

Application manual PROFlenergy Device

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Application manual
PROFlenergy Device

RobotWare 6.03

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Overview of this manual

About this manual

This manual describes the RobotWare option *963-1 PROFlenergy*.

Usage

This manual should be used during installation and configuration of the option *963-1 PROFlenergy*.

Who should read this manual?

This manual is intended for:

- Personnel that are responsible for installations and configurations of industrial network hardware/software.
- Personnel that make the configurations of the I/O system.
- System integrators.

Prerequisites

The reader should have the required knowledge of:

- PROFlenergy specification
- PROFINET network
- I/O system configuration
- IRC5 controller
- RobotStudio

References

Reference	Document ID
<i>Technical reference manual - System parameters</i>	3HAC050948-001
<i>Product manual - IRC5</i>	3HAC021313-001
<i>Operating manual - IRC5 with FlexPendant</i>	3HAC050941-001
<i>Operating manual - RobotStudio</i>	3HAC032104-001
<i>Product specification - Controller software IRC5</i>	3HAC022349-001
<i>Application manual - PROFINET Controller/Device</i>	3HAC050969-001

Other references

Reference	Description
PROFlenergy profile specification, Version V1.1 Edition 2 – Date: December 2013	Common application specification specifying methods and techniques to implement energy saving functions.
International standard IEC 61158 Type 3 International standard IEC 61784	The PROFINET network standard is described in the international standards.
www.profinet.com	The web site of PROFINET International

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Revisions

Revision	Description
-	Released with RobotWare 6.0.
A	Released with RobotWare 6.01. <ul style="list-style-type: none">• Added information about energy saving enabled I/O device, which is controlled by PROFINET controller.
B	Released with RobotWare 6.03. <ul style="list-style-type: none">• Added information about how to enable devices with <i>EnergySavingActive</i> attribute. See Selecting devices for the IO OFF mode on page 14.• Added information that robot controller sometimes donot resume to original state after energy saving state is paused during system failure or emergency stop.

Safety

Safety of personnel

When working inside the robot controller it is necessary to be aware of voltage-related risks.

A danger of high voltage is associated with the following parts:

- Devices inside the controller, for example I/O devices, can be supplied with power from an external source.
- The mains supply/mains switch.
- The power unit.
- The power supply unit for the computer system (230 VAC).
- The rectifier unit (400-480 VAC and 700 VDC). Capacitors!
- The drive unit (700 VDC).
- The service outlets (115/230 VAC).
- The power supply unit for tools, or special power supply units for the machining process.
- The external voltage connected to the controller remains live even when the robot is disconnected from the mains.
- Additional connections.

Therefore, it is important that all safety regulations are followed when doing mechanical and electrical installation work.

Safety regulations

Before beginning mechanical and/or electrical installations, ensure you are familiar with the safety regulations described in *Operating manual - General safety information*¹.

¹ This manual contains all safety instructions from the product manuals for the manipulators and the controllers.

Network security

Network security

This product is designed to be connected to and to communicate information and data via a network interface, It is your sole responsibility to provide and continuously ensure a secure connection between the product and to your network or any other network (as the case may be). You shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB Ltd and its entities are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

1 Introduction

1.1 What is PROFlenergy?

General

PROFlenergy is a profile of the PROFINET communications protocol that allows the power consumption of automation equipment in manufacturing (such as robot assembly cells, laser cutters and sub-systems such as paint lines) to be managed over a PROFINET network. It offers an open and standardized means of controlling energy usage during planned and unplanned breaks in production. PROFINET is an open standard for Industrial Ethernet. PROFINET satisfies requirements for automation technology. PROFINET solutions can be implemented for factory and process automation, for safety applications, and for the entire range of drive technology right up to clock-synchronized motion control.

Standardization

The use of open standards, simple operation, and the integration of existing system segments have driven the definition of PROFINET from the beginning. PROFINET is standardized in IEC 61158 and IEC 61784. The continual further development of PROFINET offers users a long term perspective for the implementation of their automation tasks.

Other communication profiles

PROFINET has a modular design and different PROFINET communication profiles are all combinations of modular elements from the groups' transmission technology, communication protocol, and application profiles.

Here are some examples of PROFINET communication profiles:

- PROFINET-IO - Distributed I/O (Remote I/O). Here, the familiar I/O view of PROFIBUS is retained, in which the user data from the field devices are periodically transmitted into the process model of the control system.
- PROFINET-CBA - Based on the object-oriented modelling of technological modules. Based on the object model, machines and installations are structured in PROFINET in the form of technological modules.
- PROFIsafe - Defines how safety-oriented devices (emergency shutoff switches, light grids, overfill protection systems, etc.) can communicate safety control information over a network securely enough that they can be used in safety-oriented automation tasks up to EN954's KAT4, AK6, or SIL3 (Safety Integrity Level).
- PROFIdrive - The PROFIdrive profile covers application scenarios from simple frequency converters to highly dynamic servo drivers.

1 Introduction

1.2 PROFlenergy for IRC5

1.2 PROFlenergy for IRC5

General

PROFlenergy is an application profile that specifies methods and techniques to implement energy-saving functions within a PROFINET I/O enabled device. The PROFlenergy profile is based on PROFINET in order to have a manufacturer independent basis, for an effective energy management. The profile defines a set of commands, which allow the customer to switch on and switch off energy saving modes for unused consumers during breaks in a common way.

The PROFINET network is running on the IRC5 main computer and does not require any additional hardware. PROFINET as described in this manual requires the main computer DSQC1000.

Options

The RobotWare option *963-1 PROFlenergy* allows the IRC5 controller to act as a PROFlenergy device on the PROFINET network.

The option supports the Class 1 (Standby Management) Device Profile. The robot controller can act and respond to incoming PROFlenergy commands. The option complies with the *PROFlenergy Profile Specification, Version V1.1 Edition 2 – Date: December 2013*.



Note

The option cannot be used in conjunction with option *PROFINET Anybus Device* in order to achieve a PROFlenergy device.

2 Functional description

Energy saving modes

The following energy saving modes are available:

- *BRAKES ON*
- *MOTORS OFF*
- *IO OFF*

PE_MODE ⁱ	Mode	Description	Selection
0xF0	OPERATE	The robot controller is operating. It is not possible to enter an energy saving modes from operate.	This is achieved by setting the robot controller in manual mode or if the system input signal is set to not allow energy saving.
0xFF	READY TO OPERATE	The robot controller is operating. It is possible to enter an energy saving mode.	This is achieved by setting the robot controller in automatic mode and the system input signal is set to allow energy saving.
0x3	BRAKES ON	Energy saving mode where the mechanical brakes are engaged.	20 seconds ≤ pause time < 2 minutes
0x2	MOTORS OFF ⁱⁱ	Energy saving mode where the controller is in motors off state.	2 minutes ≤ pause time < 10 minutes
0x1	IO OFF ⁱⁱⁱ	Energy saving mode where any energy enabled device managed by the PROFINET controller are paused. The robot controller is in motors off state.	10 minutes ≤ pause time

ⁱ PROFInergy mode. An energy mode with lower mode number has lower energy consumption.

ⁱⁱ The MOTORS OFF mode also have brakes engaged.

ⁱⁱⁱ The IO OFF mode also have the motors off and brakes engaged.

Prerequisites

All energy consumption levels are assumed to be 0.

Enable energy saving

At the startup of a robot system, it does not permit energy saving since the *Enable Energy Saving* is set to zero (inactive) as default. To permit energy saving, the robot controller must have energy saving enabled. Energy saving is enabled by setting the system signal *Enable Energy Saving* to one (active). Apart from enabling, the robot controller also needs to be in automatic operator mode to enter any energy saving mode.

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2 Functional description

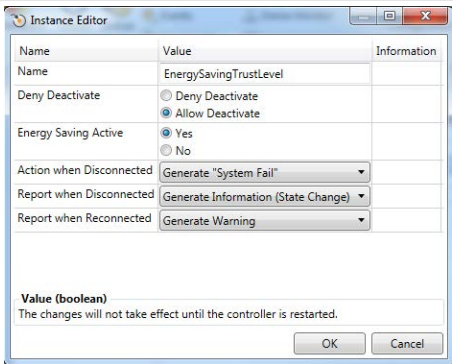
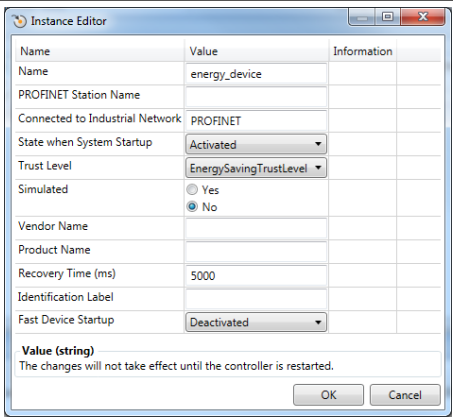
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Selecting devices for the IO OFF mode

This section describes the procedure to define devices with *EnergySavingActive* attribute. The important aspects of enabling *EnergySavingActive* in devices are:

- The devices that are connected to the internal PROFINET controller should be defined in the configuration of network devices. This helps the devices to be paused during IO OFF mode for energy saving.
- The *EnergySavingActive* attribute should be set for each device.
- It is possible to set the *EnergySavingActive* attribute through *Device Trust Level* parameter. For more information, see *Device Trust Level* in *Technical reference manual - System parameters*.
- Since, the robot controller is not in any energy saving mode at startup, all devices that are selected are set to continue or activate.

Use this procedure to define devices with *EnergySavingActive* attribute via *Device Trust Level* parameter.

	Action	Note
1	Open the Configuration Editor and select I/O System.	
2	Define a new device trust level. <ul style="list-style-type: none">• In the Type list, right-click on Device Trust Level and select New Device Trust level.• Enter the parameter details for the new device trust level.	 en1500002683
3	In the Type list, click PROFINET Device . Add the <i>EnergySavingActive</i> attribute for each device that shall carry out energy saving. <ul style="list-style-type: none">• Enter the parameter values for the device.• Trust Level, select trust level defined in the previous step. In this case, it is <i>EnergySavingTrustLevel</i>.• Click Ok.	 en1500002684

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Changing mode

To enter an energy saving mode, the robot controller must be in the state **READY TO OPERATE**. In the **READY TO OPERATE** state, the robot controller is in automatic mode and the motors may be on or off. Then the **PROFenergy** can be paused for a certain amount of time.



WARNING

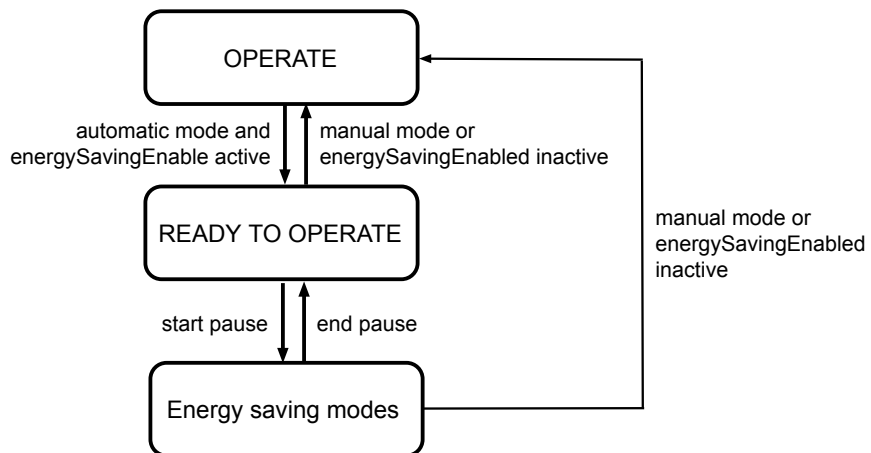
When entering an energy saving mode, the robot stops immediately, regardless of its position, speed, or connected process equipment.

The **PROFenergy** device should receive signal to end the pause to leave an energy saving mode. The robot controller resumes to its previous state, that is the same state as it had when it was paused. For example, if a **RAPID** program was executing when the pause was started then when leaving the energy saving mode, the program will resume and carry on from where it was paused.



WARNING

When the robot controller is in automatic mode, motors on can be enabled and the robot or other equipment can start to move without warning.



en1300000009

When the controller is paused for 10 minutes or longer, any selected device that is not in operate state and supports energy saving, will be paused. Also, a connected and deactivated device will be directed to pause.

The following are some of the scenarios that occurs when the robot controller has a system failure or emergency stop:

- When the robot controller is in system failure state, it is not possible to carry out any energy saving requests.
- It is possible to start and stop energy saving at emergency stop. However, sometimes the robot controller is not able to resume to same condition it had when energy saving was started.

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- The end pause will succeed but motors and program condition might not be possible to resume. It is the responsibility of the energy controller to manage, when it is not possible to resume to the original conditions.
- Turning on the power switch will set the robot controller not to save any energy.

Prohibit energy saving at critical processes

When it is necessary to protect certain process or equipment, the energy saving can be prohibited.

- Block energy saving by setting system signal *enableEnergySaving* to inactive.
- Begin the uninterruptable process.
- Finish the process.
- Allow energy saving by setting system signal *enableEnergySaving* to active.

The current energy saving status is visible through the system signal *EnergySavingBlocked*. For more information, see *Technical reference manual - System parameters*, parameter *Energy Saving Blocked*.

Ending the energy saving mode

The ending of the energy saving mode must be carried out by the same PROFINET controller that puts the robot controller in the energy saving mode.

To override an active energy saving, switch to manual mode or restart the robot controller.

3 PROFlenergy commands

Supported commands

The following PROFlenergy commands from the PROFINET controller are supported in the robot controller.

PE command	Service request ID	Modifier
Start_Pause	0x01	0x00
Start_Pause_with_time_response	0x01	0x01
End_Pause	0x02	0x00
List_Energy_Saving_Modes	0x03	0x01
Get_Mode	0x03	0x02
PEM_Status	0x04	0x00
PEM_Status_with CTTO	0x04	0x01
PE_Identify	0x05	0x00
Query_Version	0x06	0x00

For additional information, see *PROFlenergy Profile Specification, Version V1.1 Edition 2 – Date: December 2013*.

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