

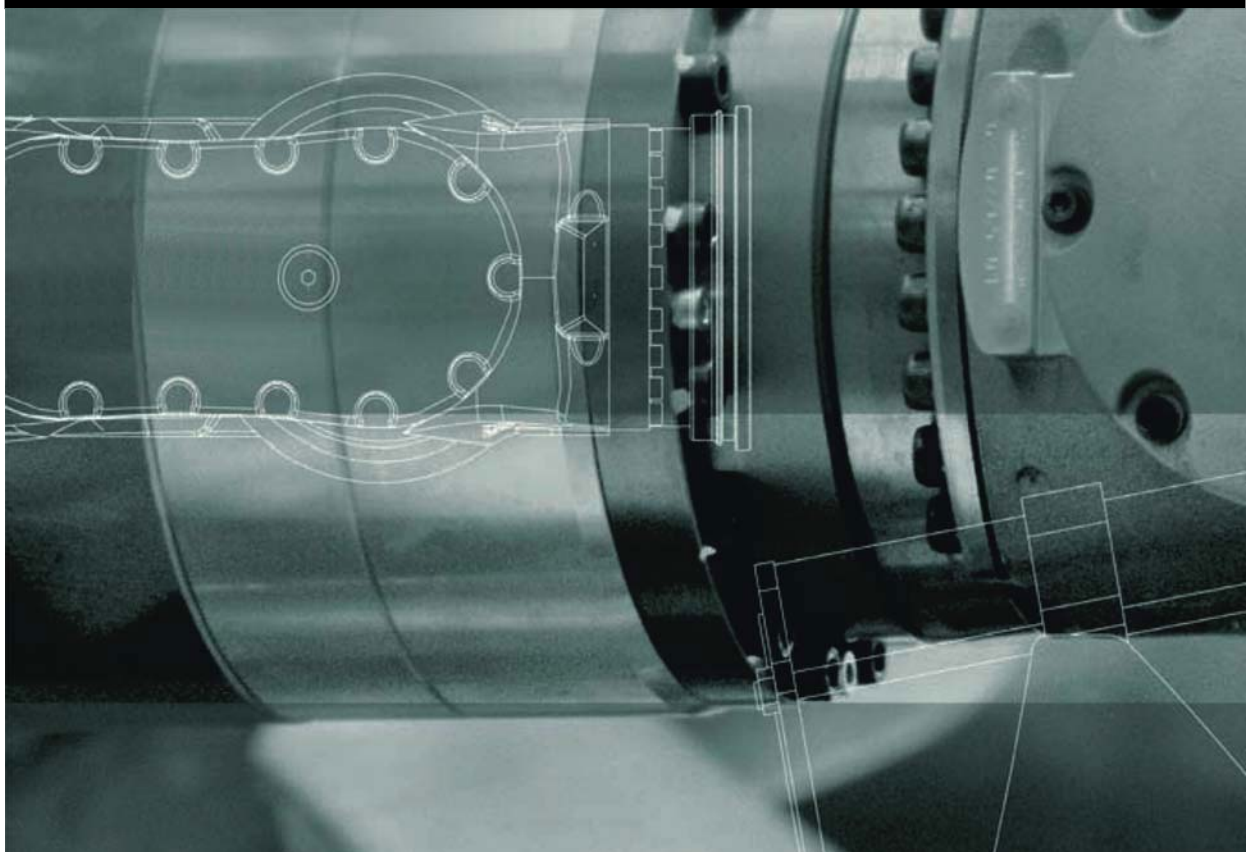
**Controller Option**

KUKA Roboter GmbH

## **KR C4 PROFINET 2.2**

**For KUKA System Software 8.2**

**For VW System Software 8.2**



Issued: 08.05.2012

Version: KR C4 PROFINET 2.2 V5 en

© Copyright 2012

KUKA Roboter GmbH  
Zugspitzstraße 140  
D-86165 Augsburg  
Germany

This documentation or excerpts therefrom may not be reproduced or disclosed to third parties without the express permission of KUKA Roboter GmbH.

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

KIM-PS5-DOC

Publication:	Pub KR C4 PROFINET 2.2 en
Bookstructure:	KR C4 PROFINET 2.2 V3.1
Version:	KR C4 PROFINET 2.2 V5 en

# Contents

<b>1</b>	<b>Introduction</b>	<b>5</b>
1.1	Target group	5
1.2	Industrial robot documentation	5
1.3	Representation of warnings and notes	5
1.4	Trademarks	5
1.5	Terms used	6
<b>2</b>	<b>Product description</b>	<b>7</b>
<b>3</b>	<b>Safety</b>	<b>9</b>
<b>4</b>	<b>Installation</b>	<b>11</b>
4.1	System requirements	11
4.2	Routing the data cables	11
4.3	Installing or updating PROFINET (KSS)	11
4.4	Installing PROFINET (VSS)	12
4.5	Uninstalling PROFINET (KSS)	12
<b>5</b>	<b>Configuration</b>	<b>13</b>
5.1	Overview	13
5.2	Configuring the record index	13
5.3	Making GSDML files available for configuration with WorkVisual	14
5.4	Making GSDML files available for configuration with Step 7 / PC WORX	14
5.5	Naming the device	15
5.5.1	Identifying the device	15
5.5.2	Resetting the device configuration to factory settings	16
5.6	Configuring the bus with WorkVisual	16
5.6.1	Configuring PROFINET Controller	16
5.6.1.1	Device settings	17
5.6.1.2	Activating fast startup	19
5.6.1.3	Reducing the amount of configuration work	20
5.6.2	Configuring a PROFINET device	21
5.6.2.1	“Communication settings” tab	22
5.6.2.2	Device Diagnostic tab	23
5.6.2.3	“PROFenergy” tab	24
5.7	Configuring the bus with Step 7 or PC WORX	25
5.8	Mapping inputs/outputs in WorkVisual	26
5.9	Safety interface via PROFIsafe (optional)	27
5.9.1	Safety functions via PROFIsafe (KR C4)	27
5.9.2	Safety functions via PROFIsafe (VKR C4)	32
5.9.3	Schematic circuit diagram of PROFIsafe enabling switch	36
5.9.4	SafeOperation via PROFIsafe (optional)	37
5.9.5	Power management via PROFINET	37
5.9.6	Logging off the higher-level safety controller	37
<b>6</b>	<b>Operation</b>	<b>41</b>
6.1	Coupling/decoupling devices	41
6.1.1	Coupling/decoupling devices via the HMI	41
6.1.2	Coupling/decoupling devices via KRL	41

6.2	PROFenergy commands .....	42
<b>7</b>	<b>Programming</b> .....	<b>45</b>
7.1	Acyclic communication .....	45
7.1.1	Acyclic data to the devices (controller ring) .....	45
7.1.2	Acyclic data to the higher-level controller (device ring) .....	46
7.2	Example of acyclic communication .....	47
<b>8</b>	<b>Diagnosis</b> .....	<b>49</b>
8.1	Displaying diagnostic data .....	49
8.1.1	Profinet Controller Stack (PNIO-CTRL) .....	49
8.1.2	Profinet Device Stack (PNIO-DEV) .....	50
8.1.3	Profinet Device .....	52
8.1.4	Profinet IO Driver (PNIODriver) .....	52
8.1.5	PROFenergy (PROFenergy) .....	53
8.2	Diagnostic signals via PROFINET .....	54
<b>9</b>	<b>Messages</b> .....	<b>55</b>
<b>10</b>	<b>KUKA Service</b> .....	<b>57</b>
10.1	Requesting support .....	57
10.2	KUKA Customer Support .....	57
	<b>Index</b> .....	<b>65</b>

# 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 Step 7 from Siemens or PC WORX from Phoenix Contact

## 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.

 <b>DANGER</b>	These warnings mean that it is certain or highly probable that death or severe physical injury <b>will</b> occur, if no precautions are taken.
---	--

 <b>WARNING</b>	These warnings mean that death or severe physical injury <b>may</b> occur, if no precautions are taken.
--	---


 <b>CAUTION</b>	These warnings mean that minor physical injuries <b>may</b> occur, if no precautions are taken.
--	---

<b>NOTICE</b>	These warnings mean that damage to property <b>may</b> 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.
---	--

### 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.

**Step 7** are trademarks of Siemens AG.

**PC WORX** is a trademark of Phoenix Contact.

## 1.5 Terms used

Term	Description
GSDML	Device description file for PROFINET
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.
PC WORX	Configuration software from Phoenix Contact
PLC	Programmable logic controller
Step 7	Configuration software from Siemens
IRT	Isochronous Real Time Cycle-synchronous communication
CBA	Component Based Automation Component-based automation
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

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

PROFINET is installed on the robot controller.


<b>Compatibility</b>	<p>KR C4 PROFINET 2.2 is compatible with the following field buses:</p> <ul style="list-style-type: none"> <li>■ KR C4 PROFIBUS</li> <li>■ KR C4 PROFIBUS CP 5614 1.0</li> <li>■ KR C4 Interbus 1.0</li> <li>■ KR C4 EtherCAT</li> </ul>
<b>Restrictions</b>	<p>Only PROFINET IO Class A, Fast Startup and PROFIsafe Device are supported.</p> <p>The following device classes / functions are not supported, for example:</p> <ul style="list-style-type: none"> <li>■ PROFINET IO Class B</li> <li>■ PROFINET IO Class C (includes the function IRT)</li> <li>■ PROFINET CBA</li> <li>■ PROFIsafe Controller</li> <li>■ Profiles, e.g. PROFIdrive</li> <li>■ Gateway devices (for converting PROFIBUS to other field buses)</li> </ul>
<b>Configuration software</b>	<p>PROFINET is configured on a laptop or PC. The following software is required for configuration:</p> <ul style="list-style-type: none"> <li>■ WorkVisual 2.3 or higher</li> <li>■ Depending on the selected procedure, additional configuration software may be required: <ul style="list-style-type: none"> <li>■ Step 7 from Siemens</li> <li>■ Or PC WORX from Phoenix Contact</li> </ul> </li> </ul> <p>The following software is required for configuring the higher-level controller:</p> <ul style="list-style-type: none"> <li>■ Step 7 from Siemens</li> </ul>
<b>Device types</b>	<p>The following device types are used with PROFINET:</p> <ul style="list-style-type: none"> <li>■ Controller: A higher-level controller that controls all the components of a system.</li> <li>■ Device: A field device subordinated to a controller. A device consists of a number of modules and submodules.</li> <li>■ Supervisor: Can be a programming device or industrial PC. Parallel to the controller, this has access to all process and parameter files.</li> </ul> <p>The 3 device types have relationships for transferring configuration data and process data.</p> <p>A physical device, e.g. the robot controller, can be a controller and/or a device. The configuration of communication relationships is carried out solely in the controller.</p>
<b>PROFInergy</b>	<p>PROFInergy enables control of the energy consumption via a PROFINET network. For this, commands are used by means of which the energy-consuming devices react to planned and unplanned interruptions.</p> <p>The PROFINET device supports PROFInergy. If PROFInergy is used, the robot controller communicates with the higher-level controller via the PROFInergy protocol.</p>





### 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 physical injuries or considerable damage to property may otherwise result.



## 4 Installation

### 4.1 System requirements

#### Robot controller

##### Hardware:

- KR C4

##### Software:

- KUKA System Software 8.2
- Or VW System Software 8.2

#### Laptop/PC

- The requirements for installation of WorkVisual are contained in the WorkVisual documentation.
- The requirements for installation of Step 7 or PC WORX are contained in the documentation for this software.

### 4.2 Routing the data cables

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

### 4.3 Installing or updating PROFINET (KSS)

#### Description

There are two option CDs for PROFINET:

- **KUKA.ProfiNet Controller / Device:** includes **PROFINET IO Controller**, **PROFINET IO Device** and **ProfiSafe Device**.
- **KUKA.ProfiNet Device:** includes **PROFINET IO Device** and **ProfiSafe Device**.



If a version of PROFINET 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 > Install additional software**.
3. Press **New software**. The entry **Profinet KRC-Nexxt** 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 **Profinet KRC-Nexxt** 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 Installing PROFINET (VSS)

PROFINET is included in VSS 8.2. It includes **PROFINET IO Controller**, **PROFINET IO Device** and **ProfiSafe Device**.

To install PROFINET, the relevant check box must be activated during the set-up for VSS 8.2.

#### 4.5 Uninstalling PROFINET (KSS)



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 > Install additional software**.
2. Select the entry **Profinet KRC-Nexxt** 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 Step 7. (>>> 5.2 "Configuring the record index" Page 13) <b>Note:</b> This step only needs to be carried out if a higher-level controller is being used.
2	Make GSDML files available. <ul style="list-style-type: none"> <li>■ For configuration with WorkVisual (&gt;&gt;&gt; 5.3 "Making GSDML files available for configuration with WorkVisual" Page 14)</li> <li>■ For configuration with Step 7 or PC WORX (&gt;&gt;&gt; 5.4 "Making GSDML files available for configuration with Step 7 / PC WORX" Page 14)</li> </ul>
3	Name the devices. (>>> 5.5 "Naming the device" Page 15)
4	Configure PROFINET. <ul style="list-style-type: none"> <li>■ Configure the bus with WorkVisual. (&gt;&gt;&gt; 5.6 "Configuring the bus with WorkVisual" Page 16)</li> <li>■ Or: Configure the bus with Step 7 or PC WORX. (&gt;&gt;&gt; 5.7 "Configuring the bus with Step 7 or PC WORX" Page 25)</li> </ul>
5	Map the inputs and outputs in WorkVisual. (>>> 5.8 "Mapping inputs/outputs in WorkVisual" Page 26)
6	Transfer the bus configuration from WorkVisual to the robot controller.
7	Reboot the robot controller. <b>Note:</b> If a change has been made in the <b>Profinet version</b> box on the <b>Communication settings</b> tab, the robot controller must be rebooted with the following settings: <ul style="list-style-type: none"> <li>■ With a cold start</li> <li>■ With the option <b>Reload files</b></li> </ul>
8	Safety interface via PROFIsafe (optional) (>>> 5.9 "Safety interface via PROFIsafe (optional)" Page 27)



Information about procedures in WorkVisual is contained in the WorkVisual documentation. Information about procedures in Step 7 or PC WORX can be found in the documentation for this software.

### 5.2 Configuring the record index

The following must be observed when configuring the higher-level controller:

The record index range that is not already reserved for PROFINET must, in part, be reserved for KUKA. The user must reserve this range when configuring the record index.

The record index has 16 bits.

Range	Description	
0x0000 to 0x7FFF	For adaptation by the user	
	0x[..]00 to 0x[..]FF	The range [...] is freely available to the user for adaptation.
	0x00[...] to 0x7F[...]	Range used by KUKA. In the range [...], the user must enter "00". <b>Note:</b> Do not enter "80". 00 = acyclic data of the KUKA robot controller (KR C) 80 = PROFI-safe F parameter
0x8000 to 0xFFFF	Reserved by PROFINET. It cannot be influenced by the user.	

### 5.3 Making GSDML files available for configuration with WorkVisual

If a device is to be configured with WorkVisual, WorkVisual requires the GSDML file for this device. The GSDML file must be obtained from the manufacturer of the device.


**Precondition** ■ There is no project open.

- Procedure**
1. Select the menu sequence **File > Import / Export**.  
The **Import/Export Wizard** window is opened.
  2. Select **Import device description file** and click on **Next >**.
  3. Click on **Browse...** and specify a directory.
  4. Confirm with **Next >**.  
A list is displayed of the devices that are to be imported.
  5. Click on **Finish**.  
The devices are imported.
  6. Close the **Import/Export Wizard** window.

### 5.4 Making GSDML files available for configuration with Step 7 / PC WORX

**Description** If a KUKA robot controller is added as a device in Step 7 or PC WORX, this software requires the GSDML file for the KUKA robot controller. A distinction must be made between whether the robot controller is running KSS 8.2 or VSS 8.2.


- Procedure**
1. Copy the GSDML file of the KUKA robot controller.  
The file can be found on the WorkVisual CD-ROM, in the following directory: DeviceDescriptions\GSDML
    - For KSS 8.2: [...]KUKA-Roboter-GmbH-KRC-nexxt-Device[...]
    - For VSS 8.2: [...]KUKA-Roboter-GmbH-VKRC-nexxt-Device[...]
  2. Insert the file in Step 7 or PC WORX.  
If, until now, a file for KSS 8.1 or VSS 8.1 has been used, it is not necessary to delete it.

 If, until now, a file for KSS 8.1 or VSS 8.1 has been used, the following setting must be made in WorkVisual: Select the entry **v8.2** in the **Profinet version** box on the **Communication settings** tab.  
(>>> 5.6.2.1 "Communication settings" tab" Page 22)

## 5.5 Naming the device

**Description** A PROFINET device is delivered without a name. In order to be able to use the device, it must first be assigned a unique name. This procedure is referred to as "Device naming".

It is advisable to assign a logical name to the device. For example, if the device belongs to a certain tool, this should be obvious from the name.

 As an alternative to the procedure in WorkVisual, the device can be renamed in Step 7 or any other software with a device naming function.


**NOTICE** The following address ranges are used by default by the robot controller for internal purposes. IP addresses from this range must not therefore be assigned when naming the device. This applies to naming of the device with WorkVisual or any other software.

- 192.168.0.0 ... 192.168.0.255
- 172.16.0.0 ... 172.16.255.255
- 172.17.0.0 ... 172.17.255.255

**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 **PROFINET** in the **Name** column and confirm with **OK**. The entry is inserted in the tree structure.
4. Right-click on **PROFINET** in the tree structure and select **Settings** from the context menu.
5. A window opens. Select the **Communication settings** tab.  
(>>> Fig. 5-6 )
6. Select the network adapter and confirm with **OK**.
7. Right-click on **PROFINET** and select **Connect** from the context menu.
8. Right-click on **PROFINET** and select **Functions > Device list and PROFINET names...** from the context menu.  
A window opens. The **Available devices** tab is displayed.
9. Double-click on the name of the desired device and change the name.

 Do not use spaces or special characters.

10. If required: Assign an IP address to the device.

The device will subsequently be assigned an IP address by the robot controller. This will cause the address assigned here to be overwritten. It may nonetheless be useful to assign the device an address here, e.g. for diagnostic purposes, as it is not otherwise possible to communicate with the device.

11. Save the changes with **Name devices**.

### 5.5.1 Identifying the device

**Precondition**

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

- Procedure**
1. Expand the tree structure of the robot controller on the **Hardware** tab in the **Project structure** window.
  2. Right-click on **PROFINET** and select **Functions > Device list and PROFINET names...** from the context menu.  
A window opens. The **Available devices** tab is displayed.
  3. Select the desired device and click on **Signal**.  
The device flashes.
  4. To stop the flashing, click on **Stop signaling**.

### 5.5.2 Resetting the device configuration to factory settings

- Precondition**
- A robot controller has been added and set as active.
  - The **PROFINET** node is inserted into the bus structure and linked.

- Procedure**
1. Expand the tree structure of the robot controller on the **Hardware** tab in the **Project structure** window.
  2. Right-click on **PROFINET** and select **Functions > Device list and PROFINET names** from the context menu.  
A window opens. The **Available devices** tab is displayed.
  3. Select the desired device and click on **Reset**.
  4. Answer the request for confirmation with **Yes**.  
The configuration of the device is reset to the factory settings.

## 5.6 Configuring the bus with WorkVisual

### 5.6.1 Configuring PROFINET Controller

- Precondition**
- A robot controller has been added and set as active.
  - The **PROFINET** 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 **PROFINET IO** 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.

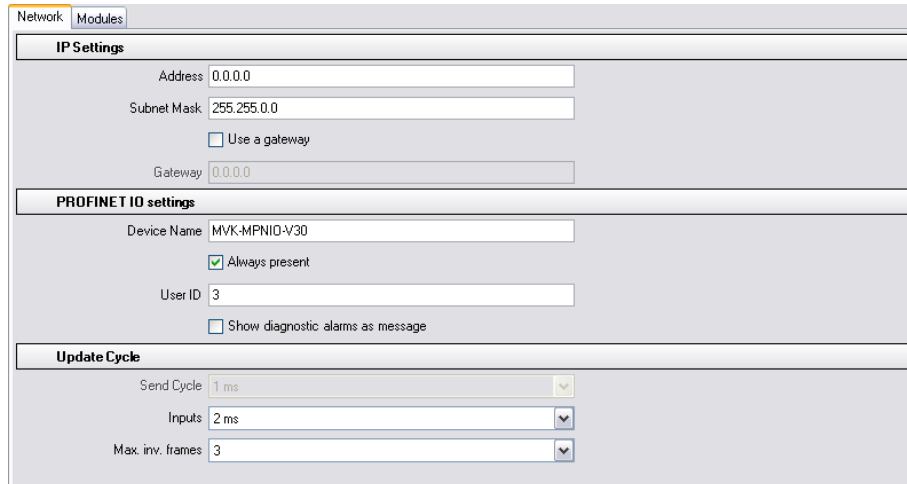
<b>NOTICE</b>	The inserted device must correspond to the actual device used in reality. Substantial damage to property may otherwise result.
---------------	--

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.  
On the **Network** tab, fill out the following boxes:
  - **IP address; Subnet mask; Use a gateway; Gateway**
  - **Device name; Always available; User ID; Display diagnostic alarm as message**
 (>>> 5.6.1.1 "Device settings" Page 17)
5. The **Modules** tab displays the slots on the device. Assign the slots to the modules used.
6. If necessary, repeat steps 4 to 7 for further devices.
7. Save the device data with **OK**.



### 5.6.1.1 Device settings

#### Network settings



The screenshot shows the 'Network' configuration tab with the following settings:

- IP Settings:**
  - Address: 0.0.0.0
  - Subnet Mask: 255.255.0.0
  - Use a gateway
  - Gateway: 0.0.0.0
- PROFINET IO settings:**
  - Device Name: MVK-MPNIO-V30
  - Always present
  - User ID: 3
  - Show diagnostic alarms as message
- Update Cycle:**
  - Send Cycle: 1 ms
  - Inputs: 2 ms
  - Max. inv. frames: 3

Fig. 5-1: Network tab

Box	Description
<b>IP address</b>	Enter the IP address of the device.
<b>Subnet mask</b>	The controller is delivered with the subnet mask 255.255.0.0 set; that is why this address is already entered. If the subnet mask has been changed, enter the changed address.
<b>Use a gateway</b>	<ul style="list-style-type: none"> <li>■ <b>Activated:</b> A gateway is used.</li> <li>■ <b>Deactivated:</b> No gateway is used.</li> </ul>
<b>Gateway</b>	Enter the IP address of the gateway. The address only needs to be entered if a gateway is to be used.
<b>Device name</b>	Enter the name of the device. This must be identical with the name assigned during the naming of the device.
<b>Always available</b>	<ul style="list-style-type: none"> <li>■ <b>Activated:</b> 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.</li> <li>■ <b>Deactivated:</b> The robot controller does not check whether the device is active when the controller boots up.</li> </ul>
<b>User ID</b>	Enter the ID of the device. The ID must not be less than 2.
<b>Display diagnostic alarm as message</b>	<ul style="list-style-type: none"> <li>■ <b>Activated:</b> Diagnostic messages are displayed in the message window of the KUKA smartHMI.</li> <li>■ <b>Deactivated:</b> No diagnostic messages are displayed in the message window of the KUKA smartHMI.</li> </ul>

Box	Description
<b>Update time</b>	<p>Enter the update time.</p> <p>Update time: The current I/O data are exchanged between the robot controller and the devices every x ms.</p> <p><b>Note:</b> The lower the value for the update time, the greater the CPU utilization.</p> <p>The PROFINET reaction time is the sum of the bus cycle time and the update time. This calculation does not take into account the reaction times of the applications which need these data (e.g. submit interpreter).</p>
<b>Max. invalid frames</b>	<p>Enter the maximum number of data packets that may be lost before the robot controller generates an error message.</p>

Slot configuration

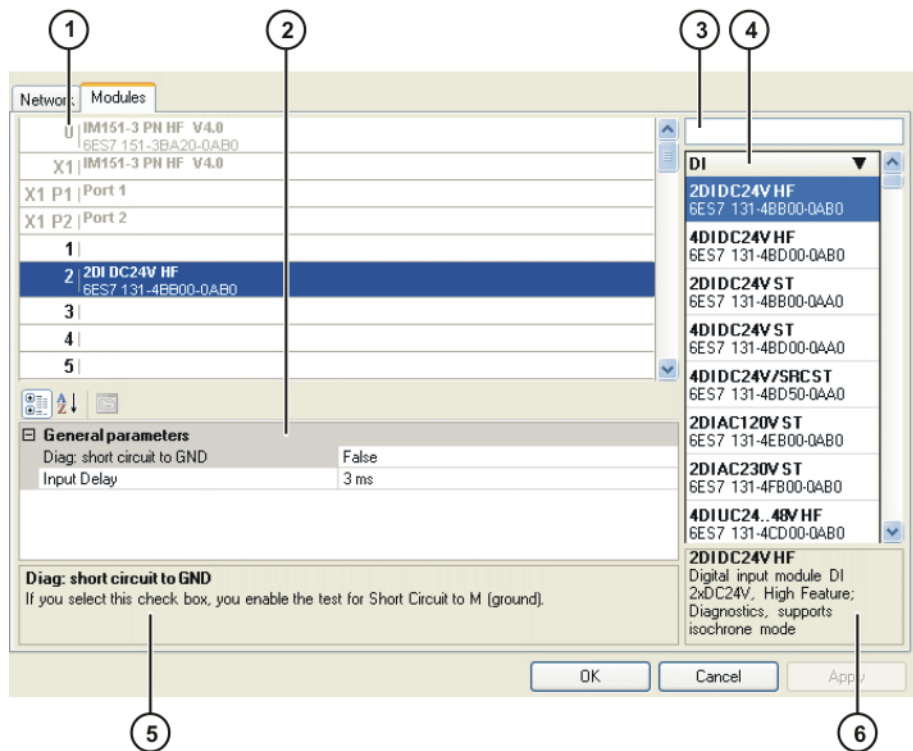


Fig. 5-2: Modules tab

- |                    |                         |
|--------------------|-------------------------|
| 1 Slot             | 4 Module window         |
| 2 Parameter window | 5 Parameter description |
| 3 Search box       | 6 Module description    |

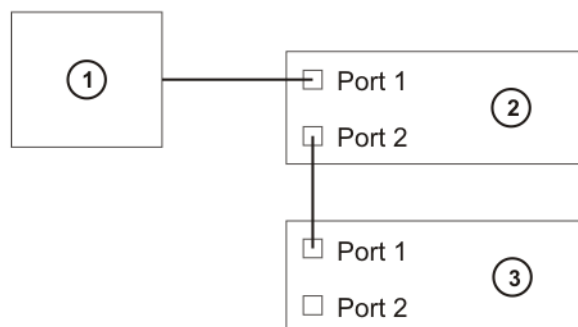
All the windows can be resized as desired.

Element	Description
Slot	<p>Number of slots on the device</p> <p>The number of slots displayed depends on the device selected. The number of slots displayed is always the maximum number possible for the device.</p> <p>Some devices have predefined slots. These cannot be modified. The lines of these slot numbers are grayed out.</p> <p>There are several possible methods for assigning a module to a slot:</p> <ul style="list-style-type: none"> <li>■ Select the desired group in the module window. Click on the desired module in the group and drag it onto the slot.</li> <li>■ Click on the slot. Select the desired group in the module window and double-click on the desired module.</li> <li>■ Right-click on the slot and select <b>Paste</b> from the context menu. Select the desired module via the module group.</li> </ul>
Parameter window	The parameter window displays module-specific parameters, which can be set via a selection menu.
Search box	The search box can be used to search for modules. The search is a full-text search.
Module window	The modules are divided into groups.
Parameter description	Describes the parameters that can be set in the parameter window.
Module description	Describes the module type and properties.

### 5.6.1.2 Activating fast startup

#### Description

When a Profinet device is coupled or run up, the device must reach its operational state as quickly as possible. A normal device can require up to 10 seconds to run up. Fast startup enables devices to reach their operational state in less than a second. This allows tools to be changed more quickly.



**Fig. 5-3: Fast startup (schematic representation)**

- 1 KR C controller
- 2 Coupling device
- 3 Couplable / decouplable device

#### Precondition

- There is an additional Profinet device between the controller and the device that is to be decoupled.

**Procedure**

The procedure is described using the example of a device with 2 ports (port 1: slot **X1 P1**, port 2: slot **X1 P2**).

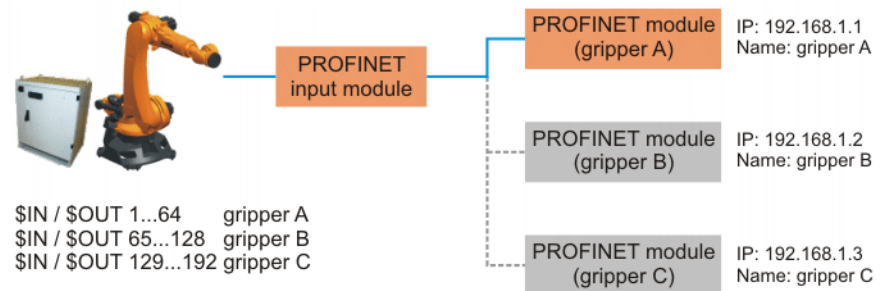
1. Right-click on the device in the tree structure and select **Settings...** from the context menu. A window opens with device settings.  
(>>> 5.6.1.1 "Device settings" Page 17)
2. On the **Modules** tab, click on the slot **X1 P1**.
3. Select the transmission medium in the parameter window.
4. Repeat steps 2 to 3 for the slot **X1 P2**.
5. Click on the slot **X1**.
6. In the parameter window, set the parameter **Prioritized start-up** to **True**.
7. Save the settings by selecting **OK**.

**5.6.1.3 Reducing the amount of configuration work****Description**

It is possible to reduce the amount of configuration work required and still retain the fast startup setting when exchanging devices. For this, the devices must have the same device type, the same IP address and the same device name. This means that only one device exists for the controller, thereby reducing the number of inputs and outputs which need to be mapped.

**Example:  
Normal scope**

In the following example, 3 devices are configured in WorkVisual as PROFINET devices (grippers A, B and C). Each one has a different name and a different IP address. During configuration, inputs and outputs need to be configured for each device here. For 3 devices, this amounts to a total of 192 inputs and outputs in this example.



**Fig. 5-4: Example: Normal scope of configuration work**

**Example:  
Reduced scope**

In the following example, only 1 device is configured in WorkVisual as a PROFINET device (gripper X). In actual fact, however, there are 3 devices with the same device name and the same IP address. In this case, inputs and outputs need to be configured for only one device. That means a total of 64 inputs and outputs in this example.



If this example is applied, only one of the identically configured devices may be coupled at a time.

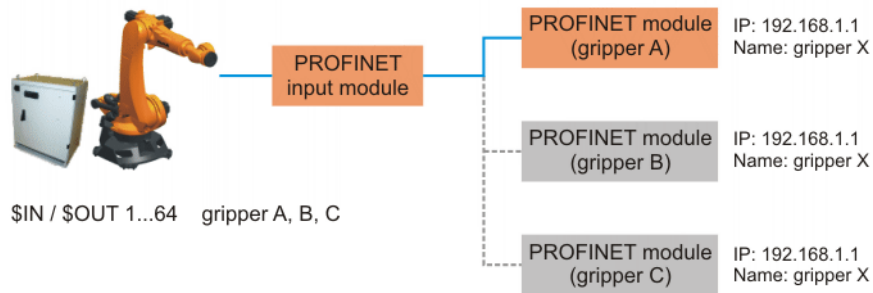


Fig. 5-5: Example: Reduced scope of configuration work

## 5.6.2 Configuring a PROFINET device

### Precondition

- A robot controller has been added and set as active.
- The **PROFINET** 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 **PROFINET** in the tree structure and select **Settings** from the context menu.
3. A window opens. Select the **Communication settings** tab.  
(>>> Fig. 5-6 )
4. Activate the check box **Activate PROFINET device stack**.
5. Fill out the following boxes:
  - **Number of device I/Os; Device name; Display diagnostic alarm as message**  
(>>> 5.6.2.1 "'Communication settings" tab" Page 22)
6. Save the setting with **Apply**.
7. Select the **Device Diagnostic** tab.  
(>>> 5.6.2.2 "Device Diagnostic tab" Page 23)
8. If, in the case of a bus error, a maintenance request or a need for maintenance, a status bit is to be sent to the PLC, activate the **Use status bit** check box in the corresponding range and enter the bit number.
9. If PROFIenergy is to be used: On the **PROFIenergy** tab, activate the **Activate PROFIenergy** check box and enter the time the controller is to remain in Hibernate mode.  
(>>> 5.6.2.3 "'PROFIenergy" tab" Page 24)
10. Save the settings by selecting **OK**.

## 5.6.2.1 “Communication settings” tab

The screenshot shows the 'Communication Settings' tab with the following configuration:

- Network Adapter:** Intel(R) PRO/1000 CT Network Connection (Microsoft's Packe)
- PROFINET Device:**
  - Enable PROFINET device stack
  - Number of device I/Os: 256
  - Device Name: kuka-noname
  - Profinetversion: v8.2
  - Bus cycle time: 8
  - Bus timeout: 20000
  - Show diagnostic alarms as message
- PROFINET Controller:**
  - Bus cycle time: 2
  - Bus timeout: 20000

Fig. 5-6: Communication settings tab

Box	Description
<b>PROFINET device</b>	
<b>Network adapter</b>	Select the network adapter used.
<b>Activate PROFINET device stack</b>	<ul style="list-style-type: none"> <li>■ <b>Activated:</b> PROFINET is used as device.</li> <li>■ <b>Deactivated:</b> PROFINET is used as controller.</li> </ul>
<b>Number of device I/Os</b>	Select the number of inputs and outputs that the device has.
<b>Device name</b>	Enter the name of the device.
<b>Profinet version</b>	Specify the version of the KUKA/VW System Software used on the robot controller.
<b>Bus cycle time</b>	<p>Enter the cycle time.</p> <p>Cycle time: The I/O data of the devices are updated in the robot controller memory every x ms.</p> <p><b>Note:</b> The lower the value for the bus cycle time, the greater the CPU utilization. The PROFINET reaction time is the sum of the bus cycle time and the update time. This calculation does not take into account the reaction times of the applications which need these data (e.g. submit interpreter).</p>
<b>Bus timeout</b>	<p>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.)</p> <p>Unit: ms</p>
<b>Display diagnostic alarm as message</b>	<ul style="list-style-type: none"> <li>■ <b>Activated:</b> Diagnostic messages are displayed in the message window of the KUKA smartHMI.</li> <li>■ <b>Deactivated:</b> No diagnostic messages are displayed in the message window of the KUKA smartHMI.</li> </ul>
<b>PROFINET controller</b>	

Box	Description
<b>Bus cycle time</b>	<p>Enter the cycle time.</p> <p>Cycle time: The I/O data of the PROFINET device are updated in the PLC memory every x ms.</p> <p><b>Note:</b> The lower the value for the bus cycle time, the greater the CPU utilization.</p> <p>The PROFINET reaction time is the sum of the bus cycle time and the update time. This calculation does not take into account the reaction times of the applications which need these data (e.g. submit interpreter).</p>
<b>Bus timeout</b>	<p>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.)</p> <p>Unit: ms</p>

### 5.6.2.2 Device Diagnostic tab

The screenshot shows the 'Device Diagnostics' tab with the following settings:

- Bus Error:**  Enable status bit, Bit Number: 80
- Maintenance Request:**  Enable status bit, Bit Number: 100
- Maintenance demand:**  Enable status bit, Bit number: 120

Fig. 5-7: Device Diagnostic tab

Box	Description
<b>Bus error</b>	
<b>Use status bit</b>	<ul style="list-style-type: none"> <li>■ <b>Activated:</b> In the case of a bus error, a status bit is sent to the PLC.</li> <li>■ <b>Deactivated:</b> No status bit is sent to the PLC.</li> </ul>
<b>Bit number</b>	<p>Enter the number of the status bit in the address range of the PLC.</p> <ul style="list-style-type: none"> <li>■ <b>0 ... Number of device I/Os - 1</b></li> </ul>
<b>Maintenance request</b>	
<b>Use status bit</b>	<ul style="list-style-type: none"> <li>■ <b>Activated:</b> If maintenance is to be carried out on the device, a status bit is sent to the PLC. It is not necessary for the maintenance to be carried out immediately; the wear limit has not yet been reached.</li> <li>■ <b>Deactivated:</b> No status bit is sent to the PLC.</li> </ul>
<b>Bit number</b>	<p>Enter the number of the status bit in the address range of the PLC.</p> <ul style="list-style-type: none"> <li>■ <b>0 ... Number of device I/Os - 1</b></li> </ul>
<b>Maintenance demand</b>	

Box	Description
<b>Use status bit</b>	<ul style="list-style-type: none"> <li>■ <b>Activated:</b> If maintenance must be carried out on the device, a status bit is sent to the PLC. The maintenance must be carried out immediately; the wear limit has been reached.</li> <li>■ <b>Deactivated:</b> No status bit is sent to the PLC.</li> </ul>
<b>Bit number</b>	Enter the number of the status bit in the address range of the PLC. <ul style="list-style-type: none"> <li>■ <b>0 ... Number of device I/Os - 1</b></li> </ul>

**i** If, in the case of **Maintenance request** or **Maintenance demand**, the same bit number is entered, these are linked by a logic OR operation.

**i** The current status of a status bit can be found in the diagnostic data (>>> 8.1 "Displaying diagnostic data" Page 49).

### 5.6.2.3 "PROFenergy" tab

The robot controller supports the following PROFenergy states:

- **Ready\_To\_Operate:** The controller is ready for operation.
- **Drive bus OFF:** The drives are switched off.
- **Hibernate:** The controller is in the rest state and only reacts to the Wake-OnLan packet.

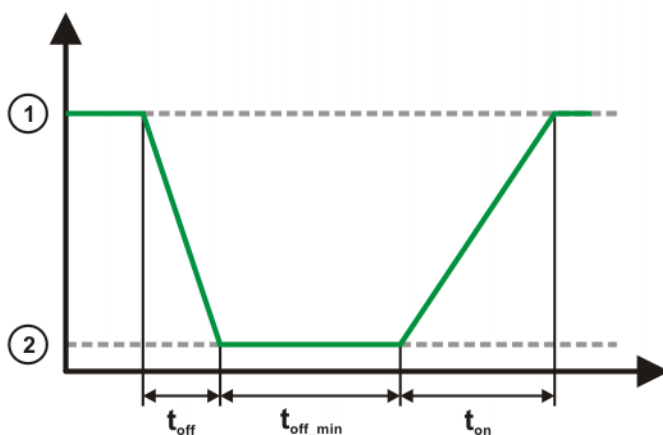


Fig. 5-8: PROFenergy states

- 1 Ready\_To\_Operate state
- 2 Drive bus OFF or Hibernate state

The PROFenergy states have the following properties:



Name	Description
<b>Time_to_Pause (t<sub>off</sub>)</b>	<p>Time until the controller has reached the <b>Drive bus OFF</b> or <b>Hibernate</b> state from the <b>Ready_To_Operate</b> state.</p> <ul style="list-style-type: none"> <li>Default value (Drive bus OFF): 5 s</li> <li>Default value (Hibernate): 50 s</li> </ul>
<b>Time_min_length_of_stay (t<sub>off_min</sub>)</b>	<p>Time in which the controller remains in the <b>Drive bus OFF</b> or <b>Hibernate</b> state. It should be possible to shut down all connected devices completely in this time before the controller reboots.</p> <ul style="list-style-type: none"> <li>Default value (Drive bus OFF): 0 s</li> <li>Default value (Hibernate): 10 s</li> </ul> <p><b>Note:</b> The value for Hibernate is the value that can be configured on the PROFlenergy tab.</p>
<b>Time_to_operate (t<sub>on</sub>)</b>	<p>Time until the controller has reached the <b>Ready_To_Operate</b> state from the <b>Drive bus OFF</b> or <b>Hibernate</b> state.</p> <ul style="list-style-type: none"> <li>Default value (Drive bus OFF): 20 s</li> <li>Default value (Hibernate): 50 s</li> </ul>

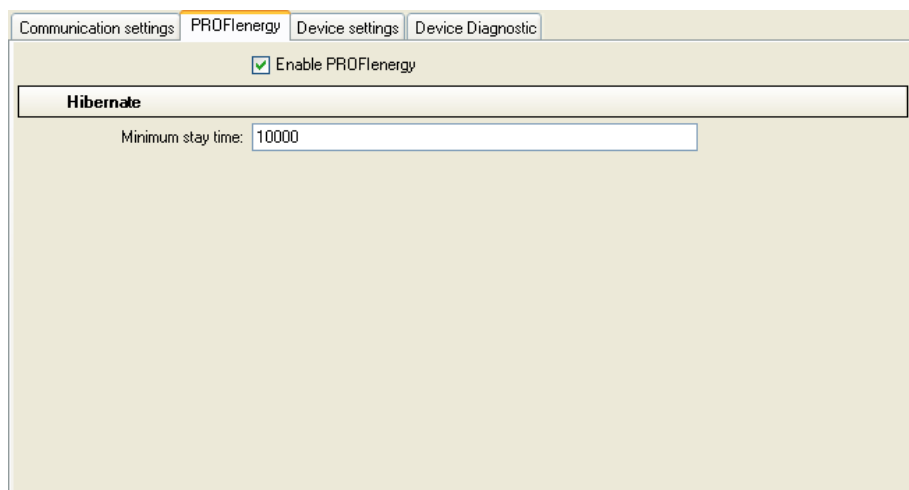


Fig. 5-9: PROFlenergy tab

Box	Description
<b>Enable PROFlenergy</b>	<ul style="list-style-type: none"> <li><b>Activated:</b> PROFlenergy is used.</li> <li><b>Deactivated:</b> PROFlenergy is not used.</li> </ul> <p>By default, the check box is deactivated.</p>
<b>Hibernate</b>	
<b>Minimum stay time</b>	<p>Enter the minimum time for which the controller is to remain in Hibernate mode.</p> <p>Default value: 10000 ms</p>

## 5.7 Configuring the bus with Step 7 or PC WORX

### Procedure

1. Configure the bus with Step 7 or PC WORX.
2. Export the configuration from Step 7 or PC WORX.
3. Import the configuration into WorkVisual.

**Configuration**

It is not possible to assign devices to a KUKA robot controller in Step 7 and PC WORX.

Remedy in **Step 7**:

1. Define a CP1616 as a controller.
2. Assign the required devices to the CP1616.

Remedy in **PC WORX**:

1. Create a project ILC 350 PN.
2. Assign the required devices to the project.

When a configuration of this type is imported into WorkVisual, WorkVisual ignores the CP1616/ILC 350 PN and takes the KUKA robot controller as the controller.

**Export**

To enable the configuration from Step 7 or PC WORX to be imported into WorkVisual, the following options must be set for the export:

- Exporting from **Step 7**:
  - Activate the checkboxes **Export default values**, **Export symbols**, **Export subnets**.
  - Activate the radiobox **Readable**.
- Exporting from **PC WORX**:
  - Select **Export PLCopen xml file**.

**Import**

On importing the configuration into WorkVisual, only the following settings are transferred:

- IP address
- Subnet mask
- Gateway (if used)
- Device name
- Slot allocation

All other settings (e.g. fast startup, parameters of modules and ports) must be performed again in WorkVisual.

**5.8 Mapping inputs/outputs in WorkVisual****Procedure**

- Map the inputs/outputs in WorkVisual.

**Signal names**

PROFINET signal names have the following structure in WorkVisual:

Example **03:01:0002 Output**

I/O	Name	Type
◀	02:01:0001 Input	BOOL
◀	02:01:0002 Input	BOOL
▶	03:01:0001 Output	BOOL
▶	03:01:0002 Output	BOOL

**Fig. 5-10: PROFINET signal names in WorkVisual**


Name	Meaning	In the example
1st value from left	Slot number <b>Note:</b> Modules without inputs/outputs, e.g. power supply modules, have a number but are not displayed in the list.	03
2nd value from left	Subslot number (generally 01)	01
3rd value from left	Index number (consecutive ascending numbering of the individual inputs/outputs)	0002
Input/Output	Direction of processing	Output

## 5.9 Safety interface via PROFIsafe (optional)

### 5.9.1 Safety functions via PROFIsafe (KR C4)

**Description** The exchange of safety-relevant signals between the controller and the system is carried out via PROFIsafe. The assignment of the input and output states in the PROFIsafe protocol is 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 <b>1</b> . 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 <b>1</b> must be assigned to the input.
1	NHE	Input for external Emergency Stop <b>0</b> = external E-STOP is active <b>1</b> = external E-STOP is not active
2	BS	Operator safety <b>0</b> = operator safety is not active, e.g. safety gate open <b>1</b> = operator safety is active

Bit	Signal	Description
3	QBS	<p>Acknowledgement of operator safety</p> <p>Precondition for acknowledgement of operator safety is the signal "Operator safety assured" set in the BS bit.</p> <p><b>Note:</b> If the "BS" signal is acknowledged by the system, this must be specified under <b>Hardware options</b> in the safety configuration. Information is contained in the Operating and Programming Instructions for System Integrators.</p> <p><b>0</b> = operator safety has not been acknowledged  <b>Edge 0 -&gt;1</b> = operator safety has been acknowledged</p>
4	SHS1	<p>Safety STOP 1 (all axes)</p> <ul style="list-style-type: none"> <li>■ FF (motion enable) is set to <b>0</b>.</li> <li>■ Voltage US2 is switched off.</li> <li>■ AF (drives enable) is set to <b>0</b> after 1.5 s.</li> </ul> <p>Cancelation of this function does not require acknowledgement.</p> <p>This function is not permissible for the EMERGENCY STOP function.</p> <p><b>0</b> = safety stop is active  <b>1</b> = safety stop is not active</p>
5	SHS2	<p>Safety STOP 2 (all axes)</p> <ul style="list-style-type: none"> <li>■ FF (motion enable) is set to <b>0</b>.</li> <li>■ Voltage US2 is switched off.</li> </ul> <p>Cancelation of this function does not require acknowledgement.</p> <p>This function is not permissible for the EMERGENCY STOP function.</p> <p><b>0</b> = safety stop is active  <b>1</b> = safety stop is not active</p>
6	RES	-
7	RES	-

## Input byte 1

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

## Output byte 0

Bit	Signal	Description
0	NHL	Local E-STOP (local E-STOP triggered) <b>0</b> = local E-STOP is active <b>1</b> = 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) <b>0</b> = drives enable is not active (the robot controller must switch the drives off) <b>1</b> = 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) <b>0</b> = motion enable is not active (the robot controller must stop the current motion) <b>1</b> = 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) <b>0</b> = enabling is not active <b>1</b> = enabling is active
4	PE	The signal "Peri enabled" is set to 1 (active) if the following conditions are met: <ul style="list-style-type: none"> <li>■ Drives are activated.</li> <li>■ Safety controller motion enable signal present.</li> <li>■ The message "Operator safety open" must not be active.</li> </ul> (>>> "Signal "Peri enabled"" Page 31)
5	AUT	The manipulator is in AUT or AUT EXT mode. <b>0</b> = AUT or AUT EXT mode is not active <b>1</b> = AUT or AUT EXT mode is active
6	T1	The manipulator is in Manual Reduced Velocity mode. <b>0</b> = T1 mode is not active <b>1</b> = T1 mode is active
7	T2	The manipulator is in Manual High Velocity mode. <b>0</b> = T2 mode is not active <b>1</b> = T2 mode is active

## Output byte 1

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

Bit	Signal	Description
2	SHS1	Safety stop 1 (all axes) <b>0</b> = Safety stop 1 is not active <b>1</b> = Safety stop 1 is active (safe state reached)
3	SHS2	Safety stop 2 (all axes) <b>0</b> = Safety stop 2 is not active <b>1</b> = Safety stop 2 is active (safe state reached)
4	RES	Reserved 13
5	RES	Reserved 14
6	PSA	PROFIsafe active (display of state of robot controller as PROFIsafe device bus device)  Precondition: PROFINET must be installed on the controller.  <b>0</b> = robot controller on PROFIsafe bus is not active <b>1</b> = robot controller on PROFIsafe bus is active
7	SP	Shutdown PROFIsafe (the robot controller announces termination of the PROFIsafe connection)  If the PLC transmits the SPA signal as confirmation after receiving the SP signal, PSA is set to <b>0</b> 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.  <b>0</b> = announcement of termination of connection is not active <b>1</b> = announcement of termination of connection is active

### Signal “Peri enabled”

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.  
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.

**5.9.2 Safety functions via PROFIsafe (VKR C4)**

**Description** The exchange of safety-relevant signals between the controller and the system is carried out via PROFIsafe. The assignment of the input and output states in the PROFIsafe protocol is 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 <b>1</b> . 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 <b>1</b> must be assigned to the input.
1	NHE	Input for external Emergency Stop <b>0</b> = external E-STOP is active <b>1</b> = external E-STOP is not active
2	BS	Operator safety Input for access to the safety zone. The signal triggers a Stop 1 in the Automatic operating modes. Cancellation of this function must be acknowledged, as the manipulator must not be allowed to resume motion if, for example, a safety gate accidentally closes itself. <b>0</b> = operator safety is not active, e.g. safety gate open <b>1</b> = operator safety is active



Bit	Signal	Description
3	QBS	<p>Acknowledgement of operator safety</p> <p>Precondition for acknowledgement of operator safety is the signal "Operator safety assured" set in the BS bit.</p> <p><b>Note:</b> If the "BS" signal is acknowledged by the system, this must be specified under <b>Hardware options</b> in the safety configuration. Information is contained in the Operating and Programming Instructions for System Integrators.</p> <p><b>0</b> = operator safety has not been acknowledged  <b>Edge 0 -&gt;1</b> = operator safety has been acknowledged</p>
4	SHS1	<p>Safety STOP 1 (all axes)</p> <ul style="list-style-type: none"> <li>■ FF (motion enable) is set to <b>0</b>.</li> <li>■ Voltage US2 is switched off.</li> <li>■ AF (drives enable) is set to <b>0</b> after 1.5 s.</li> </ul> <p>Cancellation of this function does not require acknowledgement.</p> <p>This function is not permissible for the EMERGENCY STOP function.</p> <p><b>0</b> = safety stop is active  <b>1</b> = safety stop is not active</p>
5	SHS2	<p>Safety STOP 2 (all axes)</p> <ul style="list-style-type: none"> <li>■ FF (motion enable) is set to <b>0</b>.</li> <li>■ Voltage US2 is switched off.</li> </ul> <p>Cancellation of this function does not require acknowledgement.</p> <p>This function is not permissible for the EMERGENCY STOP function.</p> <p><b>0</b> = safety stop is active  <b>1</b> = safety stop is not active</p>
6	E2	<p>E2 keyswitch (customer-specific signal for mode selection)</p> <p><b>0</b> = E2 keyswitch is not active  <b>1</b> = E2 keyswitch is active</p>
7	E7	<p>E7 keyswitch (customer-specific signal for mode selection)</p> <p><b>0</b> = E7 keyswitch is not active  <b>1</b> = E7 keyswitch is active</p>

## Input byte 1

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

## Output byte 0

Bit	Signal	Description
0	NHL	Local E-STOP (local E-STOP triggered) <b>0</b> = local E-STOP is active <b>1</b> = 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) <b>0</b> = drives enable is not active (the robot controller must switch the drives off) <b>1</b> = 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) <b>0</b> = motion enable is not active (the robot controller must stop the current motion) <b>1</b> = 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) <b>0</b> = enabling is not active <b>1</b> = enabling is active
4	PE	The signal "Peri enabled" is set to 1 (active) if the following conditions are met: <ul style="list-style-type: none"> <li>■ Drives are activated.</li> <li>■ Safety controller motion enable signal present.</li> <li>■ The message "Operator safety open" must not be active.</li> </ul> (>>> "Signal "Peri enabled"" Page 31)
5	EXT	The manipulator is in AUT EXT mode. <b>0</b> = AUT EXT mode is not active <b>1</b> = AUT EXT mode is active
6	T1	The manipulator is in Manual Reduced Velocity mode. <b>0</b> = T1 mode is not active <b>1</b> = T1 mode is active
7	T2	The manipulator is in Manual High Velocity mode. <b>0</b> = T2 mode is not active <b>1</b> = T2 mode is active

## Output byte 1

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

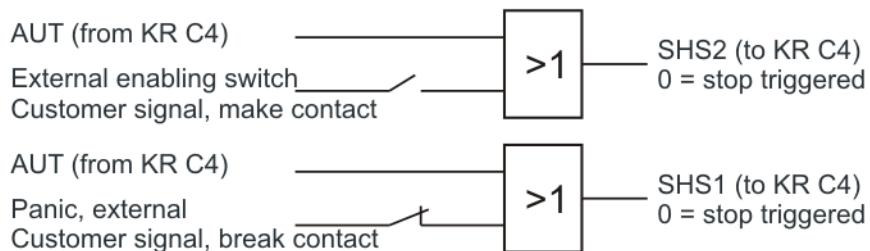
Bit	Signal	Description
2	SHS1	Safety stop 1 (all axes) <b>0</b> = Safety stop 1 is not active <b>1</b> = Safety stop 1 is active (safe state reached)
3	SHS2	Safety stop 2 (all axes) <b>0</b> = Safety stop 2 is not active <b>1</b> = Safety stop 2 is active (safe state reached)
4	RES	Reserved 13
5	RES	Reserved 14
6	PSA	PROFIsafe active (display of state of robot controller as PROFIsafe device bus device)  Precondition: PROFINET must be installed on the controller.  <b>0</b> = robot controller on PROFIsafe bus is not active <b>1</b> = robot controller on PROFIsafe bus is active
7	SP	Shutdown PROFIsafe (the robot controller announces termination of the PROFIsafe connection)  If the PLC transmits the SPA signal as confirmation after receiving the SP signal, PSA is set to <b>0</b> 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.  <b>0</b> = announcement of termination of connection is not active <b>1</b> = announcement of termination of connection is active

### 5.9.3 Schematic circuit diagram of PROFIsafe enabling switch

#### Description

An external enabling switch can be connected to the higher-level safety controller. The signals (ZSE make contact and External panic break contact) must be correctly linked to the PROFIsafe signals in the safety controller. The resulting PROFIsafe signals must then be routed to the PROFIsafe of the KR C4. The response to the external enabling switch is then identical to that for a discretely connected X11.

#### Signals



**Fig. 5-11: Schematic circuit diagram of external enabling switch**

- Enabling switch center position (make contact closed (1) = enabled) OR AUT at SHS2
- Panic (break contact open (0) = panic position) = AND not AUT at SHS1

### 5.9.4 SafeOperation via PROFIsafe (optional)



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

### 5.9.5 Power management via PROFINET

#### Description

The following signals are available for activating or deactivating different power save modes and for detecting the states of the robot controller.

#### Input byte 0



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.

Bit	Signal	Description
0	AB	Drive bus <b>0</b> = activate drive bus, condition: HIB = 0 and KS = 0 <b>1</b> = deactivate drive bus, condition: HIB = 0 and KS = 0
1	HIB	Hibernate <b>0</b> = no function <b>1</b> = initiate Hibernate on the controller, condition: AB = 0 and KS = 0
2	KS	Cold start <b>0</b> = no function <b>1</b> = initiate cold start on the controller, condition: AB = 0 and HIB = 0
3 ... 7	RES	Spare

#### Output byte 0

Bit	Signal	Description
0	AB	Drive bus <b>0</b> = drive bus activated <b>1</b> = drive bus deactivated
1	BBS	Operational readiness of the robot controller <b>0</b> = robot controller not ready <b>1</b> = robot controller ready
2 ... 7	RES	Spare

### 5.9.6 Logging off the higher-level safety controller

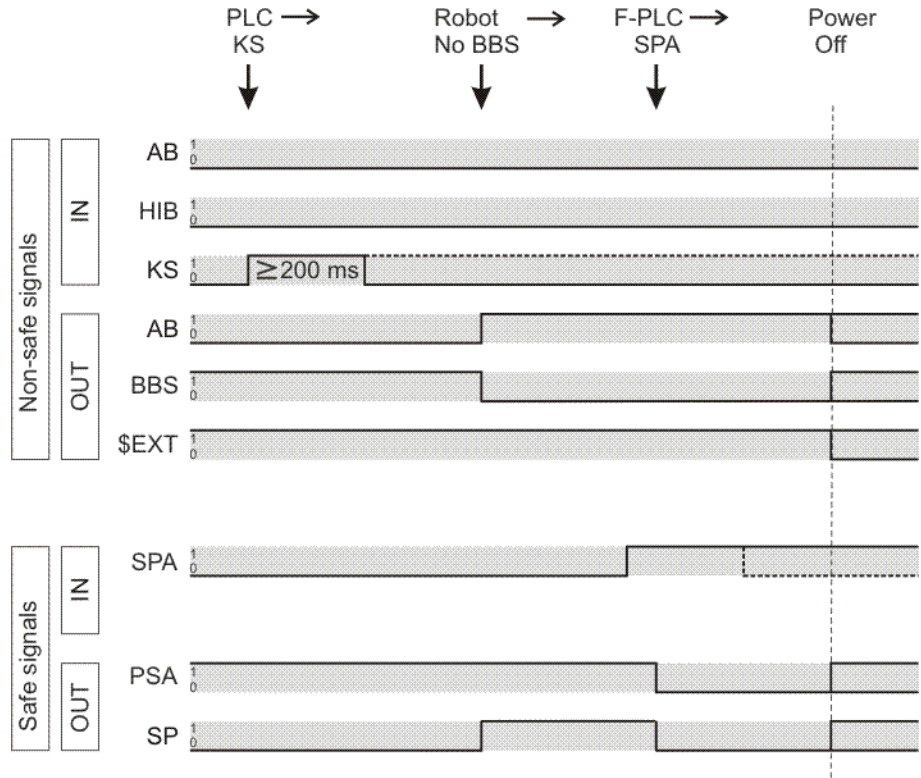
#### Description

On switching off the robot controller, the connection to the higher-level safety controller is terminated. This termination is announced so that an E-STOP does not have to be triggered for the entire system. When the robot controller is shutting down, it sends the signal Shutdown PROFIsafe [SP=1] to the higher-level safety controller, triggering a Stop 1. The higher-level safety controller confirms the request with the signal Shutdown PROFIsafe Acknowledge [SPA=1]. Once the controller is restarted and communication is re-established

with the higher-level safety controller, the signal PROFIsafe aktiv [PSA=1] is set. The following diagrams show the behavior on switching on and off.

**Shutdown**

The following example shows shutdown of the robot controller by a higher-level controller using the KS signal. The robot controller sets the signals “Drive bus deactivated [AB]” and “Controller operational readiness [BBS]” accordingly and logs off from the PROFIsafe Bus via safety-oriented signals.



**Fig. 5-12: Logging off systems from the higher-level controller**

**i** Shutdown to power save mode 0 - Hibernate is carried out in accordance with the timing shown. Instead of the KS signal, the HIB signal must be activated by the higher-level controller for at least 200 ms.

**Power save mode**

The following example shows how the robot controller is put into power save mode 2 and back into the operating state by a higher-level controller using the AB signal. The robot controller remains logged on to the PROFINET/PROFIsafe Bus.

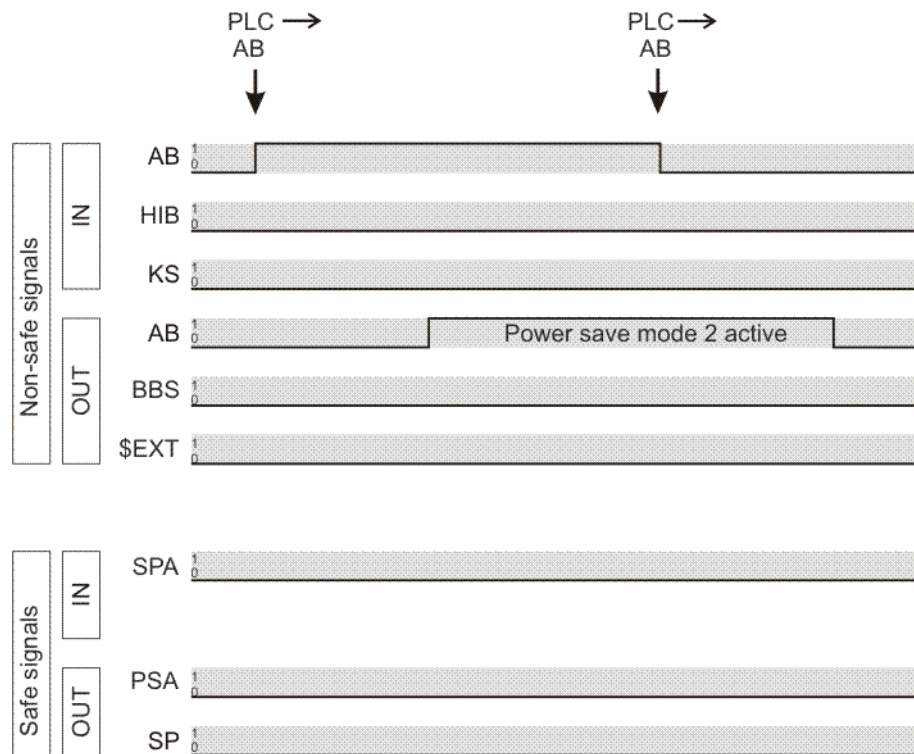


Fig. 5-13: Power save mode 2

**Switching on via WakeOnLAN**

The following example shows switch-on of the robot controller by a higher-level controller via WakeOnLAN. After receiving a Magic Packet for WakeOnLAN, the robot controller signals operational readiness via BBS. The PROFIsafe status is indicated via safety-oriented signals via PSA.

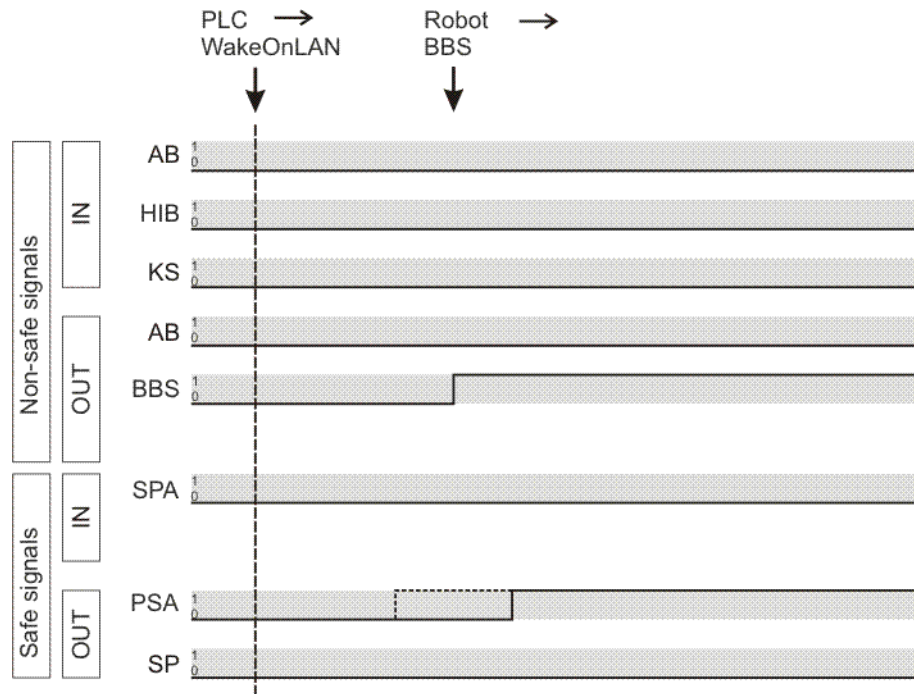


Fig. 5-14: Switching on via WakeOnLAN





## 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 PROFINET 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. **Is Active** can be set in the device data in WorkVisual.

(>>> 5.6.1.1 "Device settings" Page 17)

	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("PNIO-CTRL",60,[user ID])
  - To couple: =IOCTL("PNIO-CTRL",50,[user ID])
3. Confirm by pressing the Enter key. The device is coupled or decouple.

##### Description

[User ID]: The user ID is displayed in WorkVisual in the **User ID** box in the device settings.

(>>> 5.6.1.1 "Device settings" Page 17)

#### 6.1.2 Coupling/decoupling devices via KRL

##### Syntax

Decoupling:

```
RET =IOCTL("PNIO-CTRL",60,[user ID])
```

Coupling:

```
RET =IOCTL("PNIO-CTRL",50,[user ID])
```

##### Description

[User ID]: The user ID is displayed in WorkVisual in the **User ID** box in the device settings.

(>>> 5.6.1.1 "Device settings" Page 17)

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 ID 3 is decoupled, depending on the tool used.

```

...
IF (NEXT_TOOL == GRIPPER_1) THEN
  RET = IOCTL("PNIO-CTRL", 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:

```

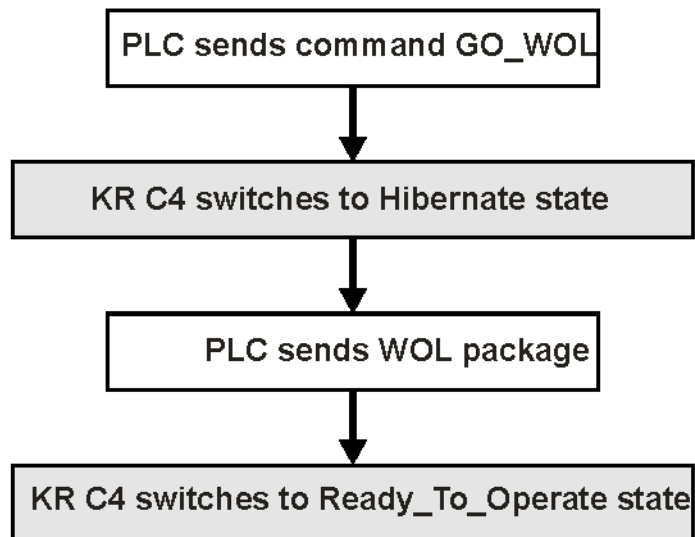
RET = IOCTL("PNIO-CTRL", 1001, 5000)

```

**6.2 PROFenergy commands**

Using PROFenergy commands, the PLC can signal to the robot controller to change the state or query information.

**Example**



**Fig. 6-1: Using commands (schematic sequence)**

**Description**

The following PROFenergy commands are supported:

Command	Description
Start_Pause	The robot controller switches to the Drive bus OFF / Hibernate state.
End_Pause	The robot controller comes back out of Hibernate / Drive bus OFF.
Start_Pause_Time_Info	Queries the time required by the robot controller to switch state.
Info_Sleep_WOL	Determines information about the PE_sleep_mode_WOL state from the device.
Go_WOL	Switches a device to the PE_sleep_mode_WOL state.

Command	Description
Query_Version	Queries the version of the PROFlenergy protocol.
List_Modes	Displays a list of energy-saving modes supported by the controller.
Get_Mode	Queries information about a specific energy-saving mode.



PLC manufacturers provide modules for controlling the commands. Some commands are executed automatically by the PLC; they cannot be executed by the user.



The use of PROFlenergy commands is described and additional information about them are provided in the Siemens documentation **Common Application Profile PROFlenergy**.



## 7 Programming

### 7.1 Acyclic communication

In addition to typical I/O communication, asynchronous communication may also be necessary between applications and the I/O driver.

Examples:

- Requesting data from the higher-level controller.
- Parameterizing I/O modules during operation. (Only possible for modules with the relevant functionality.)

#### 7.1.1 Acyclic data to the devices (controller ring)

Commands for acyclic transfer of data:

Command	Description
MASTER_READ	Command ID: 1 The controller stack requests data from a lower-level device.
MASTER_WRITE	Command ID: 2 The controller stack writes data to a lower-level device.
MASTER_RD_CONFIRMATION	Command ID: 1 The device responds to the read command from the controller stack.
MASTER_WR_CONFIRMATION	Command ID: 2 The device responds to the write command from the controller stack.

All commands are structure types. They consist of the following components:

Component	Description
CommandID	Command ID
CommandLen	Command length. The length of all parameters from "TransactionNum" (in bytes)
TransactionNum	Unique designation for the data exchange
ARID	Unique designation for "Application Relation"
SlotNumber	Slot number <b>Note:</b> Not for MASTER_RD_CONFIRMATION and MASTER_WR_CONFIRMATION.
SubSlotNumber	Subslot number <b>Note:</b> Not for MASTER_RD_CONFIRMATION and MASTER_WR_CONFIRMATION.
Index	Index for data exchange (0x0000 - 0x7FFF)
UserDataLen	Length of user data (in bytes) <b>Note:</b> Not for MASTER_WR_CONFIRMATION.

Component	Description
UserData[4096]	User data <b>Note:</b> Only for MASTER_WRITE and MASTER_RD_CONFIRMATION.
ErrorCode	Error code <b>Note:</b> Only for MASTER_RD_CONFIRMATION and MASTER_WR_CONFIRMATION.

All components except UserData[4096] are of the data type INT.

UserData[4096] = BYTE

### 7.1.2 Acyclic data to the higher-level controller (device ring)

Commands for acyclic transfer of data:

Command	Description
SPS_READ	Command ID: 3 The higher-level controller requests data from the robot controller via a read command.
SPS_WRITE	Command ID: 4 The higher-level controller writes data to the robot controller via a write command.
SPS_RD_CONFIRMATION	Command ID: 3 The robot controller responds to the read command from the higher-level controller.
SPS_WR_CONFIRMATION	Command ID: 4 The robot controller responds to the write command from the higher-level controller.

All commands are structure types. They consist of the following components:

Component	Description
CommandID	Command ID
CommandLen	Command length. The length of all parameters from "TransactionNum" (in bytes)
TransactionNum	Unique designation for the data exchange
ARID	Unique designation for "Application Relation"
SlotNumber	Slot number
SubSlotNumber	Subslot number
Index	Index for data exchange (0x0000 - 0x7FFF)
UserDataLen	Length of user data (in bytes) <b>Note:</b> Not for SPS_WR_CONFIRMATION.
UserData[4096]	User data <b>Note:</b> Only for SPS_WRITE and SPS_RD_CONFIRMATION.
ErrorCode	Error code <b>Note:</b> Only for SPS_RD_CONFIRMATION and SPS_WR_CONFIRMATION.

All components except UserData[4096] are of the data type INT.

UserData[4096] = BYTE

## 7.2 Example of acyclic communication

Example of acyclic communication in the program SPS.SUB:

```

...
1  COPEN (:LD_EXT_OBJ1, nHandle)
2  Wait for (nHandle>0)
3  WMode=#SYNC
4  RMode=#ABS
5  TimeOut=1
6
7      WAIT FOR NOT($POWER_FAIL)
8      TORQUE_MONITORING ()
9
10     ;FOLD USER PLC
11     ;Make your modifications here
12;-----
13  Offset=0
14
15  CRead (nHandle, Stat, RMode, TimeOut, Offset, "%r",Buffer[]);
16  If ( Stat.Ret1==#DATA_END ) then
17
18  Offset=0
19  CAST_FROM(Buffer[],Offset, CmdID)
20  CAST_FROM(Buffer[],Offset, CmdLen)
21
22  if (CmdID == 3) then
23      CAST_FROM(Buffer[],Offset, Transaction)
24      CAST_FROM(Buffer[],Offset, ARID)
25      CAST_FROM(Buffer[],Offset, Slot)
26      CAST_FROM(Buffer[],Offset, SubSlot)
27      CAST_FROM(Buffer[],Offset, Index)
28      CAST_FROM(Buffer[],Offset, DataLen)
29
30      Offset=0
31      wait for strClear(TMPSTR[])
32      SWRITE(TMPSTR[],STAT,Offset,"CmdId=%d CmdLen=%d TNum=%d
ARID=%d Slot=%d SubSlot=%d Index=%d DataLen=%d", CmdID, CmdLen,
Transaction, ARID, Slot, SubSlot, Index, DataLen)
33      $loop_msg[]=TMPSTR[]
34
35      wait sec 1
36
37      CmdLen = 32 ;-- User Data has 4 Bytes + 7*4 = 32
38      ErrCode=0
39      DataLen=4
40      UserData=255
41      Offset=0
42
43      CAST_TO(Buffer[],Offset,CmdID)
44      CAST_TO(Buffer[],Offset,CmdLen)
45      CAST_TO(Buffer[],Offset,Transaction)
46      CAST_TO(Buffer[],Offset,ARID)
47      CAST_TO(Buffer[],Offset,Slot)
48      CAST_TO(Buffer[],Offset,SubSlot)
49      CAST_TO(Buffer[],Offset,Index)
50      CAST_TO(Buffer[],Offset,ErrCode)
51      CAST_TO(Buffer[],Offset,DataLen)
52      CAST_TO(Buffer[],Offset,UserData)
53
54      CWrite (nHandle,Stat,WMode,"%1.40r",Buffer[])
55      Wait for (Stat.Ret1==#DATA_OK)
56
57  endif
...

```

Line	Description
... 11	The robot controller waits for a command from the higher-level controller.
22	CmdID == 3: The higher-level controller requests data from the robot controller via a read command.
23 ... 28	The robot controller reads the request.
37 ... 55	The robot controller replies to the higher-level controller.



Detailed information about the following commands is contained in the documentation CREAD/CWRITE.

- CHANNEL
- CIOCTL
- CAST\_FROM; CAST\_TO
- COPEN; CCLOSE
- CREAD; CWRITE
- SREAD; SWRITE



## 8 Diagnosis

### 8.1 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:

- **Profinet Controller Stack (PNIO-CTRL)**
- **Profinet Device Stack (PNIO-DEV)**
- **Profinet Device (device name)**
- **Profinet IO Driver (PNIODriver)**
- **PROFenergy (PROFenergy)**

#### 8.1.1 Profinet Controller Stack (PNIO-CTRL)

Name	Description
Profinet Controller Stack	Internal name of the controller instance
Bus cycle error	Number of non-compliant cycles
Trigger application	<ul style="list-style-type: none"> <li>■ [blank]: The driver accesses the PROFINET devices cyclically.</li> <li>■ [<i>ApplicationName</i>]: Access by the driver to the PROFINET devices is controlled by <i>ApplicationName</i>.</li> </ul>
Applications logged on for acyclic data	Names of the applications logged on for the service "acyclic data"
Read request counter Write request counter	The robot controller sends Read or Write commands to the devices. The counter indicates the number of packets.
Read request transaction number Write request transaction number	Transaction number
Read request AR User ID Write request AR User ID	Application Relation User ID of PROFINET device The user is to issue this ID at the following point in WorkVisual: in the device settings on the <b>Network</b> tab, in the <b>User ID</b> box.
Read request index Write request index	Record index for the acyclic data
Read request slot number Write request slot number	Number of the slot from which data are read (Read) or to which they are written (Write)
Read request subslot number Write request subslot number	Number of the subslot from which data are read (Read) or to which they are written (Write)
Read response counter Write response counter	The robot controller receives Read or Write commands from the devices. The counter indicates the number of packets.

Name	Description
Read response transaction number Write response transaction number	Transaction number
Read response ARID Write response ARID	Application Relation ID of PROFINET device ID issued by the master on booting
Read response AR User ID Write response AR User ID	Application Relation User ID of PROFINET device The user is to issue this ID at the following point in WorkVisual: in the device settings on the <b>Network</b> tab, in the <b>User ID</b> box.
Read request index Write request index	Record index for the acyclic data
Read response error code Write response error code	0 = no error
Read response error decode Write response error decode	
Read response error code 1 Write response error code 1	
Read response error code 2 Write response error code 2	

### 8.1.2 Profinet Device Stack (PNIO-DEV)

Name	Description
Profinet Device Stack	Internal name of the device instance
Device Stack Name	PROFINET name of the device instance
Profinet Device Stack Vendor ID	Manufacturer ID of the PROFINET device stack
Profinet Device Stack ID	Internal ID of the PROFINET device stack
AR ID	PROFINET Application Relation ID
Input length in Bytes	Input length of the I/O image of the configured PROFINET device in bytes
Output length in Bytes	Output length of the I/O image of the configured PROFINET device in bytes
Ready	<ul style="list-style-type: none"> <li>■ <b>1</b>: Communication between the PLC and device instance is working.</li> <li>■ <b>0</b>: No communication between the PLC and device instance.</li> </ul>
Indication message number	HMI message number of the displayed indication message
Read Status	<ul style="list-style-type: none"> <li>■ <b>0</b>: Status OK</li> <li>■ <b>1</b>: No new data are present for reading.</li> <li>■ All other values: Internal error</li> </ul>
Write Status	<ul style="list-style-type: none"> <li>■ <b>0</b>: Status OK</li> <li>■ <b>≠0</b>: Internal error</li> </ul>
Abort indication counter	Internal error counter
Data Status	PROFINET data status byte; see PROFINET specifications
AR Status	PROFINET Application Relation Status
Bus cycle error	Number of non-compliant cycles

Name	Description
Controller bus error bit active	<ul style="list-style-type: none"> <li>■ 1: Bus errors are signaled to the PLC.</li> <li>■ 0: Bus errors are not signaled to the PLC.</li> </ul>
Controller bus error bit	<ul style="list-style-type: none"> <li>■ 1: The device is OK.</li> <li>■ 0: Bus error.</li> </ul>
Controller Maintenance Request bit active	<ul style="list-style-type: none"> <li>■ 1: Maintenance request is signaled to the PLC.</li> <li>■ 0: Maintenance request is not signaled to the PLC.</li> </ul>
Controller Maintenance Request bit	<ul style="list-style-type: none"> <li>■ 1: The device is OK.</li> <li>■ 0: There is a maintenance request.</li> </ul>
Controller Maintenance Demand bit active	<ul style="list-style-type: none"> <li>■ 1: Need for maintenance is signaled to the PLC.</li> <li>■ 0: Need for maintenance is not signaled to the PLC.</li> </ul>
Controller Maintenance Demand bit	<ul style="list-style-type: none"> <li>■ 1: The device is OK.</li> <li>■ 0: Maintenance must be carried out on the device.</li> </ul>
Will be triggered by application	<ul style="list-style-type: none"> <li>■ [blank]: The driver accesses the PROFINET devices cyclically.</li> <li>■ [<i>ApplicationName</i>]: Access by the driver to the PROFINET devices is controlled by <i>ApplicationName</i>.</li> </ul>
Applications logged on for acyclic data	Names of the applications logged on for the service "acyclic data"
Read request counter Write request counter	The robot controller receives Read or Write commands from the PLC. The counter indicates the number of packets.
Read request transaction number Write request transaction number	Transaction number
Read request ARID Write request ARID	Application Relation ID of PROFINET device ID issued by the master on booting
Read request index Write request index	Record index for the acyclic data
Read request slot Write request slot	Number of the slot from which data are read (Read) or to which they are written (Write)
Read request subslot number Write request subslot number	Number of the subslot from which data are read (Read) or to which they are written (Write)
Read response counter Write response counter	The robot controller sends Read or Write commands to the PLC. The counter indicates the number of packets.
Read response timeout counter Write response timeout counter	A timeout occurs if the KUKA PROFINET device has not yet sent the Read or Write packet to the PLC after 5 seconds. After the timeout, the robot controller sends a default response meaning "feature not supported" to the PLC.
Read response transaction number Write response transaction number	Transaction number
Read response ARID Write response ARID	Application Relation ID of PROFINET device ID issued by the master on booting
Read response index Write response index	Record index for the acyclic data
Read response slot Write response slot	Number of the slot from which data are read (Read) or to which they are written (Write)

Name	Description
Read response subslot Write response subslot number	Number of the subslot from which data are read (Read) or to which they are written (Write)
Read response error code Write response error code	0 = no error
Read response error decode Write response error decode	
Read response error code 1 Write response error code 1	
Read response error code 2 Write response error code 2	

### 8.1.3 Profinet Device

Name	Description
Name	Profinet name of the device
AR User ID	Profinet Application Relation User ID (User ID in WorkVisual)
ARID	Profinet Application Relation ID
Input length in Bytes	Input length of the I/O image of the configured PROFINET device in bytes
Output length in Bytes	Output length of the I/O image of the configured PROFINET device in bytes
AR State	Profinet Application Relation status
Should be connected	<ul style="list-style-type: none"> <li>■ <b>1</b>: The setting was made during configuration that the device should be coupled during start-up</li> <li>■ <b>0</b>: The setting was made during configuration that the device should not be coupled during start-up</li> </ul>
Ready	<ul style="list-style-type: none"> <li>■ <b>1</b>: Communication with the device is working.</li> <li>■ <b>0</b>: No communication with the device.</li> </ul>
Read Status	<ul style="list-style-type: none"> <li>■ <b>0</b>: Status OK</li> <li>■ <b>1</b>: No new data are present for reading.</li> <li>■ All other values: Internal error</li> </ul>
Write Status	<ul style="list-style-type: none"> <li>■ <b>0</b>: Status OK</li> <li>■ <b>≠0</b>: Internal error</li> </ul>
Alarm message number	HMI message number of the displayed alarm message
Indication message number	HMI message number of the displayed indication message
Abort counter	Internal error counter
Data status byte	Profinet data status byte

### 8.1.4 Profinet IO Driver (PNIODriver)

Name	Description
Profinet IO-Driver	Name of the driver


Name	Description
IP address	Data that are assigned to the robot controller during device naming.
Profinet Subnetmask	
Profinet Standard Gateway	
Profinet MAC Address	Address of the network adapter via which the Profinet communicates with controllers, devices, etc.

### 8.1.5 PROFlenergy (PROFlenergy)

Name	Description
PE state	<p>Internal PROFlenergy state</p> <ul style="list-style-type: none"> <li>■ <b>Not initialized/present:</b> PROFlenergy has not been initialized or is not present.</li> <li>■ <b>No active commands:</b> No PROFlenergy commands are active.</li> <li>■ <b>Command being executed:</b> A PROFlenergy command is being executed.</li> <li>■ <b>Error state:</b> An error has occurred.</li> <li>■ <b>Start_Pause done:</b> The command Start_Pause has been executed.</li> <li>■ <b>Start_Pause_Time_Info done:</b> The command Start_Pause_Time_Info has been executed.</li> <li>■ <b>End_Pause done:</b> The command End_Pause has been executed.</li> <li>■ <b>Info_Sleep_WOL done:</b> The command Info_Sleep_WOL has been executed.</li> <li>■ <b>Go_WOL done:</b> The command Go_WOL has been executed.</li> <li>■ <b>Query_Version done:</b> The command Query_Version has been executed.</li> <li>■ <b>List_Modes done:</b> The command List-Modes has been executed.</li> <li>■ <b>Get_Mode done:</b> The command Get_Mode has been executed.</li> <li>■ <b>PEM_Status done:</b> The command PEM_Status has been executed.</li> <li>■ <b>PE_Identity done:</b> The command PE_Identity has been executed.</li> </ul>
Current PE mode	PROFlenergy mode to which the controller is currently set.
Start PE mode	PROFlenergy mode to which the controller is set before a change of mode.
Target PE mode	PROFlenergy mode to which the controller is set after a change of mode.
PE mode name	Name of the PROFlenergy mode
PE mode ID	ID of the PROFlenergy mode
PE mode attribute	Attribute of the PROFlenergy mode  <b>Note:</b> Information about the attributes can be found in the PROFlenergy specifications.
Minimum pause time	Minimum time required by the controller to switch to a different mode.
Minimum time in this mode	Minimum time the controller stays in one mode.

Name	Description
Maximum time in this mode	Maximum time the controller stays in one mode.
Power consumption	Power consumption of the controller in a specific mode

## 8.2 Diagnostic signals via PROFINET

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

## 9 Messages

Message number / ID / type	Message text / cause
11003 / M_PNIO_ALARM Notification message	Alarm from device [device name] received with alarm type [alarm type].
11005 / M_PNIO_ALARM_CRITICAL Status message	Alarm from device [device name] received with alarm type [alarm type].
11000 / M_PNIO_BUS_ERR Status message	Device [device name] could not be started within [time] ms Cause: The PROFINET communication with the device has failed.
11002 / M_PNIO_CONRESTORE Notification message	Connection to device [device name] restored.
11001 / M_PNIO_ERRCON Status message	Connection to device [device name] terminated. Cause: Power supply and/or network connection was interrupted.
13040 / M_PNIO_XML_ERR Status message	Error reading [name of configuration file] Cause: A configuration file is faulty. (IPPNIO.xml, PNIO-Driver.xml or bas_cm_api.xml)
13037 / M_PNIO_ERR_ADDPNCTRL Status message	Profinet controller stack cannot be started, error code: [error number] Cause: The PROFINET firmware is incorrectly parameterized. (bas_cm_api.xml)
13038 / M_PNIO_ERR_ADDPNDEV Status message	Profinet device stack cannot be started, error code: [error number] Cause: The file pndev1.xml is faulty.
13039 / M_PNIO_ERR_FWINIT Status message	Error initializing the Profinet firmware Cause: The Profinet software stack or the file bas_cm_api.xml is faulty.
13041 / M_PNIO_MAC_ERR Status message	Error reading the MAC address from the KLI Cause: The KLI configuration is faulty.
11007 / M_PNIO_MODULE_ERR Notification message	The configured device differs from the real device [device name], Slot [slot number], Subslot [subslot number] Cause: The configuration does not correspond to the connected device.
11006 / M_PNIODEV_ERR Status message	Connection between PLC and [device name] could not be established in [time] ms Possible causes: <ul style="list-style-type: none"> <li>■ Bus timeout is too low.</li> <li>■ The configuration of the Profinet device section on the controller does not match the configuration on the PLC.</li> <li>■ The device is defective.</li> </ul>
11004 / M_PNIODEV_CONNRESTORE Notification message	Connection between PLC and [device name] restored.

Message number / ID / type	Message text / cause
11008 / M_PNIODEV_ERRCONN Status message	<p>Connection between PLC and [device name] terminated.</p> <p>Possible causes:</p> <ul style="list-style-type: none"> <li>■ Power supply and/or network connection was interrupted.</li> <li>■ Performance problems (number of devices, cycle times).</li> </ul>
11015 / M_PNIO_PE_REG Status message	<p><i>PROFenergy cannot connect to Cabinet Control.</i></p> <p>Cause: Cabinet Control has not been loaded or is not functioning correctly.</p> <p>Remedy:</p> <ol style="list-style-type: none"> <li>1. Check system for faults.</li> <li>2. Reboot the system.</li> <li>3. If the message remains displayed: re-install system.</li> </ol>
11016 / M_PNIO_PE_REG_REFUSED Status message	<p><i>PROFenergy cannot log onto Cabinet Control.</i></p> <p>Possible causes:</p> <ul style="list-style-type: none"> <li>■ KUKA System Software version not supported by PROFenergy.</li> <li>■ Cabinet Control has not been loaded or is not functioning correctly.</li> </ul>

### Alarm types

Alarm type	Description
ALARM_TYPE_DIAG_APPEARS	A diagnostic alarm has arrived.
ALARM_TYPE_DIAG_DISAPPEARS	A diagnostic alarm has been withdrawn.
ALARM_TYPE_PULL	An I/O module has been unplugged from the device.
ALARM_TYPE_PLUG	An I/O module has been plugged into the device.



## 10 KUKA Service

### 10.1 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 linear unit (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

### 10.2 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** Headland Machinery Pty. Ltd.  
Victoria (Head Office & Showroom)  
95 Highbury Road  
Burwood  
Victoria 31 25  
Australia  
Tel. +61 3 9244-3500  
Fax +61 3 9244-3501  
vic@headland.com.au  
www.headland.com.au

<b>Belgium</b>	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
<b>Brazil</b>	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
<b>Chile</b>	Robotec S.A. (Agency) Santiago de Chile Chile Tel. +56 2 331-5951 Fax +56 2 331-5952 robotec@robotec.cl www.robotec.cl
<b>China</b>	KUKA Automation Equipment (Shanghai) Co., Ltd. Songjiang Industrial Zone No. 388 Minshen Road 201612 Shanghai China Tel. +86 21 6787-1808 Fax +86 21 6787-1805 info@kuka-sha.com.cn www.kuka.cn
<b>Germany</b>	KUKA Roboter GmbH Zugspitzstr. 140 86165 Augsburg Germany Tel. +49 821 797-4000 Fax +49 821 797-1616 info@kuka-roboter.de www.kuka-roboter.de

<b>France</b>	KUKA Automatismes + Robotique SAS Techvallée 6, Avenue du Parc 91140 Villebon S/Yvette France Tel. +33 1 6931660-0 Fax +33 1 6931660-1 commercial@kuka.fr www.kuka.fr
<b>India</b>	KUKA Robotics India Pvt. Ltd. Office Number-7, German Centre, Level 12, Building No. - 9B DLF Cyber City Phase III 122 002 Gurgaon Haryana India Tel. +91 124 4635774 Fax +91 124 4635773 info@kuka.in www.kuka.in
<b>Italy</b>	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
<b>Japan</b>	KUKA Robotics Japan K.K. Daiba Garden City Building 1F 2-3-5 Daiba, Minato-ku Tokyo 135-0091 Japan Tel. +81 3 6380-7311 Fax +81 3 6380-7312 info@kuka.co.jp
<b>Korea</b>	KUKA Robotics Korea Co. Ltd. RIT Center 306, Gyeonggi Technopark 1271-11 Sa 3-dong, Sangnok-gu Ansan City, Gyeonggi Do 426-901 Korea Tel. +82 31 501-1451 Fax +82 31 501-1461 info@kukakorea.com

<b>Malaysia</b>	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
<b>Mexico</b>	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
<b>Norway</b>	KUKA Sveiseanlegg + Roboter Sentrumsvegen 5 2867 Hov Norway Tel. +47 61 18 91 30 Fax +47 61 18 62 00 info@kuka.no
<b>Austria</b>	KUKA Roboter Austria 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
<b>Poland</b>	KUKA Roboter Austria GmbH Spółka z ograniczoną odpowiedzialnością Oddział w Polsce Ul. Porcelanowa 10 40-246 Katowice Poland Tel. +48 327 30 32 13 or -14 Fax +48 327 30 32 26 ServicePL@kuka-roboter.de

**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** OOO KUKA Robotics Rus  
Webnaja ul. 8A  
107143 Moskau  
Russia  
Tel. +7 495 781-31-20  
Fax +7 495 781-31-19  
kuka-robotics.ru

**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  
Industriestr. 9  
5432 Neuenhof  
Switzerland  
Tel. +41 44 74490-90  
Fax +41 44 74490-91  
info@kuka-roboter.ch  
www.kuka-roboter.ch

**Spain** KUKA Robots IBÉRICA, S.A.  
Pol. Industrial  
Torrent de la Pastera  
Carrer del Bages s/n  
08800 Vilanova i la Geltrú (Barcelona)  
Spain  
Tel. +34 93 8142-353  
Fax +34 93 8142-950  
Comercial@kuka-e.com  
www.kuka-e.com

<b>South Africa</b>	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
<b>Taiwan</b>	KUKA Robot Automation Taiwan Co., Ltd. No. 249 Pujong Road Jungli City, Taoyuan County 320 Taiwan, R. O. C. Tel. +886 3 4331988 Fax +886 3 4331948 info@kuka.com.tw www.kuka.com.tw
<b>Thailand</b>	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
<b>Czech Republic</b>	KUKA Roboter Austria GmbH Organisation Tschechien und Slowakei Sezemická 2757/2 193 00 Praha Horní Počernice Czech Republic Tel. +420 22 62 12 27 2 Fax +420 22 62 12 27 0 support@kuka.cz
<b>Hungary</b>	KUKA Robotics Hungaria Kft. Fő út 140 2335 Taksony Hungary Tel. +36 24 501609 Fax +36 24 477031 info@kuka-robotics.hu

**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

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





## Index

### A

Acyclic, communication 45

### C

CAST\_FROM 48

CAST\_TO 48

CBA 6

CCLOSE 48

CHANNEL 48

CIOCTL 48

Communication, acyclic 45

Configuration 13

COPEN 48

Coupling, device 41

CREAD 48

CWRITE 48

### D

Decoupling, device 41

Diagnosis 49

Diagnostic data, displaying 49

Diagnostic monitor (menu item) 49

Diagnostic signals via PROFINET 54

Documentation, industrial robot 5

### G

GSDML 6

GSDML files, making available 14

### I

Industrial Ethernet 6

Installation 11

Installation, PROFINET 11

Introduction 5

IRT 6

### K

KUKA Customer Support 57

### L

Logging off the higher-level safety controller 37

### M

Mapping, inputs/outputs 26

Messages 55

### N

Naming, device 15

### O

Operation 41

### P

PC WORX 6

PLC 6

Power management via PROFINET 37

Product description 7

PROFIsafe enabling switch 36

Programming 45

### R

Record index 13

### S

SafeOperation via PROFIsafe 37

Safety 9

Safety instructions 5

Safety interface via PROFIsafe (optional) 27

Service, KUKA Roboter 57

Signal "Peri enabled" 31

SREAD 48

Step 7 6

Subnet 6

Subnet mask 6

Support request 57

SWRITE 48

System requirements 11

### T

Target group 5

Timeout, coupling 42

Timeout, decoupling 42

Trademarks 5

### U

Uninstallation, PROFINET (KSS) 12

### W

Warnings 5



