /> as follows: <IODriver IODrvName="EIP-ADAPTER" />.

3. Save and close the file.
4. Open the file $custom.dat in the directory KRC:\STEU\Mada.
5. Adapt the entry DECL EXT_MOD_T $EXT_MOD_1={O_FILE[]" " ,OPTION 'B0000'} as follows: DECL EXT_MOD_T $EXT_MOD_1={O_FILE[]"drivers/asyncdatatokrl.o" ,OPTION 'B0010'}
6. Save and close the file.
7. Reboot the robot controller. For this, select **Shutdown** in the main menu and select the option **Reload files**.

5.8.2 Configuring the PLC (example)

The PLC configuration is described below, taking a Rockwell PLC by way of example.

Procedure

- Make the following settings on the **Configuration** tab in the **Message Configuration** window:

Box	Value
Message Type	CIP Generic
Service Type	Custom
Service Code	32
Class	64
Instance	1
Attribute	1

Example PLC program

```
// read cmd 1, cmd len 8
IF KUKA:I.Data[0].0 THEN
        ReqDataBufRead[0] := 1;
        ReqDataBufRead[1] := 8;
        MSG( MsgCtrlRead);
END_IF;

// write cmd 2, cmd len 8, Data = 0x1 0x2 0x3 0x4 0x1 0x2 0x3 0x4
IF KUKA:I.Data[0].1 THEN
        ReqDataBufWrite[0] := 2;
        ReqDataBufWrite[1] := 8;
        ReqDataBufWrite[2] := 16909060;
        ReqDataBufWrite[3] := 16909060;
        MSG( MsgCtrlWrite);
END_IF;
```

5.8.3 Example of acyclic communication

Example of acyclic communication in the program SPS.SUB:

```
...
  3  DECL INT  nHandle, tmpInt, retVal
  4  DECL STATE_T Stat
  5  DECL MODUS_T WMode
  6  DECL MODUS_T RMode
  7  DECL REAL TimeOut
  8  DECL INT  Offset
  9
 10  ; Header
 11  DECL INT CmdID
 12  INT CmdLen
 13  ; Command structure
 14  ; User data
 15  DECL INT UserData
 16  DECL CHAR Buffer[1000]
 17  DECL CHAR TmpStr[150]
...
```

```
...
 61   CRead (nHandle, Stat, RMode, TimeOut, Offset, "%r",Buffer[]);
 62   If ( Stat.Ret1==#DATA_END ) then
 63
 64   Offset=0
 65   CAST_FROM(Buffer[],Offset, CmdID)
 66   CAST_FROM(Buffer[],Offset, CmdLen)
 67
 68   if (CmdID == 1) then
 69   ;--- PLC READ
 70
 71      Offset=0
 72      wait for strClear(TMPSTR[])
 73      SWRITE(TMPSTR[],STAT,Offset,"CmdId=%d CmdLen=%d", CmdID,
         CmdLen)
 74      $loop_msg[]=TMPSTR[]
 75
 76      wait sec 1
 77
 78      ; --- Prepare Read Response
 79      CmdID = 1
 80      CmdLen = 8
 81      UserData = 255;
 82      Offset=0
 83
 84      CAST_TO(Buffer[],Offset,CmdID)
 85      CAST_TO(Buffer[],Offset,CmdLen)
 86      CAST_TO(Buffer[],Offset,UserData)
 87      CAST_TO(Buffer[],Offset,UserData)
 88
 89      CWrite (nHandle,Stat,WMode,"%1.16r",Buffer[])
 90      Wait for (Stat.Ret1==#DATA_OK)
 91
 92  else
 93      if (CmdID == 2) then
 94
 95      ;--- PLC WRITE
 96
 97              CAST_FROM(Buffer[],Offset, UserData);
 98
 99              Offset=0
100              wait for strClear(TMPSTR[])
101              SWRITE(TMPSTR[],STAT,Offset,"CmdID=%d CmdLen=%d
                 UserData=%d", CmdID, CmdLen, UserData)
102              $loop_msg[]=TMPSTR[]
103
104              wait sec 1
105
106              ; --- Prepare Write Response
107              CmdLen = 8
108
109              Offset=0
110
111              CAST_TO(Buffer[],Offset,CmdID)
112              CAST_TO(Buffer[],Offset,CmdLen)
113
114              CWrite (nHandle,Stat,WMode,"%1.8r",Buffer[])
115              Wait for (Stat.Ret1==#DATA_OK)
116
117      endif
118  endif
```

Line	Description
3 … 17	Declaration section
68	`CmdID == 1`: The higher-level controller requests data from the robot controller via a read command.
79 … 90	The robot controller reads the request.
107 … 115	The robot controller replies to the higher-level controller.

5.9 Safety interface via CIP Safety (optional)

5.9.1 Instructions for use of CIP Safety

- For each safety network or safety subnet, SNN numbers that only occur once in the entire system should be defined (FRS154).
- The SCID must be set to 0. The user is responsible for ensuring that the PLC and robot controller are correctly configured (FRS103).
- The configuration of the safe connection between the PLC and the robot controller must be tested by the user to make sure that it is functioning correctly (SRS92).
- Before setting a lock, the functional capability of the system must be tested by the user (SRS50).

5.9.2 Safety functions via CIP Safety (KR C4)

Description

The exchange of safety-relevant signals between the controller and the system is carried out via CIP Safety. The assignment of the input and output states within the CIP Safety protocol are listed below. In addition, non-safety-oriented information from the safety controller is sent to the non-safe section of the higher-level controller for the purpose of diagnosis and control.

Reserved bits

Reserved safe inputs can be pre-assigned by a PLC with the values **0** or **1**. In both cases, the manipulator will move. If a safety function is assigned to a reserved input (e.g. in the case of a software update) and if this input is preset with the value **0**, then the manipulator would either not move or would unexpectedly come to a standstill.

KUKA recommends pre-assignment of the reserved inputs with **1**. If a reserved input has a new safety function assigned to it, and the input is not used by the customer's PLC, the safety function is not activated. This prevents the safety controller from unexpectedly stopping the manipulator.

Input byte 0

Bit	Signal	Description
0	RES	Reserved 1 The value **1** must be assigned to the input.
1	NHE	Input for external Emergency Stop **0** = external E-STOP is active **1** = external E-STOP is not active
2	BS	Operator safety **0** = operator safety is not active, e.g. safety gate open **1** = operator safety is active

Bit	Signal	Description
3	QBS	Acknowledgement of operator safety Precondition for acknowledgement of operator safety is the signal "Operator safety assured" set in the BS bit. **Note:** If the “BS” signal is acknowledged by the system, this must be specified under **Hardware options** in the safety configuration. Information is contained in the Operating and Programming Instructions for System Integrators. **0** = operator safety has not been acknowledged Edge **0** ->**1** = operator safety has been acknowledged
4	SHS1	Safety STOP 1 (all axes) ■ FF (motion enable) is set to **0**. ■ Voltage US2 is switched off. ■ AF (drives enable) is set to **0** after 1.5 s. Cancelation of this function does not require acknowledgement. This function is not permissible for the EMERGENCY STOP function. **0** = safety stop is active **1** = safety stop is not active
5	SHS2	Safety STOP 2 (all axes) ■ FF (motion enable) is set to **0**. ■ Voltage US2 is switched off. Cancelation of this function does not require acknowledgement. This function is not permissible for the EMERGENCY STOP function. **0** = safety stop is active **1** = safety stop is not active
6	RES	-
7	RES	-

Input byte 1

Bit	Signal	Description
0	US2	Supply voltage US2 (signal for switching the second supply voltage, US2, without battery backup) If this output is not used, it should be set to 0. **0** = switch off US2 **1** = switch on US2 **Note:** Whether and how input US2 is used must be specified under **Hardware options** in the safety configuration. Information is contained in the Operating and Programming Instructions for System Integrators.
1	SBH	Safe operational stop (all axes) Precondition: All axes are stationary Cancelation of this function does not require acknowledgement. This function is not permissible for the EMERGENCY STOP function. **0** = safe operational stop is active. **1** = safe operational stop is not active.
2	RES	Reserved 11 The value **1** must be assigned to the input.
3	RES	Reserved 12 The value **1** must be assigned to the input.
4	RES	Reserved 13 The value **1** must be assigned to the input.
5	RES	Reserved 14 The value **1** must be assigned to the input.
6	RES	Reserved 15 The value **1** must be assigned to the input.
7	SPA	Confirmation of controller shutdown. The system confirms that it has received the shutdown signal. A second after the “SP” signal has been set by the controller, the requested action is executed, without the need for confirmation from the PLC, and the controller shuts down. **0** = confirmation is not active **1** = confirmation is active

Output byte 0

Bit	Signal	Description
0	NHL	Local E-STOP (local E-STOP triggered) **0** = local E-STOP is active **1** = local E-STOP is not active
1	AF	Drives enable (the internal safety controller in the KRC has enabled the drives so that they can be switched on) **0** = drives enable is not active (the robot controller must switch the drives off) **1** = drives enable is active (the robot controller must switch the drives to servo-control)
2	FF	Motion enable (the internal safety controller in the KRC has enabled robot motions) **0** = motion enable is not active (the robot controller must stop the current motion) **1** = motion enable is active (the robot controller may trigger a motion)
3	ZS	One of the enabling switches is in the center position (enabling in test mode) **0** = enabling is not active **1** = enabling is active
4	PE	The signal “Peri enabled” is set to 1 (active) if the following conditions are met: ■ Drives are activated. ■ Safety controller motion enable signal present. ■ The message “Operator safety open” must not be active. (>>> "Signal “Peri enabled” (PE)" Page 33)
5	AUT	The manipulator is in AUT or AUT EXT mode. **0** = AUT or AUT EXT mode is not active **1** = AUT or AUT EXT mode is active
6	T1	The manipulator is in Manual Reduced Velocity mode. **0** = T1 mode is not active **1** = T1 mode is active
7	T2	The manipulator is in Manual High Velocity mode. **0** = T2 mode is not active **1** = T2 mode is active

Output byte 1

Bit	Signal	Description
0	NHE	External E-STOP has been triggered. **0** = external E-STOP is active **1** = external E-STOP is not active
1	BS	Operator safety **0** = operator safety is not assured **1** = operator safety is assured (input BS = 1 and, if configured, input QBS acknowledged)

Bit	Signal	Description
2	SHS1	Safety stop 1 (all axes) **0** = Safety stop 1 is not active **1** = Safety stop 1 is active (safe state reached)
3	SHS2	Safety stop 2 (all axes) **0** = Safety stop 2 is not active **1** = Safety stop 2 is active (safe state reached)
4	RES	Reserved 13
5	RES	Reserved 14
6	PSA	System communication active (display of state of robot controller as CIP Safety bus device) Precondition: EtherNet/IP must be installed on the controller **0** = robot controller on CIP Safety bus is not active **1** = robot controller on CIP Safety bus is active
7	SP	Controller is being shut down (the robot controller announces termination of the CIP Safety connection) If the PLC transmits the SPA signal as confirmation after receiving the SP signal, PSA is set to **0** and the controller is shut down. One second after the SP signal has been set, the PSA output is reset by the robot controller, without confirmation from the PLC, and the controller is shut down. **0** = announcement of termination of connection is not active **1** = announcement of termination of connection is active

Signal “Peri enabled” (PE)

The signal “Peri enabled” is set to 1 (active) if the following conditions are met:

- Drives are switched on.
- Safety controller motion enable signal present.
- The message “Operator safety open” must not be active.
  This message is only active in the modes T1 and T2.

“Peri enabled” in conjunction with the signal “Safe operational stop”

- In the case of activation of the signal “Safe operational stop” during the motion:
  - Error -> braking with Stop 0. “Peri enabled” eliminated.
- Activation of the signal “Safe operational stop” with the manipulator stationary:
  Release the brakes, switch drives to servo-control and monitor for restart. “Peri enabled” remains active.
  - Signal “Motion enable” remains active.
  - US2 voltage (if present) remains active.
  - Signal “Peri enabled” remains active.

“Peri enabled” in conjunction with the signal “Safety stop 2”

- In the case of activation of the signal “Safety stop 2”:
  - Stop 2 of the manipulator.

- Signal “Drive enable” remains active.
- Brakes remain released.
- Manipulator remains under servo-control.
- Monitoring for restart active.
- Signal “Motion enable” is deactivated.
- US2 voltage (if present) is deactivated.
- Signal “Peri enabled” is deactivated.

5.9.3 SafeOperation via CIP Safety (optional)

Information on this topic is contained in the **KUKA.SafeOperation** documentation.

6 Operation

6.1 Coupling/decoupling devices

For certain applications, e.g. tool change, it is necessary to couple and decouple devices. Coupling and decoupling can be carried out via the HMI or in KRL.

Decoupling

Properties of decoupled devices:

- If decoupled devices are disconnected from EtherNet/IP or the power supply, no error is triggered.
- All I/O operations on decoupled devices remain without effect.
- Decoupled devices cannot carry out error treatment in the case of read/write errors.
- The device inputs are set to zero on decoupling.

Coupling

The IOCTL function is executed synchronously. It only returns when the device is functional and can be written to once again.

If a coupled device is not functional, e.g. because it is disconnected from the bus or supply voltage, a message is displayed after a default timeout of 10 s.

Is Active

The option **Is Active** affects the way the robot controller reacts to a decoupled device in the event of a cold start or I/O reconfiguration. The option **Is Active** can be set in the device properties in WorkVisual.

(>>> 5.4.1.2 "Device properties" Page 16)

	Is Active: Enabled	**Is Active**: Disabled
Device coupled	No error message	No error message
Device decoupled	Error message	No error message

6.1.1 Coupling/decoupling devices via the HMI

Procedure

1. Select the menu sequence **Display** > **Variable** > **Single**.
2. In the **Name** box, enter:
   - To decouple: =IOCTL("EIP-SCANNER",60,*[Device number]*)
   - To couple: =IOCTL("EIP-SCANNER",50,*[Device number]*)
3. Confirm by pressing the Enter key. The device is coupled or decoupled.

60 and 50 are IOCTL commands.

Description

[Device number]: The device number is displayed in WorkVisual in the **Number** box in the device properties.

(>>> 5.4.1.2 "Device properties" Page 16)

6.1.2 Coupling/decoupling devices via KRL

Syntax

Decoupling:

```
RET =IOCTL("EIP-SCANNER",60,[Device number])
```

Coupling:

```
RET =IOCTL("EIP-SCANNER",50,[Device number])
```

60 and 50 are IOCTL commands.

Description

[Device number]: The device number is displayed in WorkVisual in the **Number** box in the device properties.

(>>> 5.4.1.2 "Device properties" Page 16)

Return values for RET:

Value	Meaning
0	IOCTL was executed successfully.
1	Timeout
2	IOCTL contains an incorrect parameter.

Examples

Here the device with the number 003 is decoupled, depending on the tool used.

```
...
IF (NEXT_TOOL == GRIPPER_1) THEN
  RET = IOCTL("EIP-SCANNER",60,3)
ENDIF
...
```

The timeout for coupling/decoupling is set by default to 10 s. This default value can be changed. Here the value is set to 5000 ms:

```
RET = IOCTL("EIP-SCANNER",1001,5000)
```

6.2 Enabling/disabling Quick Connect

When a device is coupled or run up, it must reach its operational state as quickly as possible. A normal device can require up to 10 seconds for this. With Quick Connect, the devices reach their operational state in less than a second. This allows tools to be changed more quickly. Quick Connect can be enabled/disabled via the HMI or KRL.

Quick Connect can only be enabled for devices that support Quick Connect.

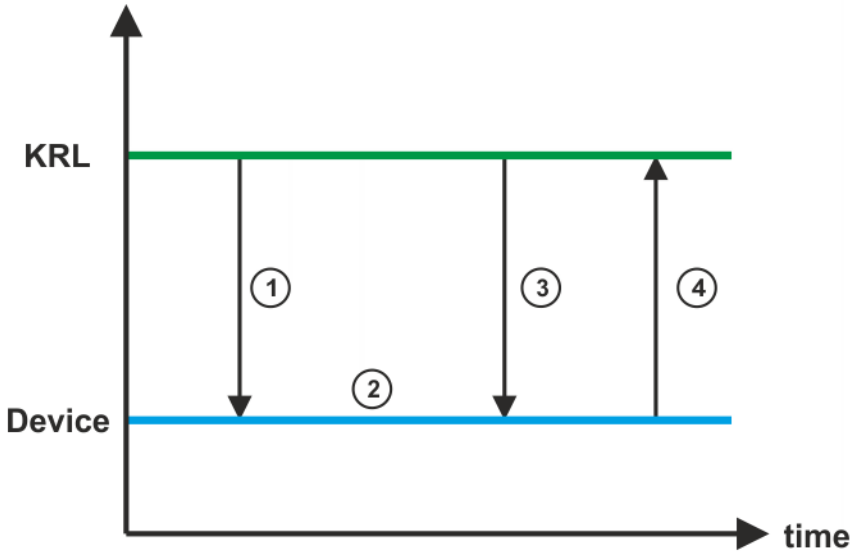

Fig. 6-1: Coupling a device with Quick Connect

Item	Description
1	Switch on device via KRL.
2	Wait time until the device has booted (e.g. 350 ms). **Note**: The time a device requires for booting is specified in the data sheet of the device.
3	Once the wait time has elapsed, send the coupling command to the device.
4	The device sends a message (Coupling successful/Error during coupling).

6.2.1 Enabling/disabling Quick Connect via HMI

Procedure

1. Select the menu sequence **Display** > **Variable** > **Single**.
2. In the **Name** box, enter:
   - To enable: =IOCTL("EIP-SCANNER",1002,*[Device number]*)
   - To disable: =IOCTL("EIP-SCANNER",1003,*[Device number]*)
3. Confirm by pressing the Enter key. Quick Connect is enabled or disabled.

1002 and 1003 are IOCTL commands.

Description

[Device number]: The device number is displayed in WorkVisual in the **Number** box in the device properties.

(>>> 5.4.1.2 "Device properties" Page 16)

6.2.2 Enabling/disabling Quick Connect via KRL

Syntax

Enable:

```
RET =IOCTL("EIP-SCANNER",1002,[Device number])
```

Disable:

```
RET =IOCTL("EIP-SCANNER",1003,[Device number])
```

1002 and 1003 are IOCTL commands.

Description

[Device number]: The device number is displayed in WorkVisual in the **Number** box in the device properties.

(>>> 5.4.1.2 "Device properties" Page 16)

Return values for RET:

Value	Meaning
0	IOCTL was executed successfully.
1	Timeout
2	IOCTL contains an incorrect parameter.

6.3 Resetting the EtherNet/IP driver

Description

A reset of the EtherNet/IP driver can be carried out via the smartHMI. A reset causes all driver files to be reloaded. Changes made in these files are applied.

EtherNet/IP scanner and EtherNet/IP adapter have separate Reset buttons. If one of the buttons is pressed, however, the reset is carried out for both the scanner and the adapter.

Precondition

- EtherNet/IP scanner and/or adapter are configured and wired.
- “Expert” user group

Procedure

1. In the main menu, select **Configuration** > **Inputs/outputs** > **I/O drivers**.
2. Select the **State** tab and press **Reset** in the **Actions** column.

7 Diagnosis

7.1 Displaying diagnostic data

> The diagnostic data can also be displayed in WorkVisual. Information about procedures in WorkVisual is contained in the WorkVisual documentation.

Procedure

1. Select **Diagnosis** > **Diagnostic monitor** in the main menu.
2. Select the desired module in the **Module** box.
   Diagnostic data are displayed for the selected module.

Description

Diagnostic data can be displayed for the following modules:

- **EtherNet/IP scanner (EIP-SCANNER)**
- **EtherNet/IP adapter (EIP-ADAPTER)**
- **EtherNet/IP device (scanner device (device name))**
- **EtherNet/IP local slave (local slave (name))**
- **EtherNet/IP local safety slave (CIP Safety)**
- **EtherNet/IP I/O driver (EIPIODRIVER)**

7.1.1 EtherNet/IP scanner (EIP-SCANNER)

Name	Description
Input size [Bytes]	Input size of the I/O map of the scanner in bytes
Output size [Bytes]	Output size of the I/O map of the scanner in bytes
Scanner bus error counter	Number of bus errors of the scanner
Asynchronous data	Applications that can exchange asynchronous data with the EtherNet/IP driver

7.1.2 EtherNet/IP adapter (EIP-ADAPTER)

Name	Description
Input size [Bytes]	Input size of the I/O map of the adapter in bytes
Output size [Bytes]	Output size of the I/O map of the adapter in bytes
Adapter bus error counter	Number of bus errors of the adapter
Asynchronous data	Applications that can exchange asynchronous data with the EtherNet/IP driver
Scanner bus error bit	Status bit that is sent to the PLC in the event of a bus error

7.1.3 EtherNet/IP device

Name	Description
Device name	Name of the device
Device ID	ID of the device
IP	IP address of the device
Device activated	■ **TRUE**: The setting was made during configuration that the device should be coupled during start-up. ■ **FALSE**: The setting was made during configuration that the device should not be coupled during start-up.

Name	Description
HMI Message number	Internal HMI message number of the displayed message
Diagnose connection active	■ **1**: Diagnosis is active. ■ **0**: Diagnosis is not active.
Connection error counter	Number of connection errors
Connection-ID	EtherNet/IP connection number
Connection type	■ **IO_CONNECTION**: Cyclical connection (Rack Optimized, Direct Input Only or Exclusive Owner) ■ **CONFIGURATION_CONNECTION**: Only for EtherNet/IP management tasks
Input size [Bytes]	Input size of the I/O map of the connection in bytes
Output size [Bytes]	Output size of the I/O map of the connection in bytes
Connection activated	■ **1**: Connection has been activated. ■ **0**: Connection has not been activated.
Connection state (Health-Bit)	■ **1**: Connection OK ■ **0**: Connection terminated
Input state	■ **0**: Connection OK ■ **33**: Timeout receiving data ■ **53**: Connection active, but no data evaluated. ■ **54**: Connecting, but no I/O data received yet. ■ **58**: No connection (TCP) ■ **65**: No connection (CIP) ■ **68**: Connecting ■ **70**: No connection (EPIC) ■ **77**: Connection terminated **Note:** Further information about the causes of status **54**, **65**, **68** and **70** can be found in the specifications of the Common Industrial Protocol.
Output state	
EIP Production packet counter	Number of data packets sent via this connection.
EIP Consumption packet counter	Number of data packets received via this connection.
CIP Status	■ **0**: No error **Note:** The description of the other values can be found in the specifications of the Common Industrial Protocol.
Extended Status	
CCO Status General	
CCO Status Reserved	
CCO Status Extended	
Production Connection ID	Internal connection IDs
Consumption Connection ID	
Originator-Target API [µs]	Real refresh rate of the Originator-Target connection
Target-Originator API [µs]	Real refresh rate of the Target-Originator connection
Originator-Target RPI [µs]	Configured refresh rate of the Originator-Target connection
Target-Originator RPI [µs]	Configured refresh rate of the Target-Originator connection

7.1.4 Ethernet/IP local slave

Name	Description
Name of local slave	Name of the local slave
Local slave ID	ID of the local slave
Connection-ID	EtherNet/IP connection number

Name	Description
Scanner bus error bit active	■ **1**: The local slave monitors the errors in the EtherNet/IP scanner and signals them to the PLC. ■ **0**: No monitoring/signaling by the local slave.
Input size [Bytes]	Input size of the I/O map of the local slave in bytes
Output size [Bytes]	Output size of the I/O map of the local slave in bytes
Input state	■ **0**: Connection OK ■ **33**: No connection ■ **53**: Connection active, but no data evaluated. ■ **54**: Connecting, but no I/O data received yet. **Note:** Further information about the causes of status **33** can be found in the specifications of the Common Industrial Protocol.
Output state	
Connection state (Health-Bit)	■ **1**: Connection OK ■ **0**: Connection terminated
HMI Message number	Internal HMI message number of the displayed message
EIP Production packet counter	Number of data packets sent via this connection.
EIP Consumption packet counter	Number of data packets received via this connection.
CIP Status	■ **0**: No error **Note:** The description of the other values can be found in the specifications of the Common Industrial Protocol.
Extended Status	
ASM Status General	
ASM Status Reserved	
ASM Status Extended	
Production Connection ID	Internal connection IDs
Consumption Connection ID	
Originator-Target API [µs]	Real refresh rate of the Originator-Target connection.
Target-Originator API [µs]	Real refresh rate of the Target-Originator connection.
Originator-Target RPI [µs]	Configured refresh rate of the Originator-Target connection.
Target-Originator RPI [µs]	Configured refresh rate of the Target-Originator connection.
Diagnose connection active	■ **1**: Diagnosis is active. ■ **0**: Diagnosis is not active.

7.1.5 Ethernet/IP local safety slave

Name	Description
CIP Safety Slave-ID	ID of the local safety slave
Input data length	Input size of the I/O map of the local safety slave in bytes
Output data length	Output size of the I/O map of the local safety slave in bytes
IO-Consumption packet counter	Number of data packets received via this connection.
IO-Production packet counter	Number of data packets sent via this connection.
IO-Consumption error counter	Number of faulty data packets received via this connection.
IO-Production error counter	Number of faulty data packets sent via this connection.
OT Connection-ID error counter	Number of faulty Originator-Target connection IDs
TO Connection-ID error counter	Number of faulty Target-Originator connection IDs

Name	Description
Input buffer run state	■ **Initializing**: Buffer is being initialized ■ **OK**: Buffer is OK and data exchange is functioning correctly ■ **Error**: See error code **Note:** The error codes are to be found under **Input buffer error code**.
Input buffer error code	■ **No error**: No error present ■ **Invalid pointer**: The offsets of the data in the buffer are invalid. ■ **Size of data too large**: The IO data packet exceeds the permissible data length.
Output buffer run state	■ **Initializing**: Buffer is being initialized ■ **OK**: Buffer is OK and data exchange is functioning correctly ■ **Error**: See error code **Note:** The error codes are to be found under **Output buffer error code**.
Output buffer error code	■ **No error**: No error present ■ **Invalid pointer**: The offsets of the data in the buffer are invalid. ■ **Size of data too large**: The IO data packet exceeds the permissible data length.
CIP Safety State	■ **OFFLINE**: CIP Safety stack has not been started. ■ **ONLINE**: CIP Safety stack has been initialized.
CIP Safety Supervisor State	**Note:** The description of the states can be found in the specification “THE CIP NETWORKS LIBRARY, Volume 5 CIP Safety”.
SNN Date	Date of the Safety Network Numbers **Note:** Further information can be found in the specification “THE CIP NETWORKS LIBRARY, Volume 5 CIP Safety”.
SNN Time	Time of the Safety Network Numbers **Note:** Further information can be found in the specification “THE CIP NETWORKS LIBRARY, Volume 5 CIP Safety”.
Module LED State	**Note:** The description of the states can be found in the specification “THE CIP NETWORKS LIBRARY, Volume 5 CIP Safety”.
Network LED State	**Note:** The description of the states can be found in the specification “THE CIP NETWORKS LIBRARY, Volume 5 CIP Safety”.
Input connection state	■ **Not allocated**: CIP Safety connection is not initialized. ■ **Initializing**: CIP Safety connection is being initialized. ■ **Established**: CIP Safety connection is functioning correctly. ■ **Lost**: CIP Safety connection has been terminated.

Name	Description
Output connection state	■ **Not allocated**: CIP Safety connection is not initialized. ■ **Initializing**: CIP Safety connection is being initialized. ■ **Established**: CIP Safety connection is functioning correctly. ■ **Lost**: CIP Safety connection has been terminated.
Diagnose connection active	■ **1**: Diagnosis is active. ■ **0**: Diagnosis is not active.

7.1.6 EtherNet/IP I/O driver (EIPIODRIVER)

Name	Description
EIPIODriver	Name of the driver
IP	Data from the network configuration of EtherNet/IP
Subnet mask	
Gateway	
MAC address	Address of the network adapter via which the EtherNet/IP communicates with scanners, devices, etc.
Network interface name	Name of the network interface
Network interface number	Number of the network interface
Stack version	Version of the software stack
User version	Version of the KUKA driver
Stack state	■ **NON_EXISTENT, IDLE**: Ethernet/IP stack has not been initialized. ■ **OFFLINE, IDLE**: Ethernet/IP stack has been initialized and configured. ■ **ONLINE, IDLE**: Ethernet/IP stack has opened all communication channels. ■ **IO_RUNNING, IDLE**: Ethernet/IP stack has been started; outputs are not being set. ■ **IO_RUNNING, RUN**: Ethernet/IP stack has been started; inputs and outputs are being set.
IO Production packet counter	Number of data packets that have been sent.
IO Consumption packet counter	Number of data packets that have been received.
IO Production packet errors	Number of faulty data packets that have been sent.
IO Consumption packet errors	Number of faulty data packets that have been received.
Explicit message transmission counter	Number of messages sent with the existing connection.
Explicit message receive counter	Number of messages received with the existing connection.
UCMM transmission counter	Number of messages sent without an existing connection.
UCMM receive counter	Number of messages received without an existing connection.
Diagnostic flag	■ **1**: Diagnosis is active. ■ **0**: Diagnosis is not active.

7.2 Advanced device diagnosis

There is an additional option for diagnosis of EtherNet/IP devices in WorkVisual.

Precondition

- The device to be diagnosed is connected and active.

Procedure

- Right-click on the device in the tree structure and select **Diagnosis...** from the context menu.

  A window opens. Local slaves, devices and the connection type are displayed in the tree structure.

Description

Every element in the tree structure has an icon that indicates the status of the connection:

- **Green icon:** Connection OK
- **Red icon:** An error has occurred

Clicking on an element in the tree structure displays the following tabs:

- Device: **Ethernet Diagnostic**
- Local slave: **Local Slave Diagnostic**; **I/O Values**
- Connection type: **EIP Connection Diagnostic**; **I/O Values**

Various diagnostic data are displayed on the **Ethernet Diagnostic**, **Local Slave Diagnostic** and **EIP Connection Diagnostic** tabs. Information on the data is displayed in the **Description** box by clicking on them.

The I/O data are shown in hexadecimal notation on the **I/O Values** tab. This allows errors in the I/O mapping to be detected. The length and status of the I/O data are also displayed.

If the check box **Refresh every 500 ms** is activated, the diagnostic data are refreshed at intervals of 500 ms.

8 Messages

Message number / ID / type	Message text / cause
13063 / M_EIP_BUSXML Status message	*Error reading [name of configuration file]* Cause: The configuration file contains errors.
13065 / M_EIP_CFG_ERROR Status message	*Error configuring EthernetIP stack with the file [name of configuration file]* Cause: The binary configuration file contains errors.
13071 / M_EIP_CHG_IP Notification message	*EIP I/O driver will modify the configuration of the KLI and restart the EIP stack*
13069 / M_EIP_CHG_IP_FAIL Status message	*Error on modification of the IP configuration of the KLI and restart of the EIP stack* Cause: IP configuration could not be modified.
13070 / M_EIP_CHG_IP_OK Notification message	*EIP I/O driver has modified the configuration of the KLI and started the EIP stack*
13073 / M_EIP_ERROR_IP Status message	*EIP I/O driver cannot determine the IP address of the KLI* Possible causes: ■ KLI is not configured. ■ DHCP is active, but no IP configuration from the DHCP is available yet.
13072 / M_EIP_ERROR_MAC Status message	*EIP I/O driver cannot determine the MAC address of the KLI* Cause: KLI is not configured or is incorrectly configured.
13074 / M_EIP_ERROR_SUBNET Status message	*EIP I/O driver cannot determine the subnet mask of the KLI* Possible causes: ■ KLI is not configured. ■ DHCP is active, but no IP configuration from the DHCP is available yet.
13064 / M_EIP_INIT_ERROR Status message	*EthernetIP stack cannot be set to Offline state* Cause: KLI is incorrectly configured or there is no IP configuration.
13066 / M_EIP_ONLINE_ERROR Status message	*EthernetIP stack cannot be set to Online state* Cause: KLI is incorrectly configured or the bus configuration is incorrect.
13067 / M_EIP_START_ERROR Status message	*EthernetIP stack cannot be set to Running state* Cause: KLI is incorrectly configured or the bus configuration is incorrect.
10047 / M_EIP_ADT_ERROR Status message	*Connection between PLC and [device name] terminated.* Possible causes: ■ Power supply and/or network connection was interrupted. ■ Performance problems (number of devices, cycle times). **Note:** This message is only displayed during operation.

Message number / ID / type	Message text / cause
10046 / M_EIP_ADTSTART_ERROR Status message	*Timeout establishing connection between PLC and [device name]* Possible causes: ■ Power supply and/or network connection was interrupted. ■ Performance problems (number of devices, cycle times). **Note:** This message is only displayed after a cold start.
10053 / M_EIP_CONN_ERROR Status message	*Connection ID [ID number] (Slot [slot number]) to EIP device [device name] terminated* Cause: Power supply and/or network connection was interrupted.
10054 / M_EIP_CONNSTART_ERROR Status message	*Timeout establishing connection ID [ID number] (Slot [slot number]) to EIP device [device name]* Possible causes: ■ Power supply and/or network connection was interrupted. ■ Performance problems (number of devices, cycle times).
10045 / M_EIP_DEV_ERROR Status message	*Connection to EIP device [device name] terminated* Cause: Power supply and/or network connection was interrupted.
10043 / M_EIP_DEVSTART_ERROR Status message	*Timeout establishing connection to EIP device [device name]* Possible causes: ■ Power supply and/or network connection was interrupted. ■ Performance problems (number of devices, cycle times).

9 KUKA Service

9.1 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

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.

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