

SmartSlice GRT1-Series

**GRT1-PNT
PROFINET IO
Communication Unit**


OPERATION MANUAL


OMRON

Notice

OMRON products are manufactured for use by a trained operator and only for the purposes described in this manual.

The following conventions are used to classify and explain the precautions in this manual. Always heed the information provided with them.

 **WARNING** Indicates information that, if not heeded, could possibly result in serious injury or loss of life.

 **Caution** Indicates information that, if not heeded, could possibly result in minor or relatively serious injury, damage to the product or faulty operation.

OMRON product references

All OMRON products are capitalized in this manual.

The first letter of the word *Unit* is also capitalized when it refers to an OMRON product, regardless of whether it appears in the proper name of the product.

Visual aids

The following heading appears in the left column of the manual to help you locate different types of information.

Note Indicates information of particular interest for efficient and convenient operation of the product.

1,2,3... Indicates various lists such as procedures, checklists etc.

Trademarks and copyrights

All product names, company names, logos or other designations mentioned herein are trademarks of their respective owners.

Copyright

Copyright © 2010 OMRON

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form, or by any means, mechanical, electronic, photocopying, recording, or otherwise, without the prior written permission of OMRON.

No patent liability is assumed with respect to the use of the information contained herein. Moreover, because OMRON is constantly striving to improve its high-quality products, the information contained in this manual is subject to change without notice. Every precaution has been taken in the preparation of this manual. Nevertheless, OMRON assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained in this publication

TABLE OF CONTENTS

Precautions	vii
1 Intended audience	viii
2 General precautions	viii
3 Safety precautions	viii
4 Operating environment precautions	ix
5 Application precautions	x
6 Conformance to EC Directives	xi

SECTION 1

Features and specifications	1
1-1 Overview of GRT1-series SmartSlice I/O Units	2
1-2 GRT1-PNT PROFINET IO Communication Unit	3
1-3 GRT1-END-M memory end unit	9
1-4 GRT1-PNT configuration	10
1-5 Basic operating procedure	12

SECTION 2

Installation and wiring	15
2-1 GRT1-PNT Unit components	16
2-2 GRT1-END-M Unit components	22
2-3 Installing the GRT1-PNT Unit	23
2-4 Wiring the GRT1-PNT Unit	28
2-5 Setting up the PROFINET IO network	32
2-6 Installation of Configuration Software	38

SECTION 3

Set-up and operation	41
3-1 Device name setting and I/O allocation	42
3-2 Unit functions	46
3-3 GRT1-END-M Unit functions	52
3-4 Set-up the GRT1-PNT Configuration	54
3-5 Monitoring the GRT1-PNT	62
3-6 I/O communication characteristics	65

SECTION 4

Troubleshooting and maintenance	69
4-1 Overview	70
4-2 Troubleshooting using the LED indicators	71
4-3 Other errors	76
4-4 Maintenance	79
4-5 Replacing the Unit	80

Appendix A	
PROFINET IO technology	83
A-1 Introduction to PROFINET	83
A-2 PROFINET Communication	84
A-3 PROFINET Distributed I/O	85
A-4 PROFINET Communication Services	89
A-5 Alarms	90
A-6 FDT/DTM Technology	91
 Appendix B	
PROFINET IO alarm messages	93
B-1 Introduction	93
B-2 Alarm messages	94
 Appendix C	
Explicit messages	95
C-1 Basic format of explicit messages	95
C-2 Explicit messages common to all IO devices	97
C-3 Example of using explicit messages	98
 Revision history	105

Precautions

This chapter provides general precautions for using the GRT1-series modules, Programmable Controllers and related devices.

The information contained in this section is important for the safe and reliable operation of the GRT1-PNT PROFINET IO Communication Unit. You must read this section and understand the information contained before attempting to set up or operate a GRT1-PNT PROFINET IO Communication Unit and related systems.

Precautions	vii
1 Intended audience.....	viii
2 General precautions.....	viii
3 Safety precautions	viii
4 Operating environment precautions	ix
5 Application precautions	x
6 Conformance to EC Directives.....	xi

1 Intended audience

This manual is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).

- Personnel in charge of installing FA systems.
- Personnel in charge of designing FA systems.
- Personnel in charge of managing FA systems and facilities.


2 General precautions

The user must operate the product according to the performance specifications described in the operation manuals.


Before using the product under conditions which are not described in the manual or applying the product to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, safety equipment, and other systems, machines, and equipment that may have a serious influence on lives and property if used improperly, consult your OMRON representative.

Make sure that the ratings and performance characteristics of the product are sufficient for the systems, machines, and equipment, and be sure to provide the systems, machines, and equipment with double safety mechanisms.


This manual provides information for installing and operating using the OMRON GRT1-PNT PROFINET IO Communication Unit. Be sure to read this manual before attempting to use the Unit and keep this manual close at hand for reference during operation.

 **WARNING** It is extremely important that the Unit is used for the specified purpose and under the specified conditions, especially in applications that can directly or indirectly affect human life. You must consult with your OMRON representative before using the Unit in a system in the above mentioned applications.


3 Safety precautions

 **WARNING** Provide safety measures in external circuits (i.e., not in the Programmable Controller), including the following items, to ensure safety in the system if an abnormality occurs due to malfunction of the PLC or another (external) factor affecting the operation of the PLC. Not doing so may result in serious accidents.

- Emergency stop circuits, interlock circuits, limit circuits and similar safety measures must be provided in external control circuits.
- The PLC will stop operation when its self-diagnosis function detects any error or when a severe failure alarm (FALS) instruction is executed. As a countermeasure for such errors, external safety measures must be provided to ensure safety in the system.
- The PLC outputs may remain ON or OFF due to deposits on or burning of the output relays, or destruction of the output transistors. As a countermeasure for such problems, external safety measures must be provided to ensure safety in the system.
- When the 24 VDC output (service power supply to the PLC) is overloaded or short-circuited, the voltage may drop and result in the outputs being turned OFF. As a countermeasure for such problems, external safety measures must be provided to ensure safety in the system.
- SmartSlice I/O Terminals will continue operating even if one or more I/O Units is removed from or falls out of the SmartSlice I/O Terminal, i.e., the other I/O Units will continue control operations, including outputs. As a countermeasure for such problems, external safety measures must be provided to ensure safety in the system.

 **WARNING** The CPU Unit refreshes I/O even when the program is stopped (i.e., even in PROGRAM mode). Confirm safety thoroughly in advance before changing the status of any part of memory allocated to Output Units, Special I/O Units, or CPU Bus Units. Any changes to the data allocated to any Unit may result in unexpected operation of the loads connected to the Unit. Any of the following operations may result in changes to memory status.

- Transferring I/O memory data to the CPU Unit from a Programming Device.
- Changing present values in memory from a Programming Device.
- Force-setting/force-resetting bits from a Programming Device.
- Transferring I/O memory files from a Memory Card or EM file memory to the CPU Unit.
- Transferring I/O memory from a host computer or from another PLC on a network.

 **WARNING** Never attempt to disassemble any Units or touch the terminal block while power is being supplied. Doing so may result in serious electrical shock or electrocution.


4 Operating environment precautions

 **Caution** Do not operate the control system in the following locations:

- Locations subject to direct sunlight.
- Locations subject to temperatures or humidities outside the range specified in the specifications.
- Locations subject to condensation as the result of severe changes in temperature.
- Locations subject to corrosive or flammable gases.
- Locations subject to dust (especially iron dust) or salts.
- Locations subject to exposure to water, oil, or chemicals.
- Locations subject to shock or vibration.


Provide proper shielding when installing the Unit in the following locations:

- Locations subject to static electricity or other forms of electric noise.
- Locations subject to strong electromagnetic fields.
- Locations subject to possible exposure to radioactivity.
- Locations close to power supplies.


 **Caution** The operating environment of the Unit can have a large effect on the longevity and reliability of the system. Unsuitable operating environments can lead to malfunction, failure and other unforeseeable problems with the system. Ensure that the operating environment is within the specified conditions at installation and remains within the specified conditions during the life of the system. Follow all installation instructions and precautions provided in the operation manuals.

5 Application precautions

Observe the following precautions when using the GRT1-PNT PROFINET IO Communication Unit.

 **WARNING** Failure to abide by the following precautions could lead to faulty operation of the Unit or the system. Always heed these precautions:

- Install double safety mechanisms to ensure safety against incorrect signals that may be produced by broken signal lines or momentary power interruptions.
- When adding a new device to the network, make sure that the baud rate is the same as other stations.
- When adding a new SmartSlice I/O Unit to the Communication Unit, make sure that the CJ1W-PNT21 PROFINET IO Communication Unit is powered down, to prevent unexpected results when starting up the new station.
- Use specified communication cables.
- Do not extend connection distances beyond the ranges given in the specifications.
- Always turn OFF the power supply to the personal computer, Slaves, and Communication Units before attempting any of the following:
 - Mounting or dismantling the CJ1W-PNT21 PROFINET IO Communication Unit, Power Supply Units, I/O Units, CPU Units, or any other Units.
 - Assembling a Unit.
 - Setting DIP-switches or rotary switches.
 - Connecting or wiring the cables.
 - Connecting or disconnecting connectors.
- Be sure that all the mounting screws, terminal screws, Unit mounting screws, and cable connector screws are tightened to the torque specified in the relevant manuals. Incorrect tightening torque may result in malfunction.
- Always use the power supply voltage specified in this manual.
- Double-check all the wiring and connection of terminal blocks and connectors before mounting the Units.
- Take appropriate measures to prevent foreign objects from entering the unit when mounting or wiring it. Failure to do so, may result in unit damage, electric shock or fire.
- Use crimp terminals for wiring. Do not connect bare stranded wires directly to terminals.
- Observe the following precautions when wiring the communication cable.
 - Separate the communication cables from the power lines or high-tension lines.
 - Do not bend the communication cables.
 - Do not pull on the communication cables.
 - Do not place heavy objects on top of the communication cables.
 - Be sure to wire communication cable inside ducts.
 - Use appropriate communication cables.
- Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied in places where the power supply is unstable. An incorrect supply power may result in malfunction.
- Install external breakers and take other safety measures against short-circuits in external wiring. Insufficient safety measures against short-circuits may result in burning.
- Double-check all the wiring and switch settings before turning ON the power supply.
- When transporting or storing the product, cover the PCB's with electrically conductive materials to prevent LSI's and IC's from being damaged by static electricity, and also keep the product within the specified storage temperature range.
- When transporting the Unit, use special packing boxes and protect it from being exposed to excessive vibration or impacts during transportation.
- Do not attempt to disassemble, repair, or modify any Units.
- Do not remove the network cable during operation. Removing the network cable result in communication failures.

 **WARNING** Failure to abide by the following precautions could lead to faulty operation of the Unit or the system. Always heed these precautions:

- Always connect to a class-3 ground (100 Ω or less) when installing the Units.
- Fail-safe measures must be taken by the customer to ensure safety in the event of incorrect, missing, or abnormal signals caused by broken signal lines, momentary power interruptions, or other causes. Not doing so may result in serious accidents.

6 Conformance to EC Directives

6-1 Applicable directives

- EMC (ElectroMagnetic Compatibility) Directives
- Low-voltage directive

6-2 Concepts

OMRON units complying with EC Directives also conform to related product standards making them easier to incorporate in other units or machines. The actual products have been checked for conformity to product standards. Whether the products conform to the standards in the system used by the customer, however, must be checked by the customer.

Product related performance of OMRON units complying with EC Directives will vary depending on the configuration, wiring, and other conditions of the equipment or control panel in which OMRON devices are installed. The customer must, therefore, perform final checks to confirm that units and the overall system conforms to product standards.

A Declaration of Conformity for the GRT1-PNT PROFINET IO Communication Unit can be requested at your nearest OMRON representative.

6-3 Conformance to EC Directives

PROFINET IO units should be installed as follows, for the complete configuration to meet the EC directives:

- 1 The units are designed for installation inside control panels. All units must be installed within control panels.
- 2 Use reinforced insulation or double insulation for the DC power supplies used for the communication power supply, internal circuit power supply, and the I/O power supplies. Ensure that stable outputs can be provided even if a 10 ms interruption occurs at the input.
- 3 The GRT1-PNT PROFINET IO Communication Unit meets the generic emission standard. However as EMC performance can vary in the final installation, additional measures may be required to meet the standards. It should therefore be verified that the overall machine or device also meets the relevant standards. You must therefore confirm that EC directives are met for the overall machine or device, particularly for the radiated emission requirement (10 m).

SECTION 1
Features and specifications

This section provides an introductory overview of the GRT1 series SmartSlice I/O Units and the GRT1-PNT PROFINET IO Communication Unit, its functions and how to set up and configure it for a PROFINET network.

SECTION 1

Features and specifications **1**

1-1 Overview of GRT1-series SmartSlice I/O Units 2

1-2 GRT1-PNT PROFINET IO Communication Unit..... 3

1-3 GRT1-END-M memory end unit..... 9

1-4 GRT1-PNT configuration..... 10

1-5 Basic operating procedure 12

1-1 Overview of GRT1-series SmartSlice I/O Units

The GRT1-Series SmartSlice I/O Units are building-block style I/O Devices, which can be expanded in small I/O increments. This provides the possibility to configure I/O systems which exactly match the various customer applications. SmartSlice I/O Units communicate with the PROFINET IO Controller Unit by remote I/O communication through a PROFINET IO Communication Unit. The figure below shows a typical I/O configuration.

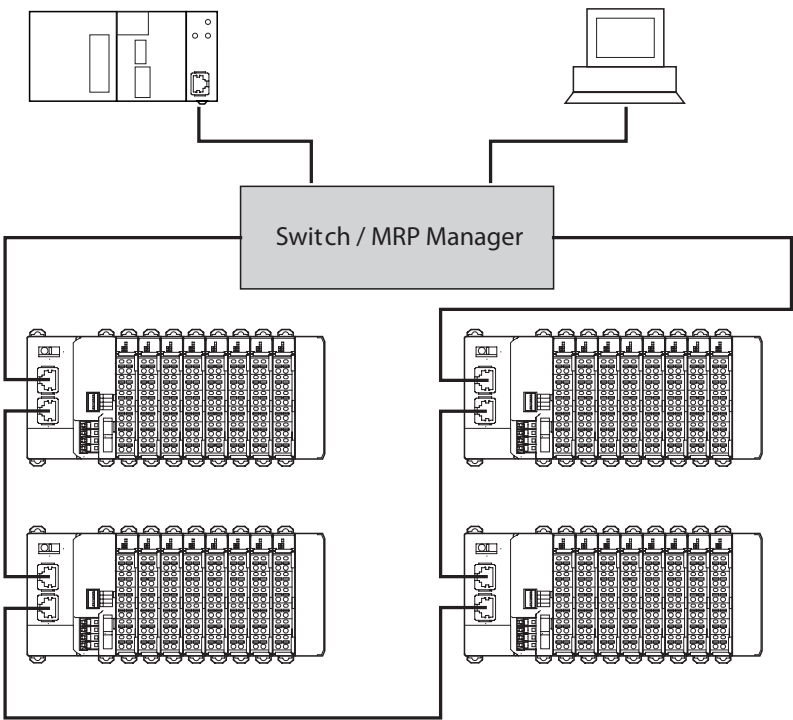


Figure 1.1: GRT1-PNTs connected to an IO Controller through Profinet

GRT1-series SmartSlice I/O and PROFINET IO Units

The GRT1-Series of SmartSlice I/O Units, Communication Units and PROFINET IO Units is constantly being expanded with new Units. Refer to the following manuals.

Name	Manual Reference
GRT1 Series SmartSlice I/O Units Operation Manual	W455
GRT1-DRT DeviceNet Communication Unit Operation Manual	W454
GRT1-PRT PROFIBUS Communication Unit Operation Manual	W04E
GRT1-CRT CompoNet Communication Unit Operation Manual	W476
SYSMAC CJ-Series CJ1W-PNT21 PROFINET IO Controller Unit Operation Manual	W12E

1-2 GRT1-PNT PROFINET IO Communication Unit

1-2-1 Features

The GRT1-PNT PROFINET IO Communication Unit for SmartSlice I/O controls data exchange between the PROFINET IO Controller and SmartSlice I/O Units over the PROFINET IO network as an IO Device. For an overview of the PROFINET IO technology refer to Appendix A PROFINET IO technology.

I/O Data Exchange

Cyclic I/O data exchange is used to exchange I/O data between the PROFINET IO Controller and SmartSlice I/O Units through the PROFINET IO Communication Unit. In addition to I/O data, status information in the PROFINET IO Communication Unit can be accessed from the PROFINET IO Controller Unit.

FINS/UDP Interface

The PROFINET IO Communication Unit is provided with a FINS/UDP Interface. This enables not only the PROFINET IO Controller to access the SmartSlice I/O Units using OMRON FINS messaging, but any device which supports a UDP interface (such as a Personal Computer using CX-Server Lite). This allows for configuration and monitoring of the SmartSlice I/O Units from remote stations.

Simplified Start-up

The PROFINET IO Communication Unit can be set up easily, just by wiring the Unit, configuring the PROFINET IO network using CX-ConfiguratorFDT and making simple DIP switch settings. The Unit's configuration is read automatically when the power is turned ON and I/O is also automatically allocated in the SmartSlice I/O Units.

Device Name Store In GRT1-END-M Memory End Unit

The separately available GRT1-END-M Memory End Unit facilitates easy replacement of the PROFINET IO Communication Unit. It optionally replaces the standard GRT1-END End Unit. No re-configuration using CX-ConfiguratorFDT is required in case of replacement of the Communication Unit. The PROFINET IO Device name, used for identification of the Communication Unit on the PROFINET IO network, is backed up and restored to and from the GRT1-END-M Memory End Unit.

Easy PROFINET IO Network Layout

The PROFINET IO Communication Unit is equipped with two ethernet ports. The built-in ethernet switch functionality allows for easy line configuration of the network, as additional external ethernet switches may not be necessary.

MRP Ring Redundancy

To avoid a single network failure causing communication failure within a large part of the network, the units can be set up in a ring topology. MRP Ring Redundancy as specified in the PROFINET standards ensures communication to all remaining devices through the redundant path.

Facilitating IO Controller Redundancy

To ensure a safe implementation of the application, the PROFINET IO Communication Unit and the PROFINET IO Controller offer the possibility of PLC system redundancy. Two IO Controllers (active and standby) are present in a network connected to all I/O Devices. This feature ensures a fast change from active to standby PLC / IO Controller in case of malfunction.

Simplified I/O Wiring

All SmartSlice I/O Units that connect to a PROFINET IO Communication Unit are equipped with screw-less clamp terminal blocks. Wiring to external I/O is accomplished just by inserting the wire into the terminals, eliminating the need to tighten terminal screws.

Table Registration

The configuration of the SmartSlice I/O Units (mounting order and I/O size) connected to a PROFINET IO Communication Unit can be registered in a table simply by setting a DIP switch. Once the table has been registered, the actual configuration is compared to the registered configuration each time that the power is turned ON. If the configuration does not match, a status flag is turned ON in the PROFINET IO Controller to indicate the error.

On-line Replacement of I/O Units

The SmartSlice I/O Unit's circuit section can be removed, so it is not necessary to turn OFF the Communication Unit's power to replace a Unit. Communication can be maintained in the remaining (connected) Units.

Parameter Backup and Restores

Before replacing a SmartSlice I/O Unit for maintenance, the parameter data set in all SmartSlice I/O Units can be backed up in the PROFINET IO Communication Unit by toggling a DIP switch. Another DIP selects the mode to automatically write the back-up parameter data to the replacement SmartSlice I/O Unit.

1-2-2 System configuration

The PROFINET IO Communication Unit connects to the IO Controller by an Ethernet network cable and it connects to the SmartSlice I/O Units by directly coupling the Units together.

I/O Data Exchange

The I/O Unit data in the PROFINET IO Communication Unit is shared with the IO Controller's Input and Output Areas through the PROFINET IO network. The I/O Units' data is collected in the PROFINET IO Communication Unit and exchanged with the IO Controller cyclically.

Messaging Services

The GRT1-PNT PROFINET IO Communication Unit also supports messaging services using FINS/UDP, allowing the user to send acyclic message commands addressed to the GRT1-PNT Unit or individual SmartSlice I/O Units. This can be sent from the PLC or for instance the Personal Computer.

End Unit for PROFINET IO

Always install an End Unit on the last I/O Unit in the system. For the PROFINET IO Communication Unit there are two options:

Type	I/O points	Model number	Description
End Unit	--	GRT1-END	End Unit to be mounted to the end of the SmartSlice I/O Terminal.
Memory End Unit	2 input bits	GRT1-END-M	End Unit to be mounted to the end of the SmartSlice I/O Terminal. The unit has a backup of the IO Device Name of the Communication Unit.

In case of replacement of the PROFINET IO Communication Unit, the PROFINET IO Device Name will be restored from the GRT1-END-M Unit to the new Communication Unit. In case of the standard GRT1-END, additional configuration download using CX-ConfiguratorFDT is required after replacement.

- Note**
- 1 Unlike the standard End Unit, the Memory End Unit will count as one SmartSlice I/O Unit. Up to 63 SmartSlice I/O Units can be connected to one PROFINET IO Communication Unit when the GRT1-END-M is used.
 - 2 The GRT1-END-M Memory End Unit functionality only applies to the PROFINET IO Communication Unit. Although the Memory End Unit has the basic End Unit functionality, the Unit is not aimed to be used together with other Communication Units.

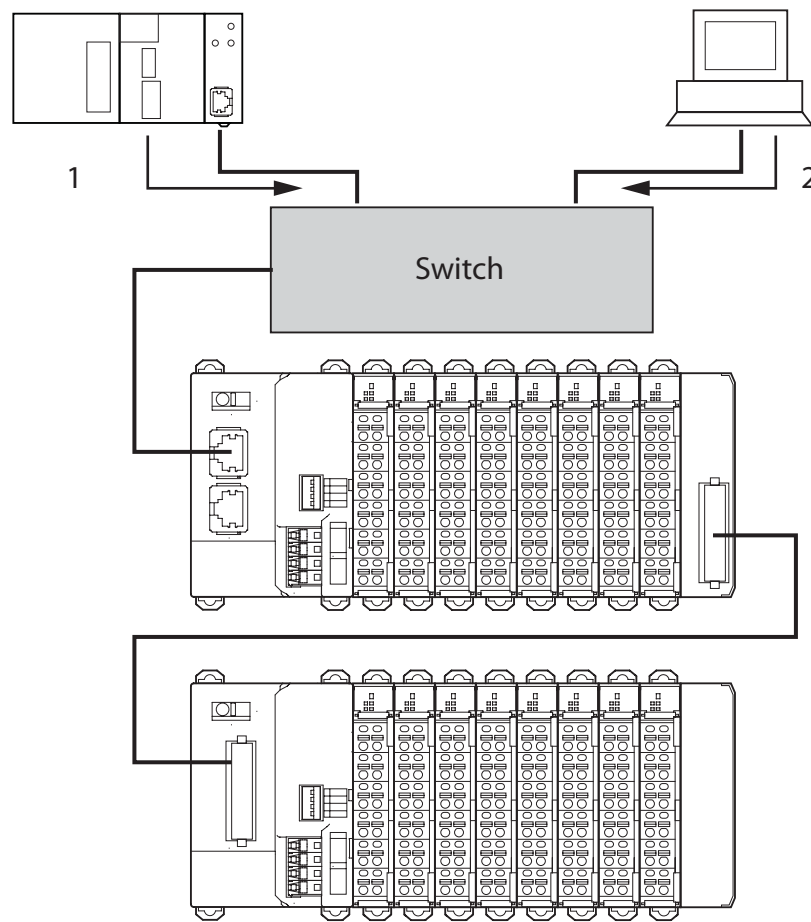


Figure 1.2: A single GRT1-PNT connects to multiple I/O blocks via Turnback units.

- 1 Remote I/O data is collected from the connected SmartSlice I/O Units and exchanged with the IO Controller Unit
- 2 Acyclic messages are used to monitor operation and write parameters to the SmartSlice I/O Units.

1-2-3 Specifications

Functional specifications

Item		Specification
Installation	Unit type	SmartSlice GRT1 series
	Model	GRT1-PNT
	Mounting position	DIN Rail mounted
	Power supply	24 V _{DC} + 10 % / – 15 % (20.4 V _{DC} to 26.4 V _{DC})
	Current consumption	140 mA (max), 120 mA typical at 24 V _{DC}
	Dimensions (WxHxD)	58 x 80 x 70 mm
	Weight	120 g (typical)
Environment	Ambient operating temperature	–10 °C to +55 °C (no icing or condensation)
	Ambient operating humidity	25 % to 85 % Relative Humidity
	Storage temperature	–40 °C to +70 °C (no icing or condensation)
	Vibration resistance	150 m/s ²
	Dielectric strength	500 VAC (between isolated circuits)
	Conformance to EMC and Electrical safety standards	EN 61131-2:2003
Front case	DIP-switches	4 DIP switches on the front of the unit: <ul style="list-style-type: none"> • Switch 1: Create / Enable registration table • Switch 2: Not used • Switch 3: Automatic restore • Switch 4: Backup Trigger
	Indicators	6 LEDs; Unit status: <ul style="list-style-type: none"> • RUN (green LED), • ERR (red LED), • UNIT PWR (green LED). SmartSlice I/O Unit status: <ul style="list-style-type: none"> • TS (red/green LED), • I/O PWR (green LED). PROFINET IO status: <ul style="list-style-type: none"> • BF (red LED).
	PROFINET IO Connector	2 x RJ45 8-pin Modular Connector (conforming to ISO 8877)
	Power	Screwless push-in connectors Unit power and I/O power are separated.
	Field Ground connector	Screwless push-in connector

Item		Specification
SmartSlice I/O System	Number of connectable SmartSlice I/O Units	64 units max. (including GRT1-END-M Memory Unit) Connected directly to the GRT1-PNT or via turnback extension units.
	Turnback cable	Length 1 m, up to 2 cables can be connected.
	SmartSlice I/O Unit connections	Building-block style configuration (Units connect with Turn-back cables)
	Base block power supply	Voltage: 24 V _{DC} Current: 4 A max
	Event messaging	Supported

Protocol specifications

Item		Specification
PROFINET interface	Protocol	PROFINET IO
	PROFINET unit type	PROFINET IO Device
	Isochronous mode	No
	Alarms	Yes
	Minimum Update Rate	8 ms
Transfer specifications	Bitrate	100 Mbps (100Base-TX)
	Automatic detection of transmission speed	Yes
PROFINET IO cable	Type	LAN balanced of category 5 or higher, according to ISO/IEC 11801 Edition 2.0
	Core cross section	AWG 22
	Maximum number of connector/socket pairs	6
	Max transmission distance	100 m (distance between nodes)
PROFINET redundancy	Protocol	Media Redundancy Protocol (MRP) client
Configuration	GSD file	GSDML-V2.1-OMRON-GRT1-PNT-20081205.xml
	DTM	Included in CX-ConfiguratorFDT
FINS service	FINS/UDP	Supported

External dimensions

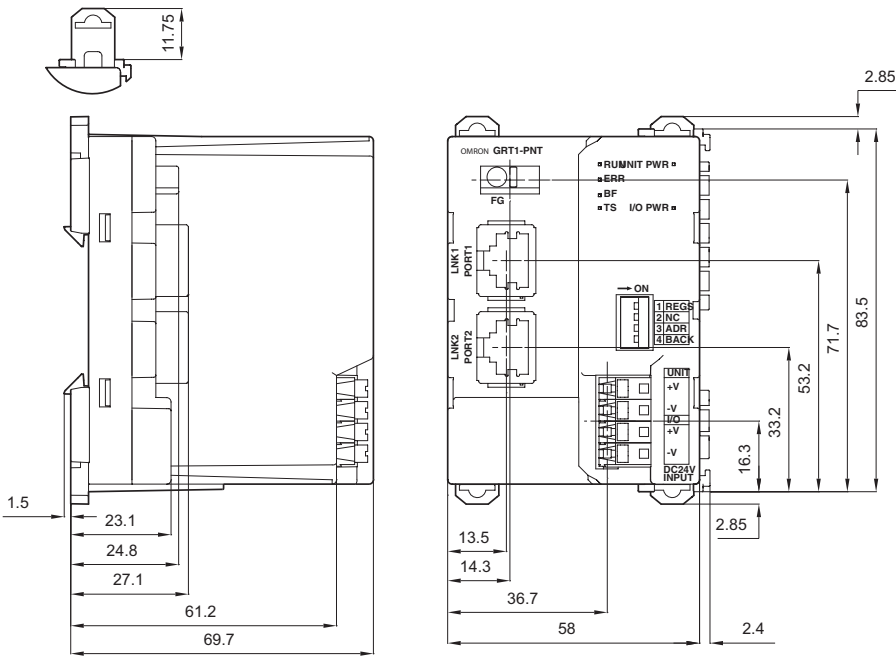


Figure 1.2.3: GRT1-PNT PROFINET IO Communication Unit external dimensions

1-3 GRT1-END-M memory end unit

Functional specifications

Item		Specification
Installation	Unit type	SmartSlice GRT1 series
	Model	GRT1-END-M
	Mounting position	DIN Rail mounted
	Current consumption	30 mA (max), 24 mA typical at 24 V _{DC}
	Dimensions (WxHxD)	19.5 x 83.5 x 55.7 mm
	Weight	60 g (typical)
Environment	Ambient operating temperature	−10 °C to +55 °C (no icing or condensation)
	Ambient operating humidity	25 % to 85 % relative humidity
	Storage temperature	−25 °C to +65 °C (no icing or condensation)
	Noise immunity	Conforms to IEC61000-4-4, 2.0 kV
	Shock resistance	150 m/s ²
	Dielectric strength	500 V _{AC}
	Enclosure rating	IP20
Front case	Indicators	TS (Two-colour LED): indicates the unit's operating status.

External dimensions

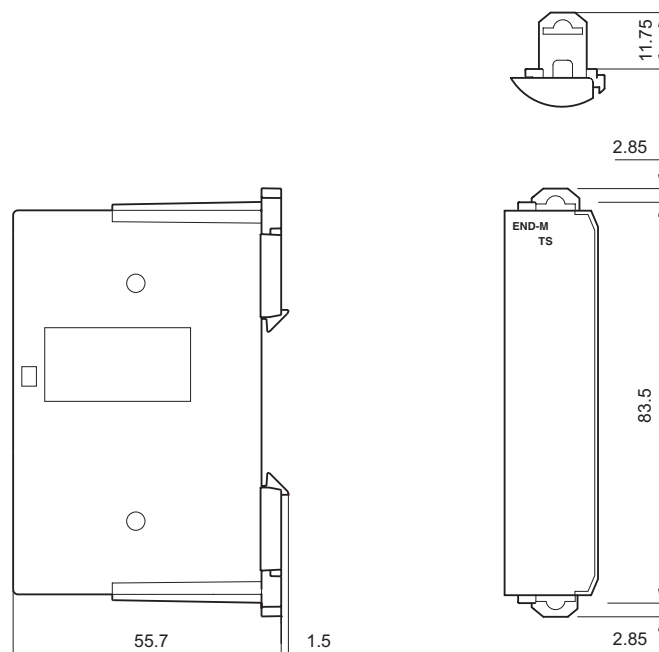


Figure 1.3: GRT1-END-M memory end unit external dimensions

1-4 GRT1-PNT configuration

PROFINET IO Configuration Means

The PROFINET IO Controller Unit requires a configuration before it can exchange I/O data with any of its IO Devices. For this configuration information on the IO device must be available. OMRON provides two means to facilitate IO Controller Unit configuration.

- A GRT1-PNT DTM
- A GRT1-PNT GSD file

GRT1-PNT Configuration DTM

The GRT1-PNT DTM is an executable component, provided by OMRON, which requires an FDT Container program like OMRON's CX-ConfiguratorFDT (see also Appendix A PROFINET IO technology, FDT/DTM Technology). The DTM runs inside this FDT Container and provides its own User Interface. It can access GRT1-PNT and SmartSlice I/O Unit data using FINS/UDP and present that to the user. It can also save the settings, using the features of the FDT Container program. The GRT1-PNT DTM provides the user with the following features.

- PROFINET I/O Configuration
- Configuration of individual SmartSlice I/O Units
- Monitoring of the SmartSlice I/O System

GRT1-PNT I/O Configuration

The I/O Configuration User Interface allows the user to define the configuration of SmartSlice I/O Units attached to the PROFINET IO Communication Unit. It also allows the user to make parameter settings for individual SmartSlice I/O Units.

The I/O Configuration is used by the PROFINET IO Controller Unit when mapping the I/O data of individual SmartSlice I/O Units onto the PLC memory areas. It is also sent by the PROFINET IO Controller Unit to the GRT1-PNT for verification when establishing communication. The I/O Configuration sent by the PROFINET IO Controller Unit must match the physical configuration attached to the GRT1-PNT PROFINET IO Communication Unit, in order to proceed with I/O data exchange.

Monitoring the SmartSlice I/O System

The Monitoring User Interfaces allows the user to read information from individual SmartSlice I/O Units. It also provides a means to read the Error Log of the GRT1-PNT PROFINET IO Communication Unit.

Configuration via GSD File

The GSD file concept is other way of configuration. The GSD file for the GRT1-PNT is an XML-based file, which contains all options required to configure a PROFINET IO Controller Unit. The file can be loaded by the configuration software of the IO Controller Units, which will then present the information to the user to allow the appropriate selections to be made.

The drawback of the GSD file is that - unlike the GRT1-PNT DTM - it only provides setting options for configuring the PROFINET IO. The GSD file does not provide the means to access data of the SmartSlice I/O Units directly.

Third-Party IO Controller Units

The GSD file for GRT1-PNT can be used to configure most third-party I/O Controller Units. The GRT1-PNT GSD file contains all the necessary parameters to allow the user to configure the IO Controller Unit for I/O data exchange.

- Note**
- 1 The GRT1-PNT DTM can also be used in third-party configuration software provided that this software supports the FDT/DTM concept.
 - 2 With the CX-ConfiguratorFDT FDT Container OMRON also provides a Generic IO Device DTM, an FDT/DTM interface between the FDT Container program and GSD files. Alternatively, this DTM can be used to set up an IO Controller Unit, using the GRT1-PNT GSD file. This Generic IO Device DTM however, does not provide the means to access data of the SmartSlice I/O Units directly.

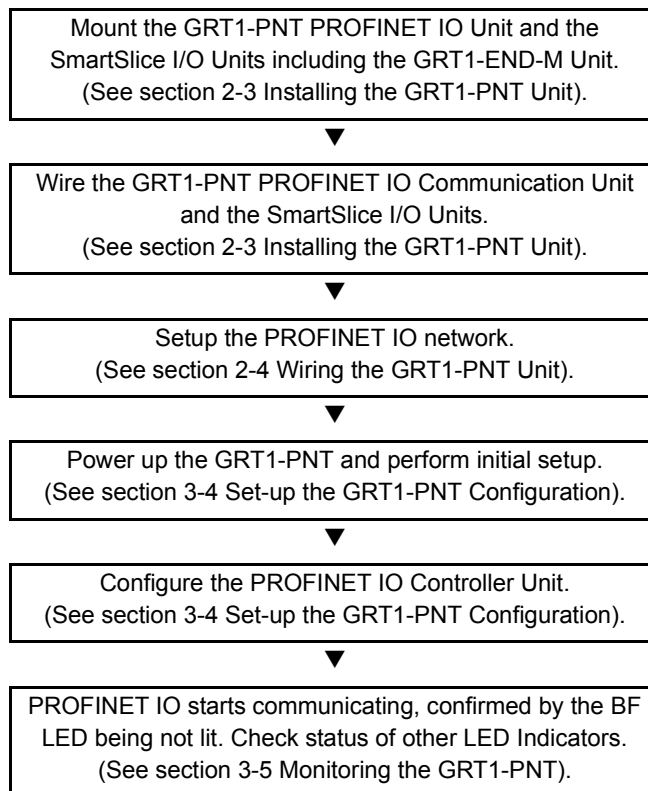
Downloading the configuration

After setting up the configuration, it must be downloaded to the PROFINET IO Controller Unit. The download process depends on the IO Controller Unit used.

1-5 Basic operating procedure

1-5-1 Overview

The following diagram provides an overview of the installation procedures. For experienced installation engineers, this may provide sufficient information. For others, cross-references are made to various sections of this manual where more explicit information is given.



1-5-2 Preparations for use

The following procedure shows the basic steps required before using the PROFINET IO Communication Unit and the SmartSlice I/O Units.

Initial setup procedure

- 1 Mount the GRT1-PNT Unit and the SmartSlice I/O system on the DIN rail. The maximum number of SmartSlice I/O Units can be 64 (including GRT1-END-M End Unit).
- 2 Wire the SmartSlice I/O Units and the GRT1-PNT Unit's power supply.
- 3 Wire the PROFINET IO network, to connect the Communication Unit to the PROFINET IO Controller Unit.
- 4 Turn ON the power to the Unit and the I/O.
- 5 Turn ON (from OFF to ON) DIP switch 1 on the front of the PROFINET IO Communication Unit. When switch 1 is turned ON, the existing SmartSlice I/O Unit configuration (connection order and I/O size) is registered in the PROFINET IO Communication Unit as a registered table. After the table is registered, leave pin 1 ON to enable the table.

Note The next time the power is turned ON, the actual SmartSlice I/O Unit configuration at power on is automatically compared to the registered table. Any SmartSlice I/O Units that do not match the registered table (connection order or I/O size) will not participate in I/O communication. I/O communication will start with the other SmartSlice I/O Units.

Configuration procedure

Use the following procedure to configure the IO Controller Unit together with the PROFINET IO Communication Unit using CX-ConfiguratorFDT and the IO Controller and IO Device DTMs:

- 1 Turn ON the PLC power supply and the power supplies of the IO Devices on the network.
- 2 In CX-ConfiguratorFDT, create a network and define the parameters and I/O configurations for the PROFINET IO Controller Unit settings and the allocated IO Devices. Choose the update rate for each IO Device.
- 3 Use the PROFINET IO Controller DTM to assign Device Names to the actual IO Devices in the network.
- 4 Download the network configuration to the PROFINET IO Controller Unit. After downloading the configuration, CX-ConfiguratorFDT will restart the PROFINET IO Controller Unit.
- 5 After restarting the PROFINET IO Controller Unit it will automatically start communication when the PLC goes into RUN/MONITOR mode.

SECTION 2
Installation and wiring

This section shows the GRT1-series PROFINET IO Communication Unit and identifies its controls and indicators. It contains the procedures for installing and wiring the Communication Unit as well as the GRT1-series SmartSlice I/O Units. It also contains the procedures for setting up the PROFINET IO network.

SECTION 2
Installation and wiring **15**

2-1	GRT1-PNT Unit components	16
2-2	GRT1-END-M Unit components.....	22
2-3	Installing the GRT1-PNT Unit.....	23
2-4	Wiring the GRT1-PNT Unit.....	28
2-5	Setting up the PROFINET IO network	32
2-6	Installation of Configuration Software	38

2-1 GRT1-PNT Unit components

2-1-1 Overview

The illustration below shows the two PROFINET IO Ethernet connectors with Link activity LED indicators (1), the Status LED indicators (3), the Field Ground Terminal (2), the DIP switches (4) and the power supply terminals (5 and 6) on the front side of the PROFINET IO Communication Unit. Each of these components is explained in the following sections.

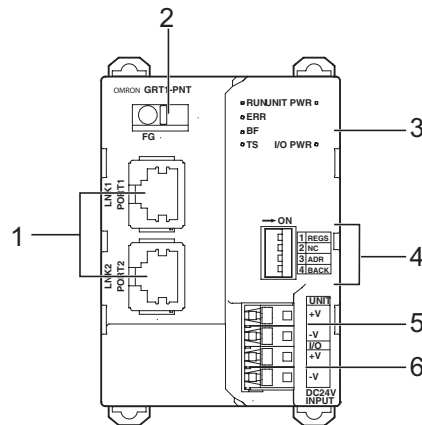


Figure 2.1: GRT1-PNT overview

2-1-2 Ethernet connectors

The GRT1-PNT contains two Ethernet connector ports. The ports are functionally the same and enable bus line network topology.

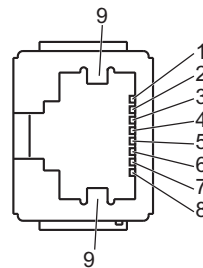


Figure 2.1.2: GRT1-PNT ethernet connector

Pin	Signal	Abbreviation	Signal direction
1	Transmission data +	TD+	Output
2	Transmission data -	TD-	Output
3	Reception data +	RD+	Input
4	Not used	---	---
5	Not used	---	---
6	Reception data -	RD-	Input
7	Not used	---	---
8	Not used	---	---
9	Field Ground	FG	---

The following standards and specifications apply to the connectors for the Ethernet twisted-pair cable.

- Electrical specifications: Conforming to IEEE 802.3 standards
- Shielded twisted-pair (STP) cable: minimum category CAT5
- Connector structure: RJ45 8-pin Modular Connector (conforming to ISO 877)

2-1-3 Field Ground Terminal

The GRT1-PNT PROFINET IO Communication Unit provides a Field gGround Terminal at the front side.

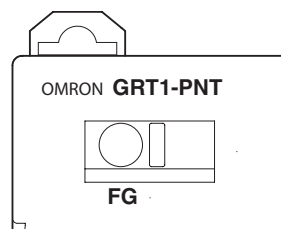


Figure 2.1.3: GRT1-PNT Field Ground Terminal

To help prevent electrical shock and/or if noise is a significant source of errors, ground the Field Ground Terminal with a ground resistance of less than 100 Ω using a 14-gauge wire (minimum cross-sectional area of 2 mm²).

Recommended Wire

Type	Gauge
Stranded wire	20 AWG to 14 AWG (0.5 to 2.0 mm ²)
Pin terminal	

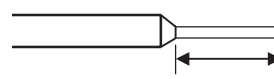
Strip Length

Pin Terminal Length

Strip wire between 8 mm and 10 mm of insulation at the ends of the wires (stranded or solid wire) or use pin terminals with a pin (conductor) length of 8 mm to 10 mm.



Strip 8 to 10 mm.



Pin length: 8 to 10 mm

2-1-4 LED indicators

The GRT1-PNT PROFINET IO Communication Unit uses the following LED indicators.

- Six LEDs to indicate status of the Unit and the PROFINET IO network
- Two LEDs at the Ethernet ports to indicate the Link activity of the ports

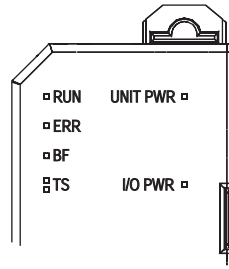


Figure 2.1.4: GRT1-PNT LED indicators

Status indicator specification

Indicator	Colour	Status	Meaning
RUN Unit status	Green	Not lit	<ul style="list-style-type: none"> Start-up test failed, unit not operational. Fatal error: Operation stopped.
		Lit	Initialization successful, unit is in normal operation.
ERR Unit error	Red	Not lit	Unit is in normal operation.
		Flashing	A start-up error has occurred.
		Lit	Fatal error in system execution.
BF PROFINET IO failure	Red	Not lit	<ul style="list-style-type: none"> No PROFINET IO communication errors occurred. I/O data exchange in progress.
		Flashing	The configuration settings sent by the PROFINET IO Controller unit are invalid. No I/O data exchange is possible.
		Lit	No PROFINET IO communication has been detected by the unit.
TS SmartSlice I/O system communication status	---	Not lit	<ul style="list-style-type: none"> No power supplied. Communication has not started with SmartSlice I/O Unit. Over current detected.
	Green	Flashing once per second	SmartSlice I/O Unit added to the system
		Flashing twice per second	Backup/Restore function operating: <ul style="list-style-type: none"> Restoring settings to SmartSlice I/O Unit, backup function operating. Downloading SmartSlice I/O Unit settings.
		Lit	Communication with SmartSlice I/O Unit established.
	Red	Flashing	Non-fatal communication error occurred: <ul style="list-style-type: none"> Communication time out. Verification error occurred with registered table. Different model Unit detected after SmartSlice I/O Unit replacement.
		Lit for 2 seconds	Failure occurred while restoring settings to SmartSlice I/O Unit or downloading SmartSlice I/O Unit settings.
		Lit	Fatal communication error occurred.
UNIT PWR	Green	Not lit	Power supply to the Unit is not present (All other LED indicators are also OFF).
		Lit	Power supply to the Unit is present.
I/O PWR	Green	Not lit	Power supply to the SmartSlice I/O Unit is not present. The SmartSlice I/O Units may be operative, but no output is available.
		Lit	Power supply to the SmartSlice I/O Unit is present.

Link activity specification

Indicator	Colour	Status	Meaning
LINK	Green	Not lit	No ethernet communication on corresponding port.
		Lit	Transmission/reception is in progress with connected switch/I/O Controller for corresponding port.

2-1-5 DIP switches

Four DIP switches on the front of the Communication Unit are provided for operational settings. The factory setting is OFF for all DIP switches.

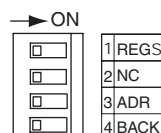


Figure 2.1.5: GRT1-PNT DIP switches

DIP Switch	Caption	Description
1	REGS	Create / Enable Registration Table
2	NC	Not Used (Always OFF)
3	ADR	Automatic Restore
4	BACK	Backup Trigger

Note It is recommended to use the features that are made available by DIP switches 1, 3 and 4 (as discussed on the next page).

DIP Switch 1: REGS

If DIP switch 1 is turned from OFF to ON while the Unit's power is ON, the existing SmartSlice I/O Unit configuration (connection order and I/O size) is registered in the PROFINET IO Communication Unit as a registered table.

If DIP switch 1 is ON when the Unit's power is turned ON, the actual SmartSlice I/O Unit configuration at start-up is automatically compared to the registered table. Any SmartSlice I/O Unit that does not match the registered table will not participate in SmartSlice I/O communication.

Switch 1 REGS	Function
ON	Registered table is enabled: if there is a verification error, the affected Unit will not participate in communication.
OFF	Registered table is disabled: all Units always participate in communication.
OFF to ON	Register I/O Unit table (Unit Power must be ON)
ON to OFF	Clear registered I/O Unit table (Unit Power must be ON)

DIP Switch 2: NC

DIP switch 2, marked NC, is not used and should always be set to OFF.

DIP Switch 3: ADR

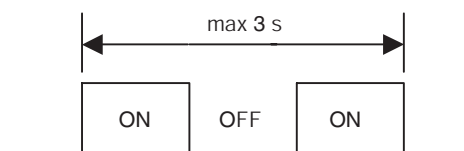
When DIP switch 1 is ON (registered table enabled) and DIP switch 3 is switched to ON, parameter data is automatically restored to the SmartSlice I/O Units that had parameter data backed up.

Switch 3 ADR	Function
OFF	Automatic restore function disabled.
OFF to ON	Automatic restore function enabled (when pin 1 is ON).

DIP Switch 4: BACK

When DIP switch 1 is ON (registered table enabled) and DIP switch 4 is turned OFF to ON, the parameter data of all connected SmartSlice I/O Units is backed up in the Communication Unit.

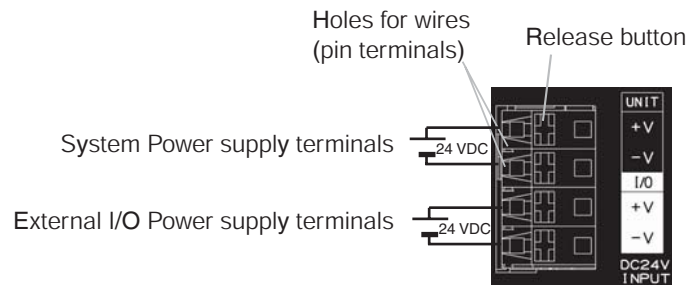
Switch 4 BACK	Function
ON	Switch ON to OFF to ON to start the parameter backup (when DIP switch 1 is ON).
OFF	---



The backup operation starts after DIP switch 4 is turned from ON to OFF to ON within 3 seconds.

2-1-6 Power supply connector

The PROFINET IO Communication Unit has two 24 V_{DC} power supply terminals on the front of the Unit.



Power supply terminals	Function
System	These terminals supply power to the internal circuits of both the PROFINET IO Communication Unit and the connected SmartSlice I/O Units (through the SmartSlice bus).
External I/O	These terminals supply power to the external I/O that is connected to the connected SmartSlice I/O Units.

Both the SmartSlice I/O System power supply and the external I/O power supply are connected with screwless clamping-type terminals.

Note System power supply and External I/O power supply are not transferred through the GCN2-100 Turnback cable. The GRT1-TBR Right Turnback Units provide the same set of Power Supply terminals as the PROFINET IO Communication Unit.

2-2 GRT1-END-M Unit components

2-2-1 Overview

The illustration below shows the front view of the GRT1-END-M with the TS LED indicator (1).



Figure 2.2.1: GRT1-END-M overview

2-2-2 LED Indicators

The GRT1-END-M Memory End Unit uses a single LED indicator to indicate the SmartSlice I/O Unit status.

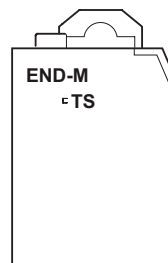


Figure 2.2.2: GRT1-END-M LED indicators

Name	Colour	Status	Meaning	
TS	Green	Lit	Normal status	Normal unit status. Normal network status.
		Flashing	Operating	The automatic restore / backup function is operating.
	Red	Lit	Fatal error	Unit hardware error (EEPROM error or WDT error)
		Flashing	Non-fatal error	Communication time out, etc.
	---	Not lit	No power	<ul style="list-style-type: none"> Unit power supply is OFF. Unit is waiting for initialization. Unit is being reset.

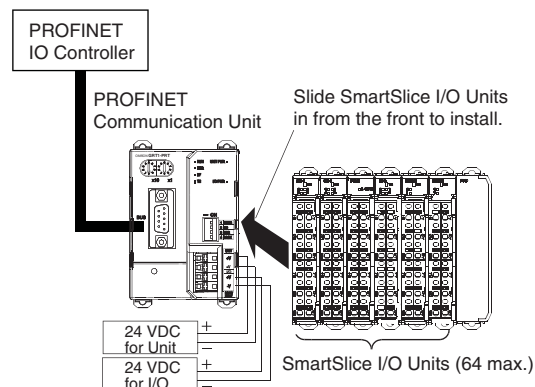
2-3 Installing the GRT1-PNT Unit

2-3-1 Handling precautions

When installing the PROFINET IO Communication Unit and the SmartSlice I/O Units, observe the following handling precautions.

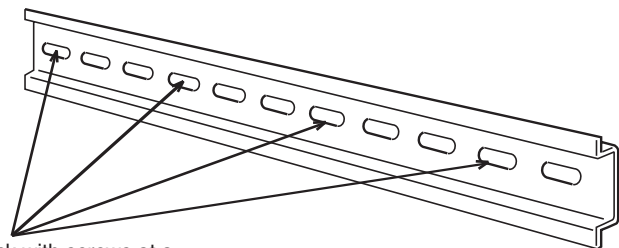
- Always turn OFF the power supply to the PROFINET IO Communication Unit, the SmartSlice I/O Units and the external I/O, before mounting or dismounting a Unit or connecting or disconnecting cables.
- Do not connect or disconnect the PROFINET IO Communication Unit's communication cable while the PROFINET IO network is operating.
- Ensure that the power supplies for the PROFINET IO Communication Unit, the SmartSlice I/O Units and the external I/O are wired correctly.
- Provide separate conduits or ducts for the control lines to prevent noise from high-tension lines or power lines.

The SmartSlice I/O system is installed and set up as a PROFINET IO Device. A PROFINET IO communication cable connects the PROFINET IO Communication Unit and the IO Controller. Up to 64 SmartSlice I/O Units can be connected to one GRT1-PNT Unit.



2-3-2 Installation on a DIN Rail

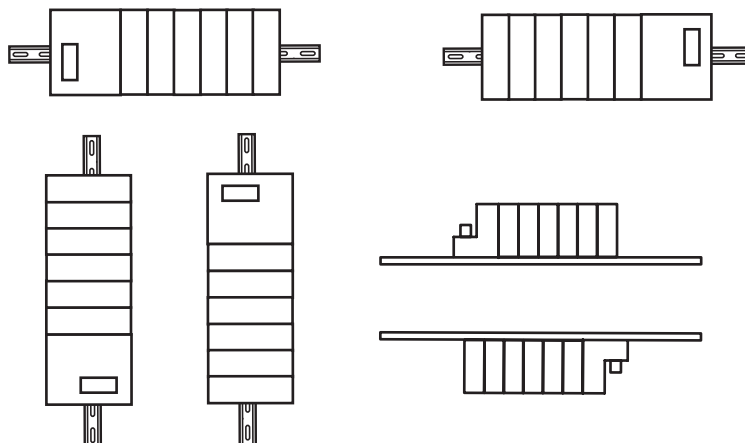
The GRT1-PNT and SmartSlice I/O Units must be mounted on a DIN Rail. Attach the DIN Rail with screws in every third mounting hole.



Attach the track with screws at a maximum spacing of 105 mm between adjacent screws.

**SmartSlice I/O System
Orientation**

The system can be mounted in any of the following 6 directions.

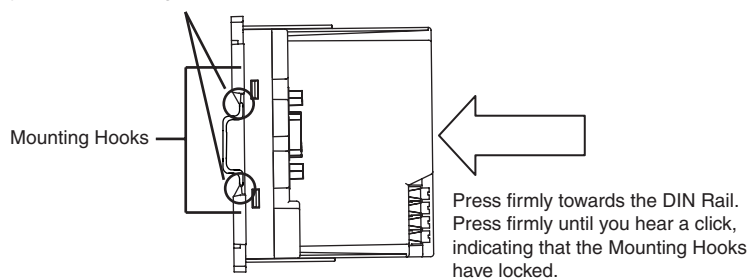


Note Please note the vertical orientations are not recommended because the heat dissipation may limit product life time.

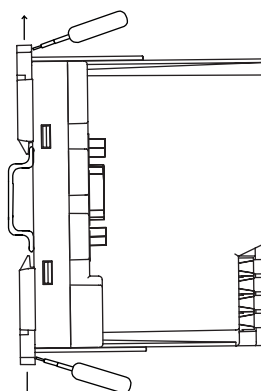
Installing a unit

To install a PROFINET IO Communication Unit on the DIN Rail, press the Unit onto the DIN Rail from the front. Press the Unit firmly until it clicks, indicating that the Unit's DIN Rail Mounting Hooks have all locked onto the DIN Rail.

When the Unit is pushed onto the DIN Rail, verify that the Mounting Hooks have locked.

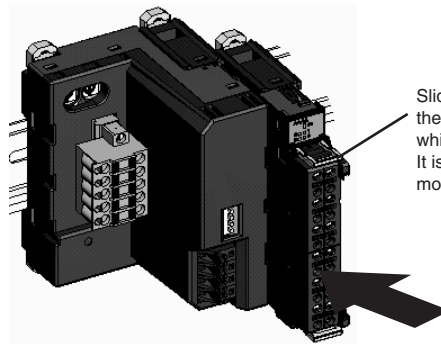
**Removing a unit**

Use a standard screwdriver to release the DIN Rail Mounting Hooks at the top and bottom of the Unit and pull the Unit straight away from the DIN Rail.



2-3-3 Connecting the PROFINET IO Unit and SmartSlice I/O Units

Connect the first SmartSlice I/O Unit to the PROFINET IO Communication Unit by aligning the sides of the Units and sliding in the SmartSlice I/O Unit from the front. Insert the Unit until it clicks, indicating that the Unit has locked onto the DIN Rail. Normally it is not necessary to release the Unit's mounting hooks when mounting the Unit.



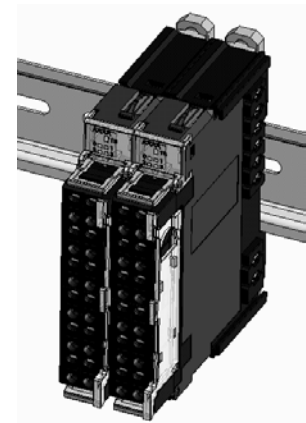
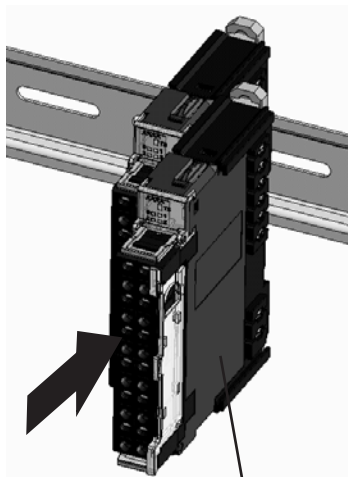
Slide the Slice I/O Unit toward the DIN Track from the front. Insert the Unit until you hear a click, which indicates that the Unit has locked on the Track. It is normally not necessary to release the DIN Track mounting hook when mounting the Unit.

!Caution Do not touch the connector on the Unit's base block.

2-3-4 Connecting additional SmartSlice I/O Units

Connect additional SmartSlice I/O Units by aligning the sides of the Units and sliding in the next Unit from the front. Insert each Unit until it clicks, indicating that the Unit has locked onto the DIN Rail. Normally it is not necessary to release the Unit's mounting hooks when mounting the Unit.

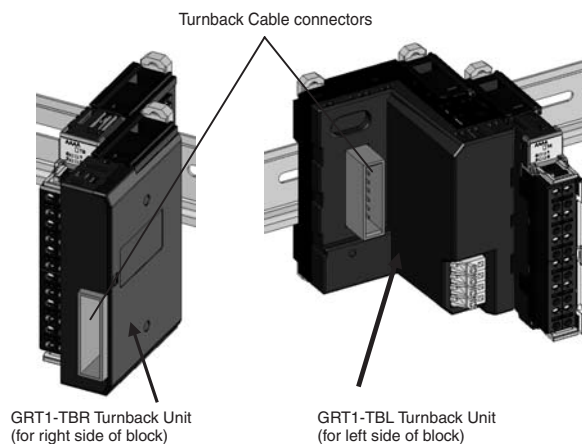
Up to 64 SmartSlice I/O Units can be connected to one PROFINET IO Communication Unit.



Slide the Unit to the DIN Track from the front. Insert the Unit until you hear a click, which indicates that the Unit has locked on the Track. It is normally not necessary to release the DIN Track mounting hook when mounting the Unit.

Connecting Turnback Units

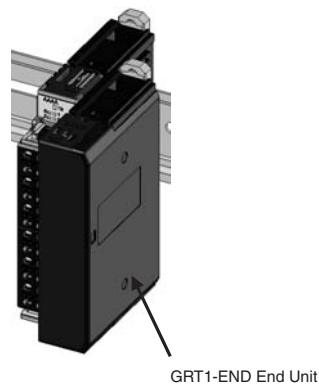
When a SmartSlice I/O System is divided into blocks, connect a GRT1-TBR Right Turnback Unit to the right end of the first block and connect a GRT1-TBL Left Turnback Unit to the left side of the expansion block. Mount these Turnback Units on the DIN Rail in the same way as the SmartSlice I/O Units. Use a GCN2-100 Turnback Cable to connect the Turnback Units together. Mount additional SmartSlice I/O Units on the expansion block.



Note The Turnback Units can be used to divide a SmartSlice I/O System into **up to three blocks**.

Connecting an End Unit

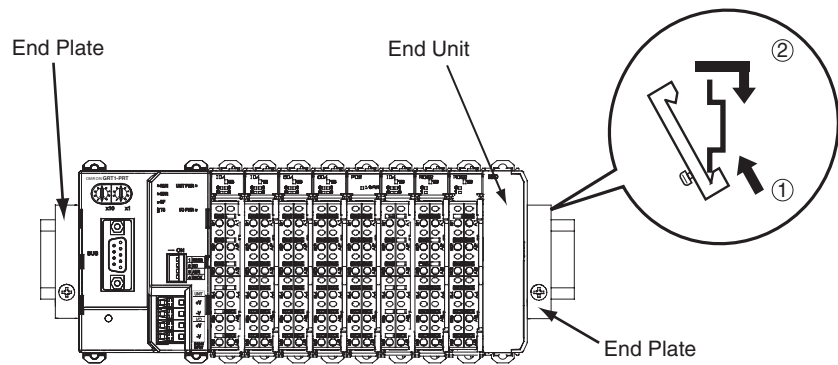
At the end of the last block, mount a GRT1-END End Unit or a GRT1-END-M Memory End Unit. Mount the Unit on the DIN Rail in the same way as the SmartSlice I/O Units.



Mounting End Plates

Always secure the SmartSlice I/O System on the DIN Rail by installing End Plates on both sides of the System.

- 1 First hook the bottom of the End Plate on the bottom edge of the DIN Rail.
- 2 Attach the top of the End Plate, and pull the End Plate down onto the top edge of the DIN Rail.
- 3 Tighten the End Plate's securing screw.



2-4 Wiring the GRT1-PNT Unit

2-4-1 Connecting the SmartSlice I/O System Power Supply

The GRT-PNT PROFINET IO Communication Unit has two sets of power supply terminals. See section 2-1-6 Power supply connector.

The following wiring example shows how power can be supplied to the various units in the SmartSlice I/O system.

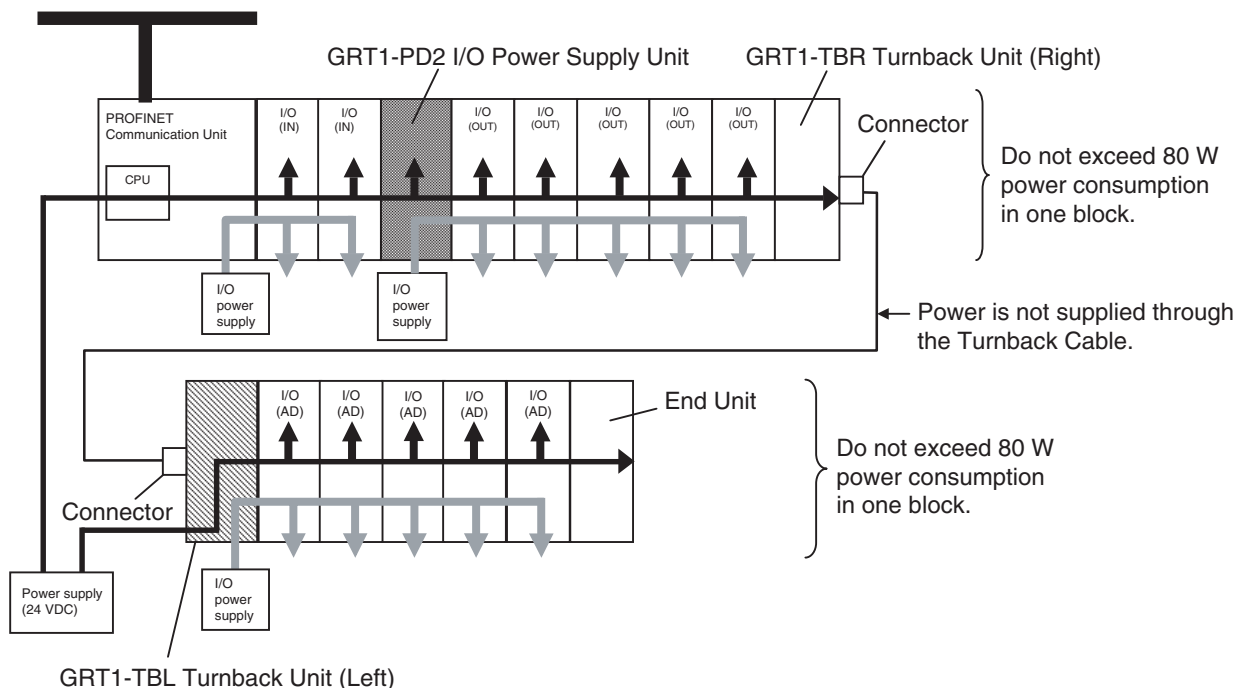


Fig. 2-4-1 Wiring example

Evaluating the Power Supply Requirements

Unit Power Supply

The maximum power consumption for SmartSlice I/O Units is 80 W per block.

1,2,3...

- 1 Calculate the power consumption of all SmartSlice I/O Units connected to the PROFINET IO Communication Unit (including other Units like Turnback Units and End Unit). Refer to the *GRT1 Series SmartSlice I/O Units Operation Manual (W455)* for the power value for each SmartSlice I/O Unit.
- 2 If the power consumption exceeds 80 W, mount a Right Turnback Unit (GRT1-TBR) on the SmartSlice I/O Unit at the point where the power consumption still is less than 80 W.
- 3 Connect the 24 V_{DC} Unit power supply to the Left Turnback Unit (GRT1-TBL) of the next expansion block.

Note

- 1 The GRT1-TBL is equipped with separate power supply terminals for the Unit power supply and I/O power supply.
- 2 When dividing the supply power, always wire (supply) the power from the same power supply, as shown in the wiring example above.

I/O Power Supply

The maximum I/O current consumption is 4 A.

- 1,2,3...**
- 1 Calculate the total current consumption used by all external I/O of the connected SmartSlice I/O Units (including other Units like the Memory End Unit). Refer to the *GRT1 Series SmartSlice I/O Units Operation Manual* (W455) for the (maximum) current value for each SmartSlice I/O Unit.
 - 2 If the current consumption exceeds 4 A or you want to provide separate systems for inputs and outputs, divide the SmartSlice I/O Units at the desired point with a GRT1-PD2 I/O Power Supply Unit and provide a separate external I/O power supply.
 - 3 It is also possible to provide a separate external I/O power supply at a Left Turnback Unit (GRT1-TBL).

- Note**
- 1 The GRT1-TBL is equipped with separate power supply terminals for the Unit power supply and I/O power supply.
 - 2 Always use isolated power supplies for the power supplies.
 - 3 Power is not supplied through the GCN2-100 Turnback Cable from one block to the next, as shown in the wiring example above.

2-4-2 Wiring Methods

Connect the power supply wires (24 V_{DC}) to the PROFINET IO Communication Unit's screwless clamping power supply terminals. Apply pin terminals to the wire ends before inserting them in the wire terminals.

Recommended Power Supplies

Use a SELV power supply with over current protection.

A SELV power supply has redundant or increased insulation between the I/O, an output voltage of 30 V_{RMS} and a 42.4 V_{peak} or maximum of 60 VDC.

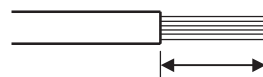
Recommended power supply: S82K-01524 (OMRON) or S8TS-06024 (OMRON).

Recommended Wire

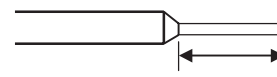
Type	Gauge
Stranded wire	20 AWG to 16 AWG (0.5 to 1.25 mm ²)
Solid wire	
Pin terminal	

**Strip Length
Pin Terminal Length**

Strip wire between 7 mm and 10 mm of insulation at the ends of the wires (stranded or solid wire) or use pin terminals with a pin (conductor) length of 8 mm to 10 mm.

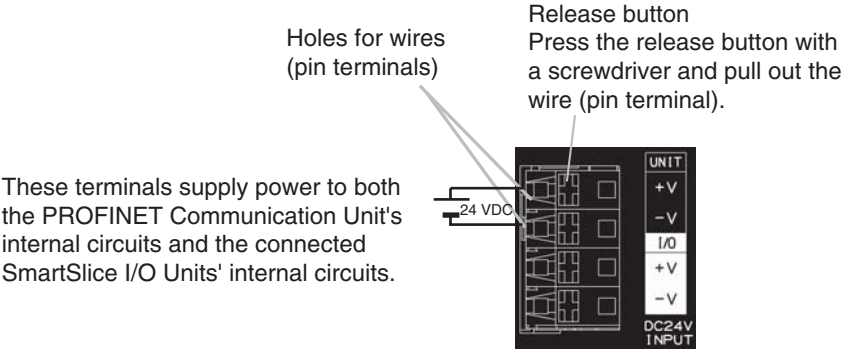


Strip 8 to 10 mm.



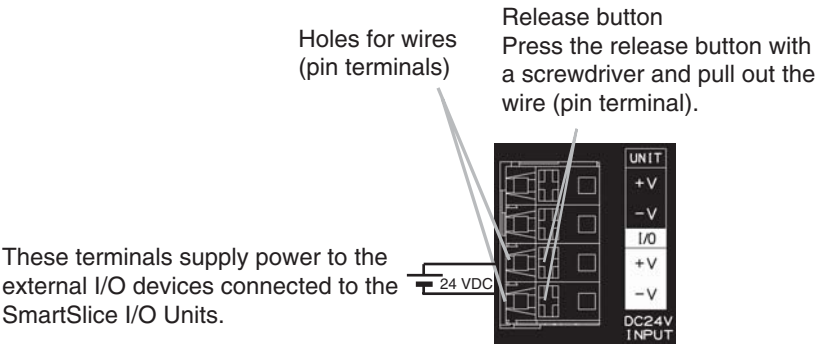
Pin length: 8 to 10 mm

Supplying Power to the Units



The upper two terminals supply power to the internal circuits of the PROFINET IO Communication Unit and of the connected SmartSlice I/O Units.

Supplying I/O Power



The lower two terminals supply power to the external I/O Devices connected to the SmartSlice I/O Units.

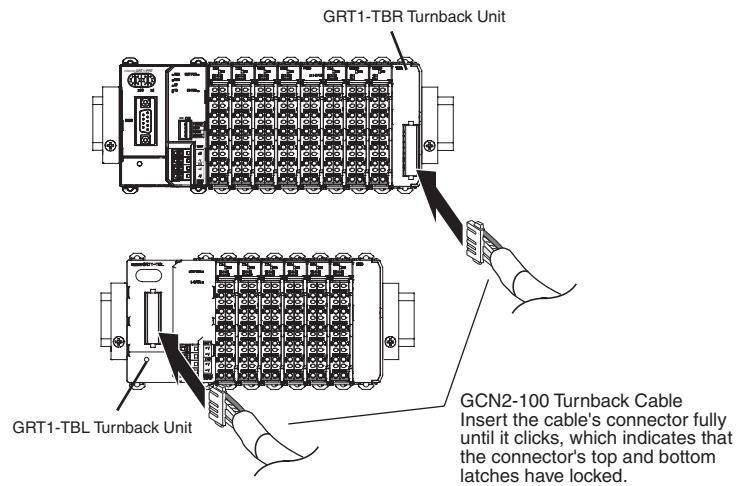
Note The GRT1-TBL Left Turnback Unit and GRT1-PD2 I/O Power Supply Unit have the same screwless clamping power supply terminals as the PROFINET IO Communication Unit. These terminals are wired in the same way as the PROFINET IO Communication Unit's terminals, by inserting the power supply wires.

Removing Wires

To remove the wires press the release button above the terminal hole using a slotted precision screwdriver and pull out the wire.

2-4-3 Connecting the Turnback units

When a SmartSlice I/O System is divided into blocks to expand the system, connect the GRT1-TBR Right Turnback Unit of one block to the GRT1-TBL Left Turnback Unit of the next block with a GCN2-100 Turnback Cable, as shown in the following diagram. A single PROFINET IO Communication Unit can be expanded with up to two additional blocks, connected with two Turnback Cables (2 m total).



Insert each cable connector fully until it clicks, which indicates that the connector's top and bottom latches have locked.

Note The GCN2-100 Turnback Cable does not propagate supply power from one block to the next one. Always wire (supply) the power to the GRT1-TBL Left Turnback Unit from the same power supply that supplies the PROFINET IO Communication Unit.

2-5 Setting up the PROFINET IO network

2-5-1 Network structure

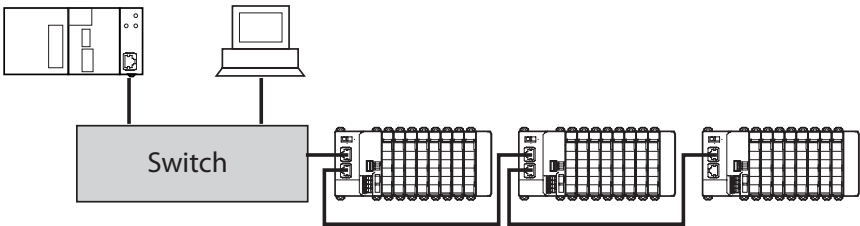
Various configurations are possible.

When connecting GRT1-PNT unit within a network, the following precautions apply:

- Please be aware any additional Ethernet communication may influence the PROFINET IO Communication.
- It is recommended to separate the PROFINET IO network from the other (IT) network.
- Severely overloading the built-in Ethernet switch with traffic may cause the switch to temporarily block the ports, interrupting all traffic including PROFINET IO communication.

2-5-1-1 Line

A line topology consists of placing multiple IO Devices in series. Many IO Devices, such as the GRT1-PNT Unit, have an ethernet switch integrated in the Unit. This creates an easy way to connect the IO Devices.



Benefits:

- For bigger networks this topology implies lower cabling effort.
- This is a traditional field bus structure (compare PROFIBUS-DP).
- The Ethernet Switch is optional.

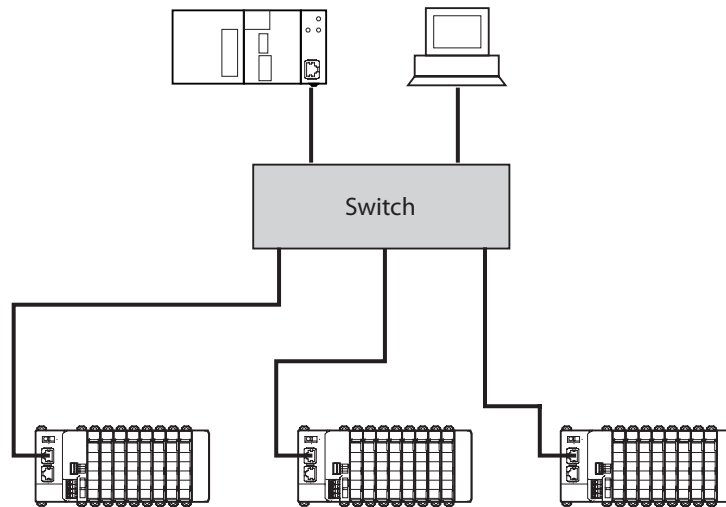
Disadvantages:

- Communication paths through many switches affect transmission times.
- A malfunction of a single integrated device will result in disconnecting part of the network.

Part	Recommendation
Switch (optional)	Industrial Ethernet Switch (either managed or unmanaged).

2-5-1-2 Star

The star topology is the standard-most topology for Ethernet networks. A central switch will allow communication to all individually attached devices.

**Benefits:**

- Flexible adding and removing devices without interrupting the network.
- Easy monitoring and diagnostics of the network.

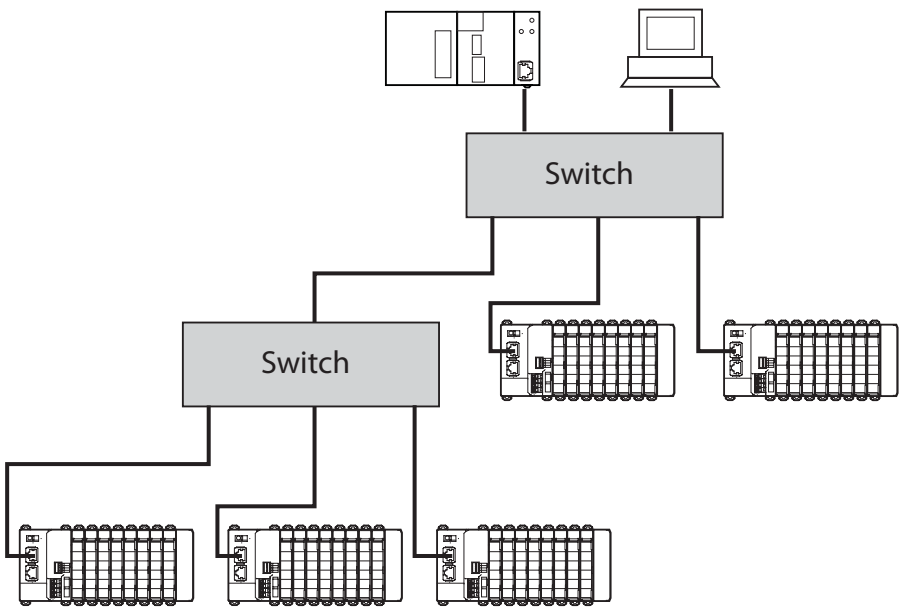
Disadvantages:

- Cabling effort.
- Error state of switch will fail complete network.

Part	Recommendation
Switch	Industrial Ethernet Switch (either managed or unmanaged).

2-5-1-3 Tree

The tree topology is a hierarchial combination of multiple star topologies interconnected with each other.



Benefits:

- Shorter data communication at local node. Avoiding excessive traffic through a single switch.
- Hierarchy enables better transparency of the network

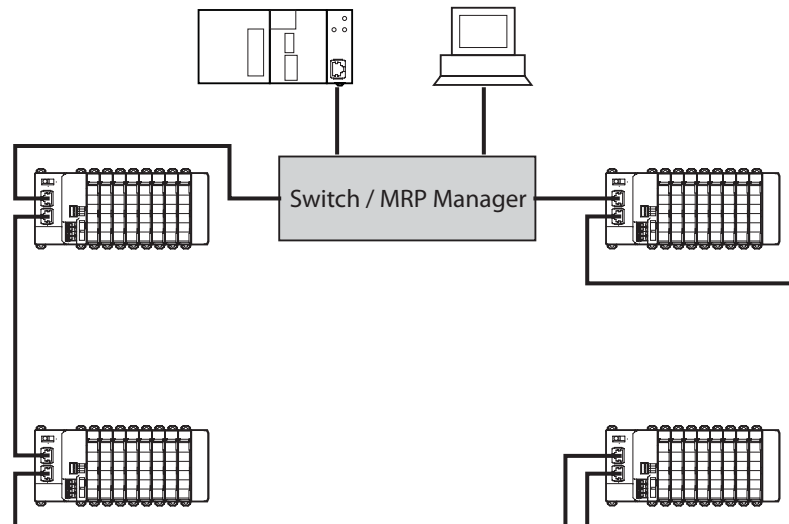
Disadvantages:

- Cabling effort.
- Error state of switch will fail complete network.

Part	Recommendation
Switch	Industrial Ethernet Switch (either managed or unmanaged).

2-5-1-4 Ring

The ring topology is achieved by closing both ends of a line. A network redundancy ring protocol such as MRP (see section 2-5-2 MRP Ring Redundancy) will provide a method of monitoring the state of the network and switch the communication path in case of problems.



Benefits:

- Malfunction of a single switch / IO Device will not result in disconnecting part of the network. The network redundancy mechanism will automatically maintain the connection with the other devices.

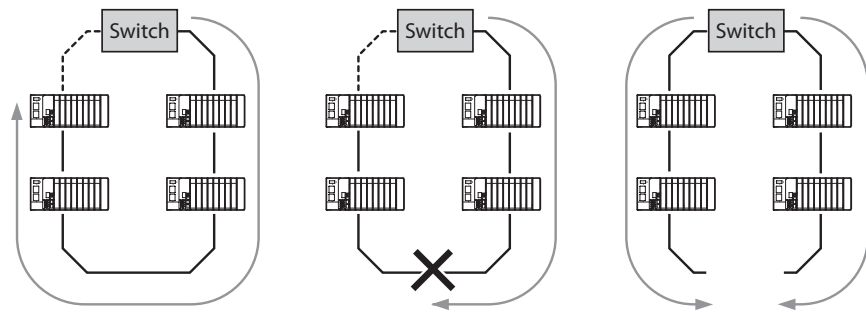
Part	Recommendation
Switch	Industrial Ethernet Switch supporting MRP manager protocol. Suggestion: Hirschmann Automation and Control GmbH, Series RS20/30/40, Software Version 4 or higher.

2-5-2 MRP Ring Redundancy

The internal Ethernet Switch in the GRT1-PNT Unit supports the Media Redundancy Protocol (MRP). This protocol, which is part of the PROFINET IO Specification, enables the Unit to be part of a ring-shaped network structure. This ring network structure will give network redundancy.

In case one of the line connections fails, the MRP ensures communication to all IO Devices remains possible through the redundant path. The ring structure can contain up to 50 Units and typically switches to the redundant path within 150 ms (max 500 ms).

The network requires an MRP manager to facilitate the redundancy. As an MRP client, there are no specific settings required for the GRT1-PNT Unit. Please refer to the manual of the used MRP manager unit for details on how to set up and operate the MRP network.



In case a connection fails, MRP Ring Redundancy ensures communication to all devices through the alternative path.

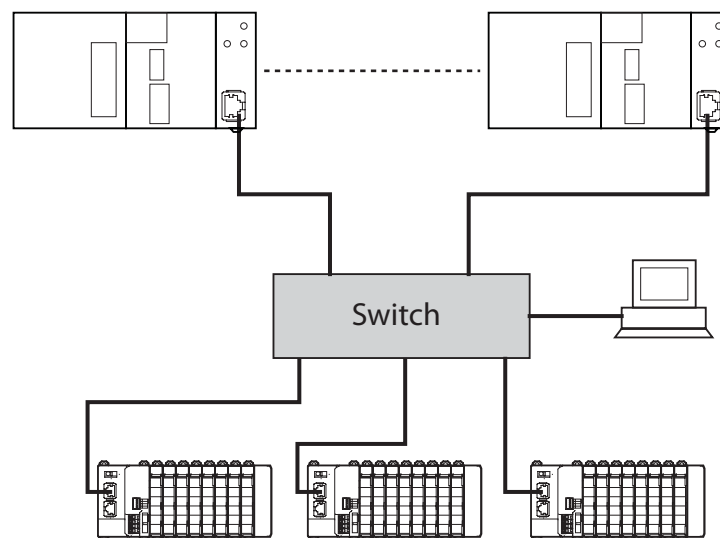
2-5-3 PROFINET IO Controller redundancy

The PROFINET IO Controller redundancy feature ensures seamless change-over of active PLC / IO Controller to the standby PLC / IO Controller in case of malfunction. To support the PROFINET IO Controller redundancy, a redundancy Function Block can be downloaded from the OMRON website.

Both the active as the standby IO Controller have data exchange with all IO Devices in the network. Only the active IO Controller is in control of the output of the IO Devices.

In case of malfunction of the active IO Controller, the Function Block will transfer control to the standby PLC system. In order to avoid momentary changes in output data during this control change, the Data Hold parameter should be set high enough for the standby IO Controller to take over. This value should be determined experimentally.

For details about setting the PROFINET IO Controller redundancy refer to *PROFINET IO Controller manual (W12E)*.



2-5-4 Establishing the PROFINET IO network

This section describes how to create, connect to and configure the PROFINET IO network using the CX-ConfiguratorFDT software and the Device DTMs.

- 1 Select the Network Components (see previous section) and build network.
- 2 Connect the Personal Computer to the ethernet network.
 - The PROFINET Scan Tool to assign the IO Device names can only operate connected to the ethernet network.
 - The parameter settings and monitoring of the GRT1 Slice I/O Units is done directly on the ethernet network.
- 3 Start the CX-ConfiguratorFDT software. Install the appropriate GSD files and DTMs for the connected IO Devices.
- 4 Configure the system to communicate with PLC / Profinet IO Controller. Add the PROFINET IO Controller as parent to the network.
 - Set IP address in DTM.
 - Set IP address in on-line by using the Network Scan View.
 - Confirm the on-line connection by putting the DTM on-line.
- 5 Build up the network within CX-ConfiguratorFDT. Add the IO Devices to the Tree of the network by drag-dropping from the Device Catalogue. Assign the modules for each individual IO Device.
- 6 Allocate the modules of the IO Devices to the intended PLC memory areas.
- 7 Download the configuration to the Unit.
- 8 Confirm proper operation. Checking the Monitoring GUI of DTM and LED status of the Unit.

2-6 Installation of Configuration Software

In order to operate the GRT1-PNT and the SmartSlice I/O system the PROFINET IO Controller needs to be configured for communication with the GRT1-PNT. For this purpose OMRON provides the GRT1-PNT DTM via the OMRON web site <http://www.omron-industrial.com/>

After installation the DTM will run in the FDT Container, allowing the user to set up the I/O configuration and set the parameters of the GRT1-PNT and of the individual SmartSlice I/O Units.

2-6-1 Installation requirements

The following are the minimum requirements for a PC to install the GRT1-PNT DTM configuration software:

- PC Pentium III or higher, 500 MHz minimum
- Operating System: Windows 2000 SP2 or Windows XP
- RAM: 256 MB minimum
- Hard disk space: 256 MB minimum
- Graphics resolution: 1024 x 768 pixels minimum
- Installed FDT Container software, e.g. OMRON's CX-ConfiguratorFDT.

2-6-2 Installation procedure

DTM Installation

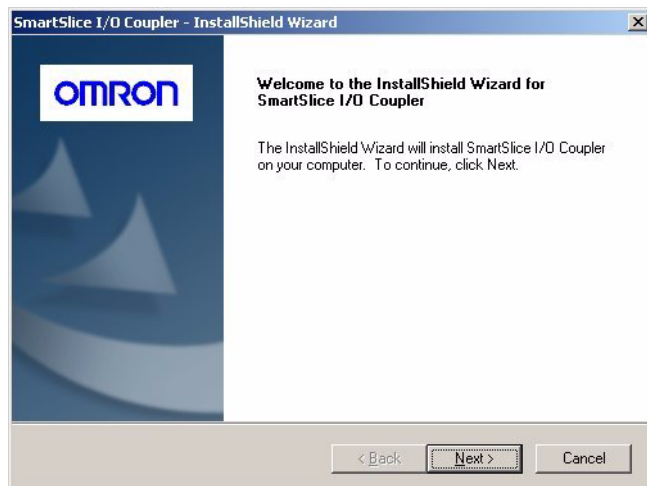
This section explains how to install the SmartSlice I/O Coupler DTM software.

- 1,2,3... 1 Exit all other Windows-based programs.
- 2 Double-click the file **SmartSlice_IO_Coupler_Setup.exe**.
The setup program for the GRT1-PNT DTM will start.



Select the preferred Language for the Setup and click **OK**.

- 3 The user is then guided through the installation process.



Pressing the **Next** button will start the installation.

- 4 When done, the installation program will notify the user of its completion.
The update of the Device Catalogue of the FDT Container is required

Updating the Device Catalogue

After installation of the GRT1-PNT DTM the Device Catalogue in the FDT Container needs to be updated, to show the new GRT1-PNT DTM in the list of available devices. For CX-ConfiguratorFDT the following procedure applies.

- 1,2,3...
 - 1 Open the Device Catalogue window in CX-ConfiguratorFDT.
 - 2 Press the **Update** button to initiate the update sequence.

After updating, the GRT1-PNT DTM will be shown in the list of available devices. It can now be used to setup a PROFINET IO network and configure the Controller Unit.

Note In case the required PROFINET IO Controller DTM has not been installed, this needs to be done first to allow the full features of the GRT1-PNT DTM to be used.

2-6-3 GRT1-PNT GSD File

Apart from the GRT1-PNT DTM, OMRON provides a GSD file to allow configuration of third-party PROFINET IO Controller Units, which do not provide an FDT Container.

The GSD file - **GSDML-V2.1-OMRON-GRT1-PNT-20081205.xml** - is available through the OMRON Web site <http://www.omron-industrial.com/>

Section 3-4-3 Set-up using the GSD file discusses the configuration of the PROFINET IO CX-ConfiguratorFDT using this GSD file.

Using the GSD file for configuration allows the user to configure the Controller Unit for I/O data exchange with the GRT1-PNT and the SmartSlice I/O System. It does not however, provide the acyclic messaging capabilities to access parameters and status information in individual SmartSlice I/O Units. The GRT1-PNT DTM does provide this capability.

The next section will discuss the features of the GRT1-PNT in detail as well as how to set up, configure and operate the SmartSlice I/O System in a PROFINET IO network.

SECTION 3

Set-up and operation

This section describes the operational aspects of the GRT1-PNT and the SmartSlice I/O System. It first discusses the operational features which can be used, prior to describing how to set up the system and how to operate and monitor it on a PROFINET IO network.

SECTION 3

Set-up and operation

41

3-1 Device name setting and I/O allocation.....	42
3-2 Unit functions	46
3-3 GRT1-END-M Unit functions.....	52
3-4 Set-up the GRT1-PNT Configuration	54
3-5 Monitoring the GRT1-PNT	62
3-6 I/O communication characteristics	65

3-1 Device name setting and I/O allocation

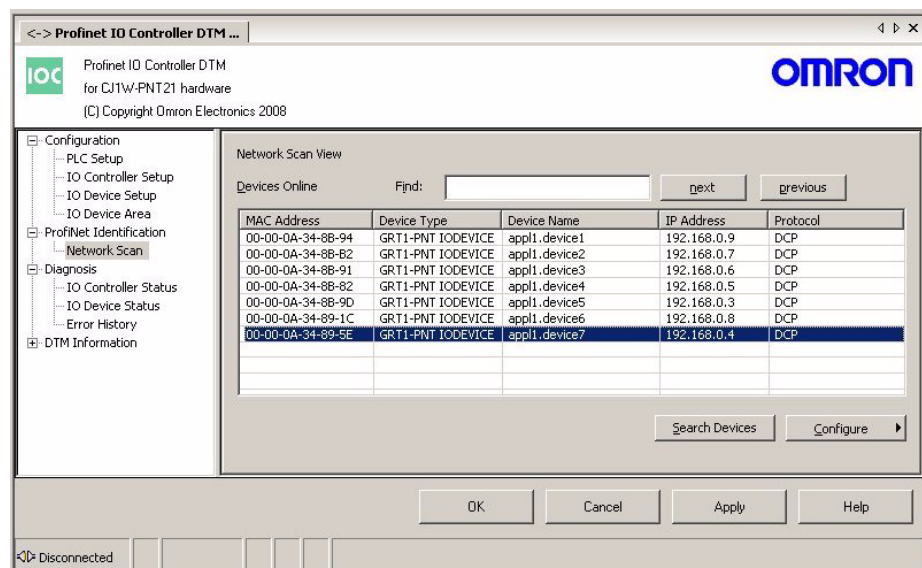
In order to identify the PROFINET IO Communication Unit on the PROFINET IO network, it needs to be assigned a PROFINET IO Device Name. This Device Name is an ASCII string, which is written to the IO Devices by the PROFINET IO Controller DTM or configurator. Using the Device Name the PROFINET IO Controller can configure parameter settings and establish I/O Data Exchange.

For the OMRON PROFINET IO Controller the IO Device is also assigned an IO Device Number. This number is used for the Device-related status and for the acyclic (FINS) communication to the IO Device. This IO Device number is set for each IO Device in the IO Controller DTM and is part of the configuration downloaded to the IO Controller Unit.

Similarly, the individual SmartSlice I/O Units need a unique address to identify each of them to the GRT1-PNT Unit. Contrary to the GRT1-PNT Unit, the individual SmartSlice I/O Unit addresses are assigned automatically at start-up.

3-1-1 Device name setting

For the OMRON CJ1W-PNT21 PROFINET IO Controller, the Device Names are set using the Network Scan View:

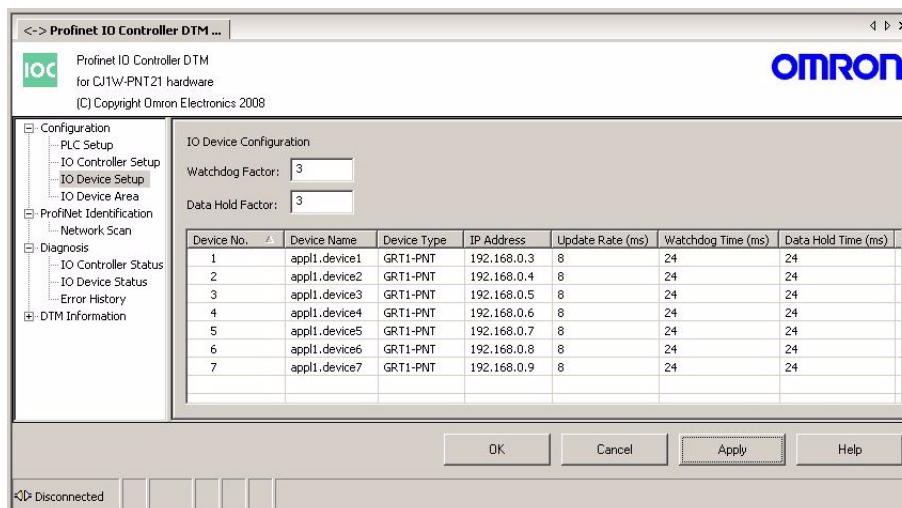


The actual IO Device can be distinguished either by the MAC address printed on the Unit or the Flash or Signal function of the Scan Tool. This function flashes the indicator LEDs for 3 seconds, identifying the Unit on the rack.

- Note**
- 1 Be sure to have unique Device names for each of the IO Devices in the network. As the name is used as identification, duplicate names will result in communication failure.
 - 2 It is not required to set IP addresses directly to the IO Device using the Scan Tool. The addresses are set by the IO Controller at startup. Please define the specific IP addresses in the IO Controller configuration.
 - 3 The Device Name should comply to the PROFINET naming rules, for instance no CAPS are used. This is checked by the Scan Tool.

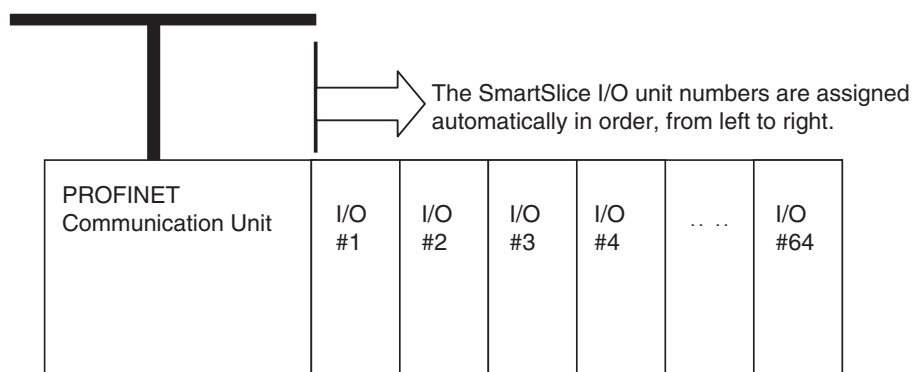
3-1-2 Device number setting

The Device Number setting for each IO Device is used for the Device-related status in PLC CIO memory and for the acyclic (FINS) communication to the IO Device. This IO Device number is set in the IO Controller DTM and is part of the configuration downloaded to the IO Controller Unit.



3-1-3 SmartSlice I/O Unit number allocation

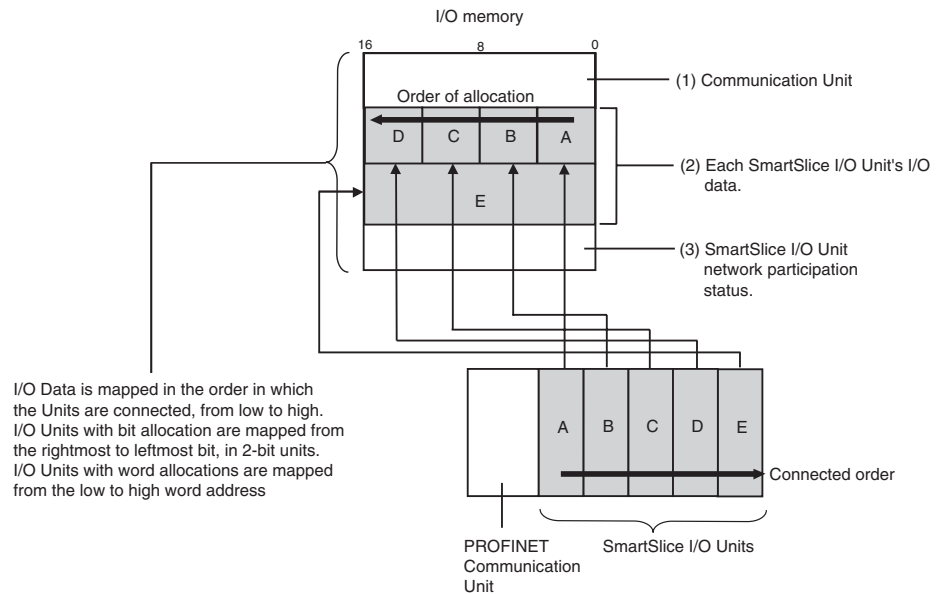
The SmartSlice I/O Unit numbers are used to identify the individual SmartSlice I/O Units in the SmartSlice I/O system. These unit numbers are assigned automatically at start-up, when the power is turned ON. The numbering starts from #1 and runs from left to right. It is not necessary for the user to set these numbers.



- Note**
- 1 The presence of Turnback units and cables does not influence the automatic allocation of Unit numbers.
 - 2 The unit numbers allocated automatically to the SmartSlice I/O Units are not related to the PROFINET IO Addressing.

3-1-4 SmartSlice I/O allocation to the GRT1-PNT unit

The SmartSlice I/O Units' I/O data is mapped on the I/O memory of the GRT1-PNT, from which it is transferred to the PROFINET IO Controller unit. This allocation is done automatically and determined by the SmartSlice I/O Unit's type. The figure below shows this mapping.

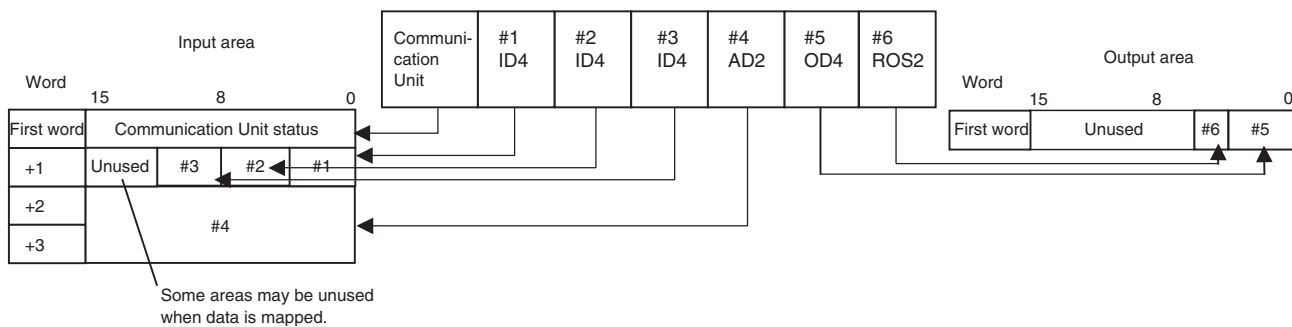


- Note**
- 1 One block of mapped Output data (from the Controller Unit) and one block of mapped Input data are maintained in the GRT1-PNT and transferred to/from the Controller Unit.
 - 2 The first Input data word always contains the SmartSlice I/O Status word.
 - 3 The GRT1-END-M End Unit must be configured in the SmartSlice I/O allocation. It contains two input bits and should be allocated to the last slot of the configuration.
 - 4 Bit-sized SmartSlice I/O Units, e.g. GRT1-ID4, GRT1-OD4 are grouped together in words. They are mapped from the right-most bit to the left-most bit, in 2-bit units.
 - 5 Word-sized SmartSlice I/O Units, e.g. GRT1-AD2, GRT1-DA2V are mapped to one or more words, from the low to the high word address.
 - 6 Total size of mapped I/O data can be 64 words output and 64 words input.

I/O Allocation Example

I/O data is mapped to the GRT1-PNT Units I/O data blocks in the same order the SmartSlice I/O Units are connected to the PROFINET IO Communication Unit, regardless of the I/O Units' models.

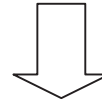
The example below shows the I/O data mapping to the Input / Output blocks.



The following example shows the mapping of Output Units.

SmartSlice I/O Unit configuration

Communi- cations Unit	#1 OD4	#2 OD4	#3 OD4	#4 ROS2	#5 OD4	#6 DA2V
-----------------------------	-----------	-----------	-----------	------------	-----------	------------



Data is allocated in 2-bit units to I/O Units which require 4 bits. There may be unused areas as shown in the following table.

Word	15		8		0
+0	#5	#4	#3	#2	#1
+1	Unused				#5
+2	#6				
+3					

Allocated Data Size

Data type	Data size
I/O data (input and output)	GRT1-ID4(-1) / GRT1-OD4(-1): 4 bits per Unit. GRT1-ROS2: 2 bits. GRT1-DA2V/DA2C: 2 words output data e.g.
Communication Unit status flags	1 word
SmartSlice I/O Unit communication participating/withdrawn flags	Participating flags: 4 words Withdrawn flags: 4 words Total: 8 words
I/O data (inputs) + Communication Unit status flags	Amount of I/O data being used + 1 word

Communication Unit's Status Flags

These flags can be used to monitor the status of the connection between the GRT1-PNT and the SmartSlice I/O Units as well as the status of the SmartSlice I/O Units themselves. The status flags take up 1 word and the information is transferred to the Controller as part of the Input data. Please refer to 3-5-1 Communication Unit's Status Flags.

3-2 Unit functions

The following table lists the PROFINET IO Communication Unit's functions.

Function name	Summary	Setting / monitoring method
Table registration	Reads the configuration of the SmartSlice I/O Units connected to the Communication Unit and registers that information in a table.	Set with DIP switch.
Backup	Records the parameter data of all connected I/O Units in the Communication Unit.	Set with DIP switch.
Automatic restore	Automatically downloads the backed-up parameter data to the appropriate Unit.	Set with DIP switch.
On-line replacement	I/O Units can be replaced without turning the power OFF.	No setting required.
I/O communication error history	A history of communication errors with connected I/O Units can be collected in the Communication Unit.	Set / read with Configurator or explicit message.

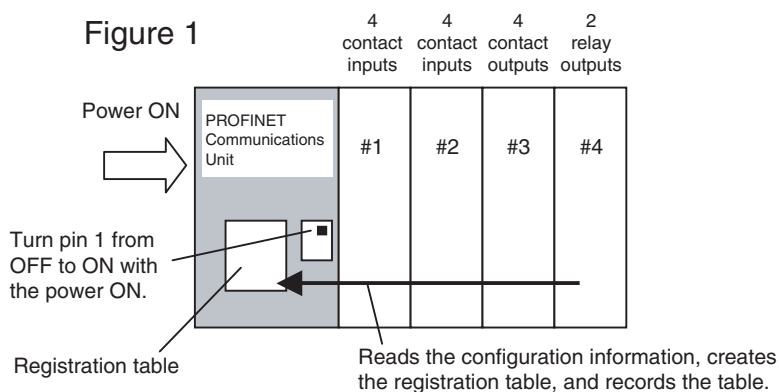
3-2-1 Table registration function

Function Overview

This function registers the configuration of the SmartSlice I/O Units connected to the PROFINET IO Communication Unit in a table within the Unit, to allow the registered I/O table to be compared automatically with the actual configuration each time the power is turned ON. The configuration is registered by turning ON (OFF to ON) DIP switch 1 of the PROFINET IO Communication Unit while the SmartSlice I/O Units' power supply is ON. The registered table is enabled if DIP switch 1 is ON when the power is turned ON. If DIP switch 1 is OFF when the power is turned ON, the registered table is disabled and the Communication Unit will automatically detect the actual I/O configuration and start communication.

Creating a New Registration Table

The SmartSlice I/O System's actual I/O configuration can be read and registered in the table just by switching DIP switch 1 (REGS) from OFF to ON while the PROFINET IO Communication Unit's power supply is ON. If the registration table is being refreshed, the old contents will be erased.



Note The configuration information records the order that the SmartSlice I/O Units are connected and the I/O size (input or output, number of bits) of each SmartSlice I/O Unit. The I/O Unit model numbers are not recorded.

Comparison with the Registered Table

When DIP switch 1 (REGS) is ON and an I/O configuration table has been registered in the Communication Unit, the actual I/O configuration is automatically compared to the registered table when the power is turned ON. A verification error will occur if a registered I/O Unit cannot join I/O communication or an unregistered I/O Unit is detected.

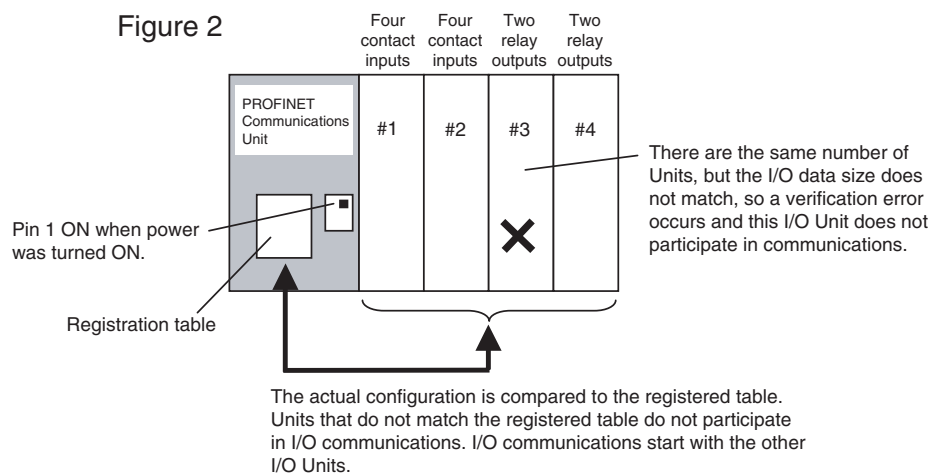
In case of verification errors, the affected SmartSlice I/O Units will not participate in I/O communication. I/O communication will start with the other SmartSlice I/O Units.

Example of Comparison between Figure 1 and Figure 2

From left	I/O	Bits		From left	I/O	Bits
#1	Input	4	Mismatch	#1	Input	4
#2	Input	4		#2	Input	4
#3	Output	4		#3	Output	2
#4	Output	2		#4	Output	2

Registered table

Actual configuration

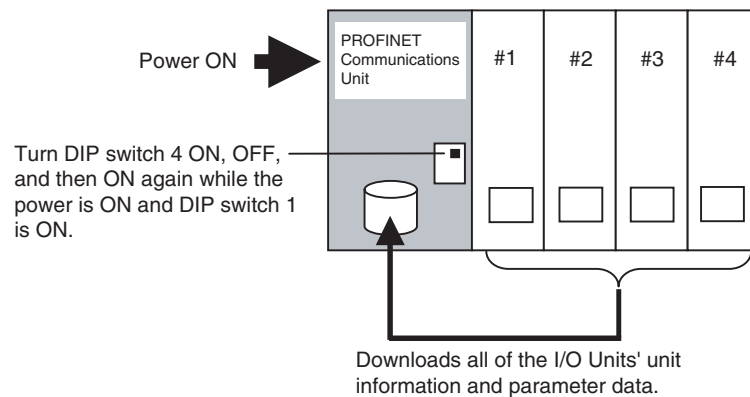


- Note**
- 1 Register the I/O configuration table when all of the SmartSlice I/O Units are communicating, i.e., when the PROFINET IO Communication Unit's TS indicator is lit green.
 - 2 A mismatch (verification error) with the registered table is indicated at the PROFINET IO Communication Unit's TS indicator (flashing red). The error details can be retrieved using the GRT1-PNT DTM. Also, the error history can be read with an explicit message command.

3-2-2 Backup function

Function Overview

The backup function records the parameter data of all SmartSlice I/O Units connected to the PROFINET IO Communication Unit. The parameter data recorded in the Communication Unit can be restored to the SmartSlice I/O Units later with the automatic restore function when a SmartSlice I/O Unit has been replaced.



- 1,2,3...**
- 1 Verify that the power is ON, DIP switch 1 (REGS) is ON, and all of the SmartSlice I/O Units are participating in I/O communication.
 - 2 Turn DIP switch 4 (BACK) ON, then OFF, and then ON again within 3 seconds to start the back up.
 - 3 While the data is being backed up, the PROFINET IO Communication Unit's TS indicator will flash green every 0.5 second. The TS indicator will stop flashing (not lit) when the backup is completed. If the backup operation fails, the TS indicator will be lit red for 2 seconds.

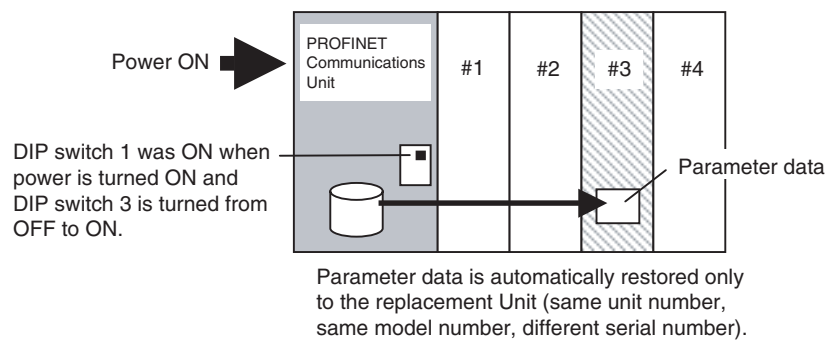
- Note**
- 1 Do not turn OFF the power supply or reset the Configurator while data is being backed up. The data will not be backed up properly if the power is turned OFF.
 - 2 The backup data will be erased along with the registered I/O configuration table if DIP switch 1 (REGS) is turned OFF.
 - 3 Backing up the parameter data is recommended to allow easy replacement of faulty Units in the future.

3-2-3 Automatic restore function

Function Overview

When a SmartSlice I/O Unit has been replaced, this function will automatically download (restore) SmartSlice I/O Unit parameter data that was previously backed up in the PROFINET IO Communication Unit. The following conditions are required to execute the automatic restore function:

- DIP switch 1 (REGS) was ON when the power was turned ON, and the registered table is therefore enabled.
- DIP switch 3 (ADR) was ON when the power was turned ON, and the automatic restore function is therefore enabled.
- Parameter data has been backed up in the PROFINET IO Communication Unit.



Preparing Data Restore

- 1 Create backup data in the Communication Unit with the backup function. For details, see section 3-2-2 Backup function.
- 2 Turn ON DIP switch 3 (ADR).

Replacing a Unit

1,2,3...

- 1 Turn OFF the SmartSlice I/O System's power supply and the I/O power supply.
- 2 Release the locks on the front of the SmartSlice I/O Unit that must be replaced and remove the terminal block. The wiring can remain connected.
- 3 Remove the main block of the SmartSlice I/O Unit and replace it with a new SmartSlice I/O Unit of the same type.
- 4 Mount the terminal block that was removed in step 2 and latch the locks that were released.
- 5 When the power is turned ON again, the Communication Unit will automatically detect the Unit that was replaced and download the backup data. The SmartSlice I/O Unit's TS indicator will indicate the results of the restore operation.
 - If the download was successful, the Unit will be reset automatically and join I/O communication normally. The I/O Unit's TS indicator will be lit green.
 - If the download failed, the I/O Unit's TS indicator will flash red.
 - If the connected Unit is the wrong model, the I/O Unit's TS indicator will be lit red.

Note

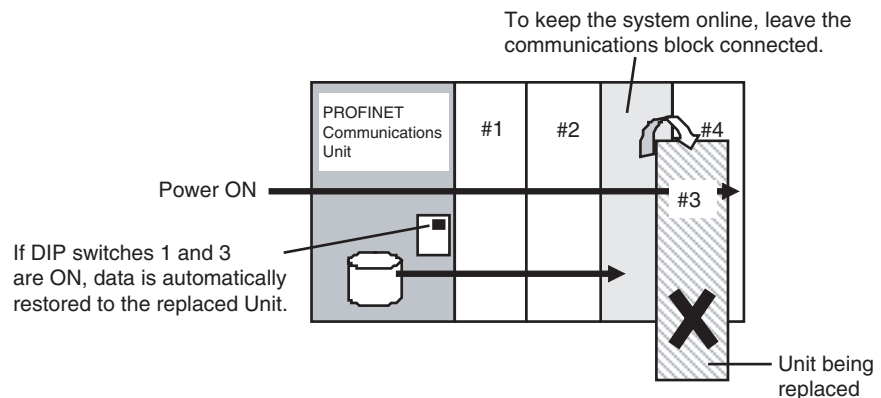
- 1 Do not turn OFF the power supply or reset the PROFINET IO Communication Unit while data is being restored. The data will not be restored properly if the power is turned OFF.
- 2 When a SmartSlice I/O Unit has been replaced with the power ON and the new I/O Unit joins I/O communication, the new Unit will be compared to the previous one and the parameter data restore operation will start automatically. While data is being restored, the PROFINET IO Communication Unit's TS indicator will flash green every 0.5 second. The TS indicator will stop flashing (not lit) when the restore operation is completed. If the restore operation fails, the Automatic Restore Monitor Flag (bit 13 of the Communication Unit status flags) will be turned ON and the Communication Unit's TS indicator will be lit red for 2 seconds.

3-2-4 On-line replacement function

Function Overview

When one of the SmartSlice I/O Units connected to the PROFINET IO Communication Unit must be replaced, the Unit can be replaced without turning OFF the power. The Units can be replaced on-line because the SmartSlice I/O Units are made up of 3 blocks: the base block, main block, and terminal block.

When replacing a SmartSlice I/O Unit, leave just the base block connected and replace the main block. I/O communication will continue with the other I/O Units even while the problem Unit is being removed and replaced.



Replacing a Unit

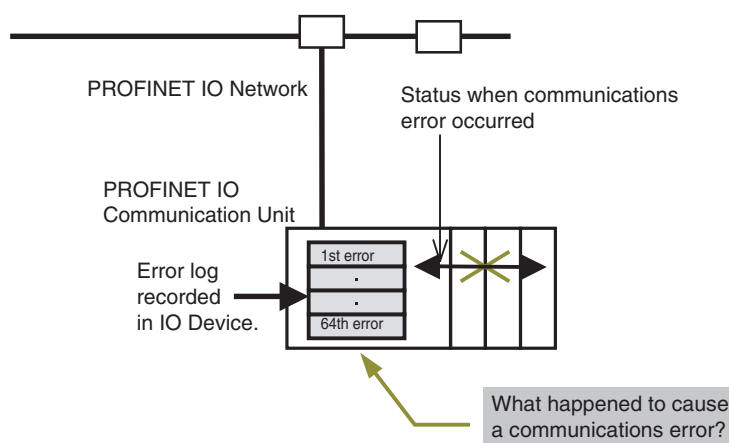
- 1,2,3...**
- 1 Turn OFF the I/O power supply of the I/O Unit being replaced.
 - 2 In CX-ConfiguratorFDT right-click on the icon of the GRT1-PNT and select **Go Online**.
 - 3 Release the locks on the front of the I/O Unit that must be replaced and remove the terminal block. The wiring can remain connected.
 - 4 Remove the main block of the SmartSlice I/O Unit and replace it with a new I/O Unit of the same type.
 - 5 Mount the terminal block that was removed in step 2 and latch the locks that were released.
 - 6 Turn ON the I/O power supply.

- Note**
- 1 When a Unit withdraws from I/O communication during replacement, the corresponding SmartSlice I/O Unit Communication Withdrawn Flag will go ON and the PROFINET IO Communication Unit's TS indicator will flash red.
 - 2 Before using the automatic restore function, the preparation for automatic restoration (creating backup data and turning ON DIP switch 3) must be completed. See section 3-2-3 Automatic restore function for details.
 - 3 Always turn OFF the I/O Unit's I/O power supply before replacement in order to prevent false output signals, false input signals, and electrical shocks. In addition, if external power is supplied to the terminal block for a Unit such as a Relay Output Unit, turn OFF that power supply before replacing the Unit.
 - 4 Only replace one I/O Unit at a time.
 - 5 Always replace the I/O Unit with the same model of I/O Unit. If a Unit is replaced with a different model, there may be unexpected outputs and the restore operation may not be completed properly.
 - 6 If the base block is faulty or damaged, turn OFF the power supply and replace the entire Unit. Even in this case, the I/O Unit's parameter data will be restored automatically if the automatic restore function is enabled when the power is turned ON.

3-2-5 I/O Communication error history monitor

Function Overview

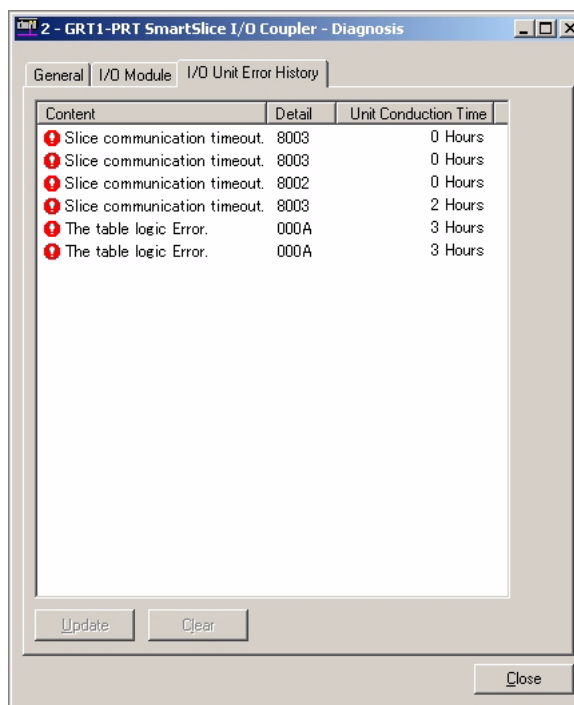
The PROFINET IO Communication Unit can record the 64 most recent internal SmartSlice I/O Unit errors in the Unit's error history. When more than 64 errors occur, the oldest entry is deleted to make space for the newest error entry. The communication error history can be read from the GRT1-PNT DTM or via messaging services.



Checking Using the GRT1-PNT DTM

To check the internal communication error history using the GRT1-PNT DTM and OMRON's FDT Container CX-ConfiguratorFDT, perform the following actions.

- 1,2,3... 1 Turn ON the PROFINET IO Communication Unit's power supply.
- 2 In CX-ConfiguratorFDT right-click on the icon of the GRT1-PNT and select **Go Online**.
- 3 In CX-ConfiguratorFDT right-click on the icon of the GRT1-PNT, and select **Diagnosis**.
- 4 Select the **I/O Unit Error History** tab in the Diagnosis Window. The communication error history for the most recent errors that occurred will be displayed, as shown in the following image. To display the most recent error history, click the **Update** button.



Note The method described is also available in third-party FDT Containers, although slightly different terminology may be used in the menus.

3-3 GRT1-END-M Unit functions

The GRT1-END-M Memory End Unit ensures a quick and easy replacement of the GRT1-PNT in case of malfunction. The END-M Unit contains the Device Name of the IO Device, which is used for the identification within the PROFINET network. When configuring the PROFINET network, any Device Name written by the Scan Tool of the IO Controller DTM to the IO Device will be written immediately into the END-M Unit.

Be sure to execute the Backup function (see section 3-2-2 Backup function) after setting the Device Name at configuration time and afterwards to enable the Automatic Restore function of section 3-2-3 Automatic restore function. In this way also a replacement of a malfunctioning GRT1-END-M can be done without additional configuration actions.

At power-up of the system, the Device Name in the GRT1-PNT is compared to the Device Name that is stored in the GRT1-END-M and updated according to the following rules.

Name in GRT1-PNT	Name in GRT1-END-M	Resulting Name in GRT1-PNT
(empty)	(empty)	(empty) (see note 1)
(empty)	Name A	Name A
Name A	(empty)	Name A (see note 2)
Name A	Name B	Name B

- Note**
- 1 Configuration with IO Controller DTM/Scan Tool is required.
 - 2 This state will not occur when the Automatic Restore Function is enabled.

I/O Data

The GRT1-END-M Memory End Unit will allocate two bits in the PROFINET IO Communication Unit's Input data area.

Bit	Description
0	Device Name bit OFF: the unit does not contain a Device Name ON: the unit contains a Device Name
1	Reserved for future use

Warning status area

The GRT1-END-M Unit has two status areas. Each Unit's Status Flags are turned ON and OFF based on the threshold/monitor values set for the function in that Unit. A flag in the Communications Unit will be turned ON only when the corresponding flag has been turned ON in one of those status areas.

The Communications Unit's Status Flag information is transmitted to the Controller Unit. The SmartSlice I/O Unit's status area information can be read from a Programming Device.

The SmartSlice I/O Unit's Warning Status Area contains the following 16 bits. The Warning Status Area provides notification of minor errors detected in the Unit.

When any of these flags goes ON, bit 2 of the Communications Unit's Status Flags is turned ON and that information is transmitted to the Controller Unit.

Bit	Function	Description
0 to 2	Reserved	-
3	Unit Maintenance Flag OFF: normal ON: error (monitor value exceeded)	Monitors the power ON time warning value set for the Unit Conduction Time Monitor function.
4 to 15	Reserved	-

Alarm status area

The SmartSlice I/O Unit's alarm status area contains the following 16 bits. The Alarm Status Area provides notification of serious errors detected in the Unit. When any of these flags goes ON, bit 3 of the Communications Unit's Status Flags is turned ON and that information is transmitted to the Controller Unit.

Bit	Function	Description
0	Reserved	-
1	EEPROM Data Error Flag	OFF: normal ON: error occurred
2 to 15	Reserved	-

3-4 Set-up the GRT1-PNT Configuration

Setting up a PROFINET IO Controller Unit to exchange parameters and I/O data with the GRT1-PNT and the SmartSlice I/O System involves defining the I/O configuration to the IO Controller Unit and setting parameters needed at run-time. Refer to Appendix A PROFINET IO technology for more information on PROFINET IO network commissioning.

For configuring the PROFINET IO network with the GRT1-PNT Units, it is required to connect the Personal Computer directly to the ethernet network. It will be able to:

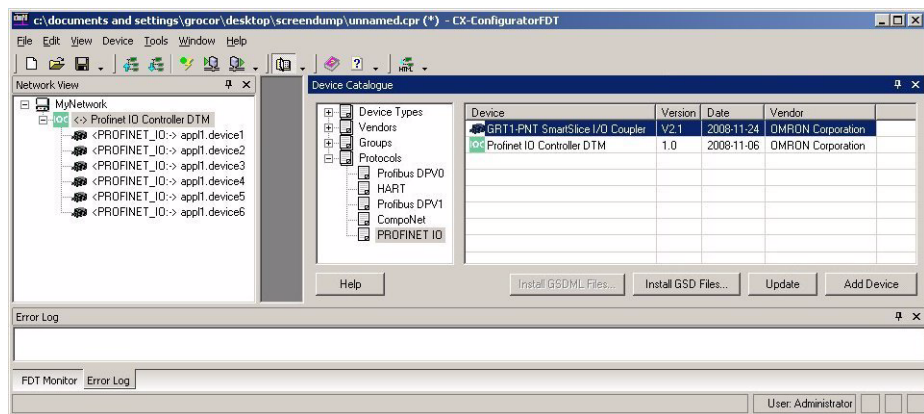
- Configure the IO Device names directly on the network.
- Use the online functions of the GRT1-PNT DTM to access detailed SmartSlice I/O Unit parameters.

A direct ethernet connection of the Personal Computer to the PROFINET IO network can also be used to connect to the PLC CPU through the IO Controller. It can be used to configure and monitor the PLC and the PROFINET IO Controller. Please note this is also possible using the other communication interfaces (for instance Toolbus) of the PLC CPU.

This section discusses the methods of configuration.

3-4-1 Defining the PROFINET IO network

Defining the PROFINET IO network in the CX-ConfiguratorFDT, starts with defining the PROFINET IO Controller Unit and assigning the IO Devices to it. Defining and assigning devices can be achieved using drag & drop from the CX-ConfiguratorFDT Device Catalogue. Refer to the *CS/CJ-series PROFINET IO Controller Unit Operation Manual (W012E)* for more information on how to assemble a network. The figure below shows CX-ConfiguratorFDT with an assembled network in the left window pane and the Device Catalogue opened in the main window pane.



To define the I/O Configuration of the GRT1-PNT PROFINET IO Communication Unit, double-click the device in the Network View. A separate configuration window will pop up, which is described in the next section.

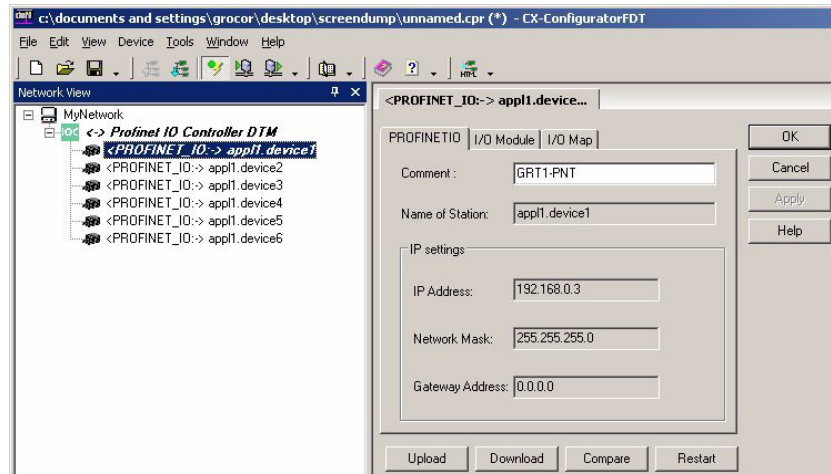
3-4-2 Set-up using the DTM

GRT1-PNT DTM window which pops up after double-clicking the GRT1-PNT entry in the Network View is shown below.

The window has two tab pages: one for the settings of the PROFINET IO Communication unit itself and one for defining connected I/O Modules.

Note The buttons on the bottom will be enabled only when the DTM is on-line.

PROFINET IO tab



Comment

The comment field contains comments or descriptions of the station.

Name of Station

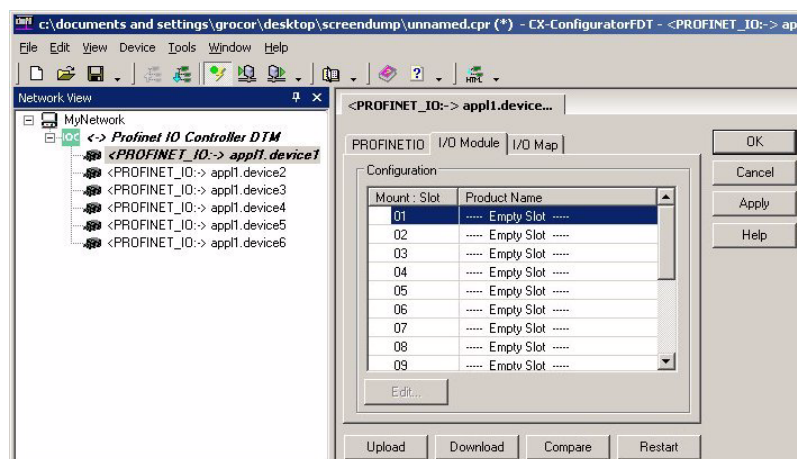
This field contains the name of the station, by which it is known to the IO Controller.

IP settings

This sections contains the IP address, network mask and gateway address. These address are assigned by the IO Controller and cannot be changed here.

I/O Module Tab

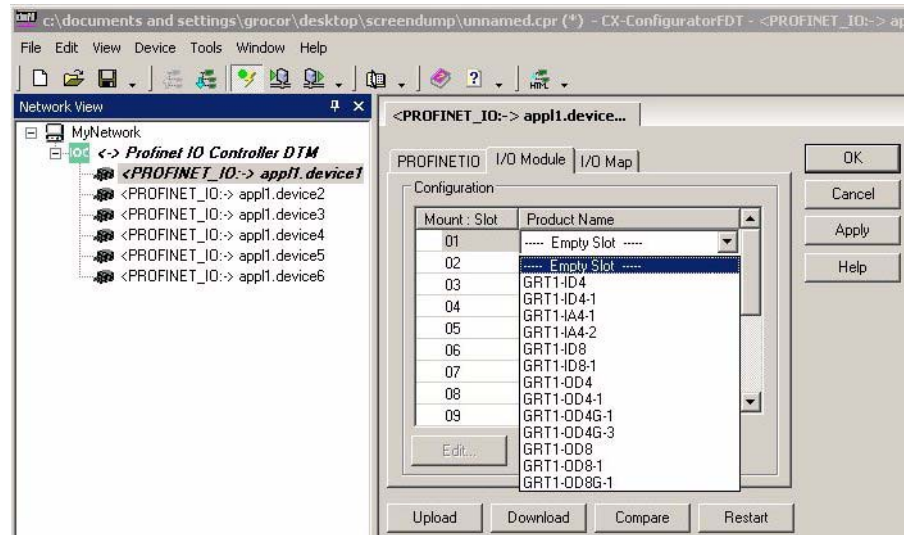
The I/O Module tab, shown below, defines the I/O Configuration for the GRT1-PNT. This I/O Configuration is downloaded to the PROFINET IO Communication Unit and sent to the physical device by the Communication Unit for verification at the start of communication.



Edit

This function allows the user to edit the current configuration.

- 1,2,3... 1 Double-click the first row (slot): a drop-down list appears, as shown in the next figure.



- 2 Select the type of SmartSlice I/O Unit which is in this first slot, right next to the GRT1-PNT.
- 3 Repeat this SmartSlice I/O Unit allocation for each other slot in which a SmartSlice I/O Unit will be present.

- Note**
- 1 Not shown in the list is the first input word, containing the GRT1-PNT Unit status word (refer to section 3-1-4 SmartSlice I/O allocation to the GRT1-PNT unit for an explanation on this word). The GRT1-PNT DTM automatically inserts the status word in the I/O Configuration.
 - 2 The sequence of I/O Devices selected in the I/O Module tab must match the sequence of physical devices attached to the GRT1-PNT. Otherwise I/O Communication will not be achieved.
 - 3 The grouping of bit-sized SmartSlice I/O data into words is performed automatically by the GRT1-PNT.

As an alternative to selecting the I/O Configuration manually, the complete I/O Configuration can be uploaded from the GRT1-PNT Unit. To accomplish this, perform the following steps.

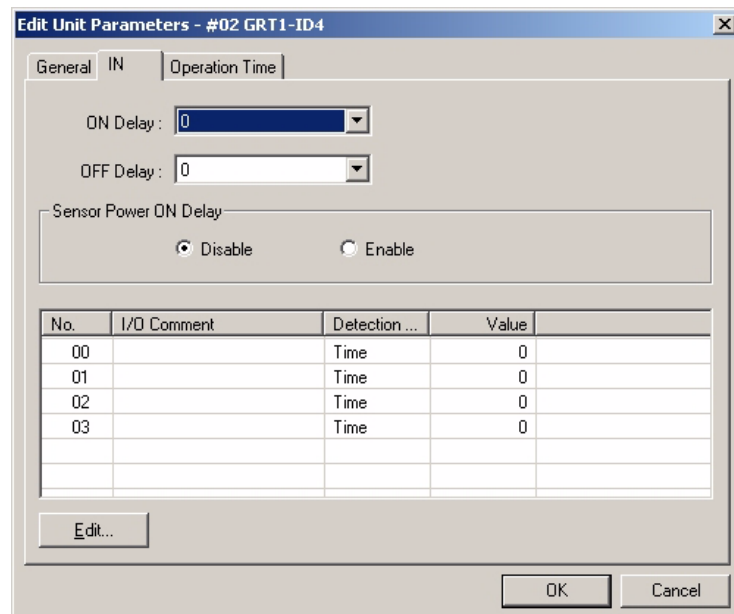
- 1,2,3... 1 In the Network View, select the GRT1-PNT and right-click the mouse.
- 2 From the context menu, which pops up, select the option **Go Online**.
- 3 Press the **Upload** button. This will initiate an upload of all SmartSlice I/O Information, i.e. I/O Configuration, Unit types and Unit parameters. From this upload, the I/O Configuration in the Configuration list will be assembled automatically.

- Note** Uploading may take some time, due to the amount of parameters.

Editing SmartSlice I/O Unit Settings

After making the I/O configuration selection, the settings of individual SmartSlice I/O Units can be set or changed. To do this, perform the following steps.

- 1,2,3... 1 Select the SmartSlice I/O Unit in the I/O Configuration.
- 2 Press the Edit button below the I/O Configuration list. The appropriate setting window will pop up.



- Note**
- 1 In order to download/upload settings for individual SmartSlice I/O Units, the DTM has to be on-line with the physical GRT1-PNT Unit, i.e. it has to be able to establish a connection with the device.
 - 2 In the case of the GRT1-AD2 some parameter settings will affect the I/O Configuration, i.e. it will change the I/O size for that particular SmartSlice I/O Unit. In that case, the I/O Configuration for the PROFINET IO Controller Units needs to be (re-) downloaded. If this is required, an appropriate warning window will pop up.
 - 3 The configuration options and windows for individual SmartSlice I/O Units are described in detail in the *GRT1 Series SmartSlice I/O Units Operation Manual (W455)*.
 - 4 The GRT1-PNT Unit Version 1.0 does not support the Output Hold setting for the SmartSlice I/O Units in case of host communication/PROFINET IO fault (Idle action). Outputs will always Clear after the PROFINET IO Data Hold Time expires, even if Hold is selected in the I/O Unit.
Units Version 1.1 and higher support the Hold/Clear selection for each output.

Using the On-Line Functions

In order to use the online functions of the GRT1-PNT DTM, be sure to connect the Personal Computer directly to the ethernet network. The communication will go directly to the GRT1-PNT unit, not through the IO Controller.

At the bottom of the GRT1-PNT DTM are four buttons which will be enabled after the DTM has established communication with the physical device. Switching to on-line must be done via the FDT Container. To switch to on-line, perform the following steps in the configurator.

- 1,2,3... 1 In the Network view, right-click the GRT1-PNT.
- 2 From the context menu, which pops up, select the option **Go Online**.

The functions of the buttons are discussed below.

Upload Button

Pressing the **Upload** button will initiate an upload of all SmartSlice I/O Information, i.e. I/O Configuration, Unit types and Unit parameters. From this upload, the I/O Configuration in the Configuration list will be assembled.

Note Uploading may take some time, due to the amount of parameters.

Download Button

Pressing the **Download** button will initiate a download of all SmartSlice I/O Information, i.e. I/O Configuration, Unit types and Unit parameters.

Compare Button

Pressing the **Compare** button will initiate a comparison between the I/O Configuration and parameters of all SmartSlice I/O Units and the data stored within the DTM. In case a mismatch is found, a warning screen will pop up to notify the user.

Reset Button

Pressing the **Reset** button will initiate a system reset, i.e. the GRT1-PNT as well as the attached SmartSlice I/O Units will be reset. A Reset will also force the connected SmartSlice I/O Units to restore their settings from their non volatile storage. In some cases a reset is a necessity to force the SmartSlice IO Units to use newly written parameters.

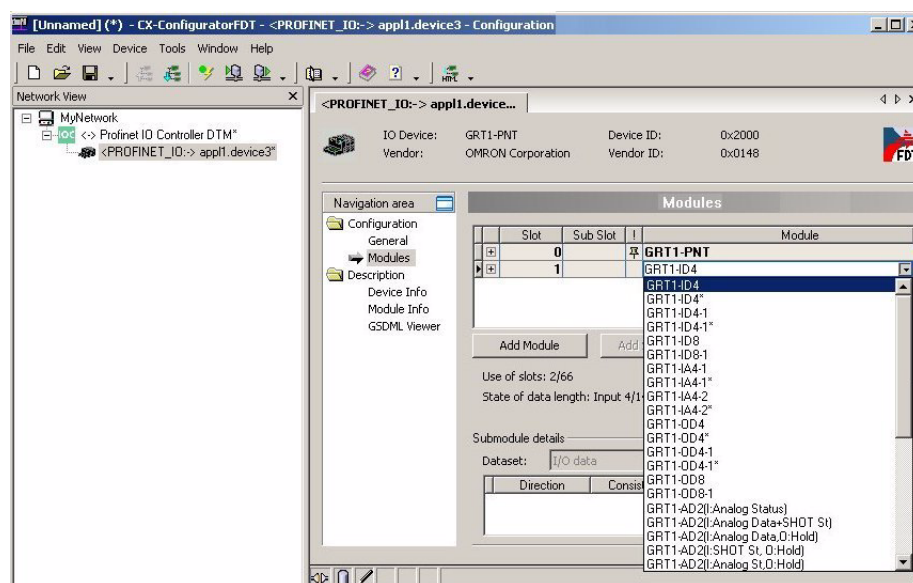
Note If changes have been made via the SmartSlice I/O Unit's parameter windows, which require a system reset, the user is notified of this through a pop notification window.

3-4-3 Set-up using the GSD file

In case third-party IO Controller Units are used, of which the Configuration software does not support FDT/DTM technology, the GRT1-PNT GSD File can be used to configure that IO Controller.

- Note**
- 1 Using the GSD File allows for I/O Configuration and I/O data exchange with the IO Controller Unit. It does not provide easy access to other Unit parameters.
 - 2 PROFINET IO Controller Units can also be configured using the GSD File, although the DTM is available and has many more features.

The figure below shows the Generic IO Device DTM, used in CX-ConfiguratorFDT to handle GSD Files.



Defining the I/O Configuration

To define the I/O configuration, perform the following steps.

- 1,2,3... 1 Select the Configuration Modules.
- 2 Select the individual I/O modules in the same sequence as they are physically connected to the Communication Unit GRT1-PNT by clicking **Add Module**.
- 3 Click on the added module to show the available modules.
- 4 Select the required module.
- 5 If applicable, repeat the previous steps to add another module.

Observe the following.

- The 2- and 4-point Digital Units occupy 2 or 4 bits of I/O data. Adjacent digital Input Units or Output Units must be assembled in to 1 word.
- To assemble multiple Digital Units, first select the appropriate Unit listed in the available Modules list, which is not marked with an asterisk. This will indicate the start of a new word. For the subsequent units the I/O modules marked with an asterisk must be selected until a word has been filled up.
- When using digital input (or output) units after an analog input (or output unit), a new word has to be allocated. Select a module which is not marked with an asterisk.
- After a word has been filled up, a new word must be started by selecting again the next I/O module not marked with an asterisk.
- Do not attempt to put Input Units and Output Units in one and the same word. This will result in a parameterization error, after downloading the configuration to the Controller Unit.
- The 8-point digital, analog and counter Units occupy whole words.

To further explain the mapping sequence, an example is given below.

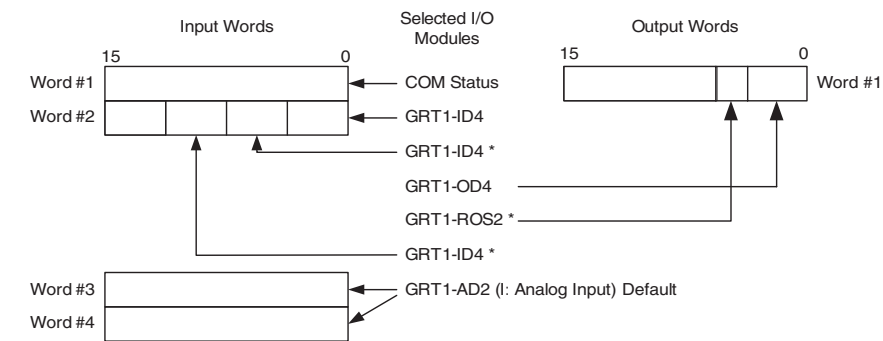
Example

To illustrate how the Digital and Analog SmartSlice I/O Units are mapped on to I/O words, and how to implement this using the GSD File, consider the table below.

SmartSlice I/O Unit	Selected I/O Module	I/O Word/Bit
GRT1-PNT	COM Status	Input Word #1
GRT1-ID4	GRT1-ID4	Input Word #2, Bit 0 to 3
GRT1-ID4	GRT1-ID4 *	Input Word #2, Bit 4 to 7
GRT1-OD4	GRT1-OD4	Output Word #1, Bit 0 to 3
GRT1-ROS2	GRT1-ROS2 *	Output Word #1, Bit 4 to 5
GRT1-ID4	GRT1-ID4 *	Input Word #2, Bit 8 to 11
GRT1-AD2	GRT1-AD2 (I: Analog Data) Default	Input Word #3 and #4

The table above lists the physical configuration in the left-most column, the I/O Module selected from the list of available I/O modules in the middle and the I/O words onto which the modules are mapped in the right-most column.

The figure below further illustrates the I/O Configuration selection.

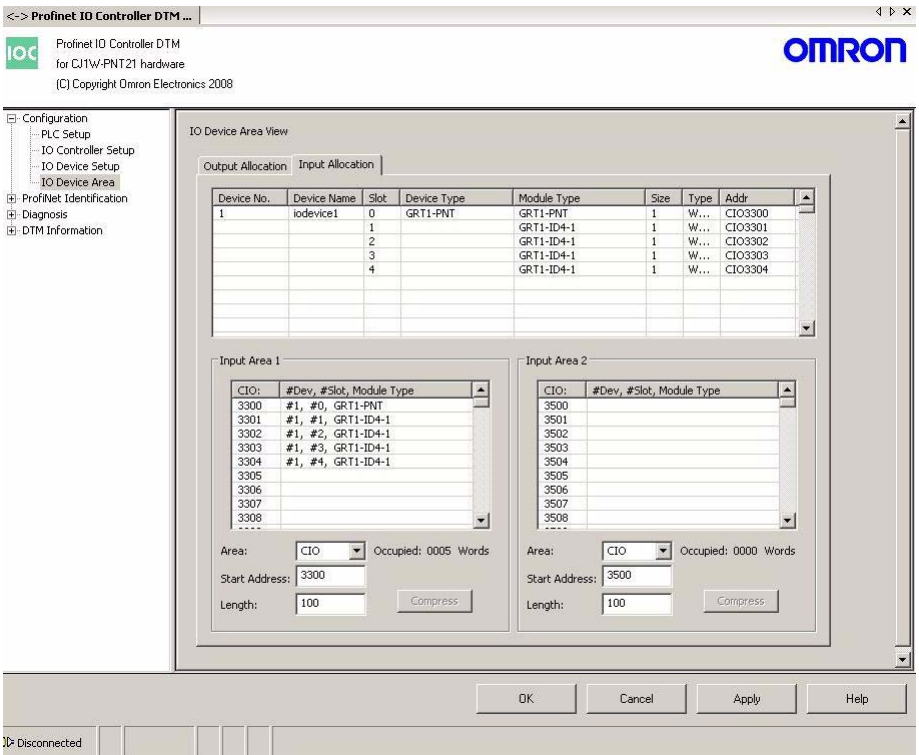


3-4-4 Mapping I/O data

The I/O Configuration can now be mapped on to the PROFINET IO Controller Unit. The PROFINET IO Controller Unit provides a means to map individual I/O Configuration modules to specific memory areas.

Example

As an example, the I/O mapping of the I/O Configuration made using the Generic Device IO DTM is shown in the window below.



The window above shows the SmartSlice I/O Input data, mapped onto CIO 3300 to 3304. The first row indicates the COM Status word, the other rows indicate the GRT1-ID Units.

After setting up the I/O Configuration, it needs to be downloaded to the Controller Unit.

For information on how to map the I/O data on to the PLC memory, refer to the *PROFINET IO Controller Unit Operation Manual* (W12E).

3-5 Monitoring the GRT1-PNT

After network commissioning has been finished and there is communication between the PROFINET IO Controller Unit and the GRT1-PNT, there are multiple ways to monitor the status of the GRT1-PNT and its connected SmartSlice I/O Units.

The monitoring status is available are displayed by the DTMs or can be accessed from the IO Controller and used within the PLC program.

Monitoring Features

There are three types of monitoring information

- The Communication Unit's Status Flag as part of PROFINET IO Data
- The PROFINET IO Communication Status as indicated by the PROFINET IO Controller
- The GRT1-PNT status information using the DTM

3-5-1 Communication Unit's Status Flags

The Communication Unit's status or in short COM status flags are allocated as the first word within the PROFINET IO Data with the PROFINET IO Controller.

These flags can be used to monitor the status of the connection between the GRT1-PNT and the SmartSlice I/O Units as well as the status of the SmartSlice I/O Units themselves. The table below defines the individual bits in the Status word.

Bit	Content	Description
0	SmartSlice I/O Bus Communication Error Flag	Monitors the status of SmartSlice I/O System communication.
1	Reserved	---
2	SmartSlice I/O Unit Warning Flag 0: Normal 1: Error detected	Indicates a minor SmartSlice I/O Unit error. This flag goes ON when there is an error in any of the connected SmartSlice I/O Units.
3	Reserved	---
4	SmartSlice I/O Unit Alarm Flag 0: Normal 1: Error detected	Indicates a major SmartSlice I/O Unit error. This flag goes ON when there is an error in any of the connected SmartSlice I/O Units.
5 to 7	Reserved	---
8	Port 2 Link Status 0 = Link up 1 = Link down	Indicates the communication link status of port 2.
9	Port 1 Link Status 0 = Link up 1 = Link down	Indicates the communication link status of port 1.
10 to 11	Reserved	---
12	Unit Maintenance Flag 0: Normal 1: Error (monitor value reached)	Monitors the Unit's operating time: the power ON time threshold set with the Unit power ON time monitor function.

Bit	Content	Description
13	Automatic Restore Monitor Flag 0: Restore successful 1: Restore failed	Indicates whether or not the automatic parameter restoration to the SmartSlice I/O Units was completed successfully.
14	Communication Unit Error Flag 0: Normal 1: Error occurred	This is the overall Unit status flag. This flag will be ON if any of the other flags (bits 0 to 13) is ON.
15	I/O Refreshing Flag 0: I/O communication stopped 1: I/O communication normal	Indicates whether I/O data is being exchanged normally.

By sending Explicit CIP messages to the Unit, the individual status information of the SmartSlice I/O Units can be read. Please refer to Appendix C Explicit messages.

3-5-2 PROFINET IO Communication Status and Alarms

The PROFINET IO Controller indicates the status of the PROFINET IO Communication with the Unit. This also includes the PROFINET IO Alarms the GRT1-PNT may send based on its state of the SmartSlice I/O Unit.

Appendix B PROFINET IO alarm messages describes the detailed information about PROFINET IO Alarms. Please refer to the PROFINET IO Controller manual (W12E) about details on accessing PROFINET IO Device status and alarms.

3-5-3 GRT1-PNT Unit Status using the DTM

The GRT1-PNT PROFINET IO Communication Unit's DTM provides multiple features to monitor the detailed status of the Unit.

Switching the DTM to Online

To use these features, the GRT1-PNT must be online, i.e. the DTM must establish communication with the physical device. Switching to on-line must be done via the FDT Container. To switch to online, perform the following steps in CX-ConfiguratorFDT.

1,2,3...

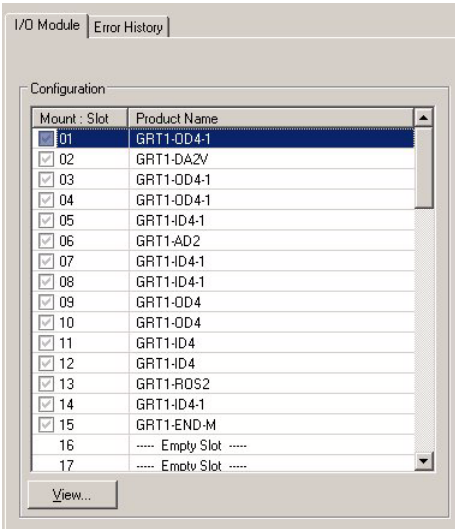
- 1 In the Network view, right-click the GRT1-PNT.
- 2 From the context menu, which pops up, select the option **Go Online**.

To access status information on the PROFINET IO and SmartSlice I/O communication, again select the context menu, and select the Diagnosis option.

Individual SmartSlice I/O Units can also be monitored through the PROFINET IO connection. This data can be retrieved through the I/O Module tab and the I/O Error History tab of the Diagnosis window.

SmartSlice I/O Status

When selecting the I/O Module tab, the window as shown below will appear.



In case an on-line connection to the GRT1-PNT is open, the View button will be enabled. Selecting a SmartSlice I/O Unit and pressing the View button will open a status window for the selected SmartSlice I/O Unit. This information is described in detail in the *SmartSlice GRT1 Series Slice I/O Units Operation Manual (W455)*.

I/O Unit Error History

The I/O Unit Error History can be monitored, when selecting the I/O Unit Error History Tab. This window has also been described in section 3-2-5 I/O Communication error history monitor.

3-6 I/O communication characteristics

This section describes the characteristics of PROFINET IO communication between a GRT1-PNT and an OMRON IO Controller Unit. Use this section for reference when planning operations that require precise I/O timing.

The equations provided here are valid under the following conditions:

- All of the required IO Devices are participating in communication.
- No errors are being indicated by the IO Controller Unit.
- No third-party IO Controller or communication is active in the network.

Note This manual describes the communication with the SmartSlice I/O System only. For detail on the IO Controller Unit or overall PROFINET IO network, refer to the *CJ-series PROFINET IO Controller Units Operation Manual*.

I/O Response Time

The I/O response time is the time between the reception of an input signal at an Input Unit in the SmartSlice I/O System and the actual output signal occurring on an Output Unit in the SmartSlice I/O System after processing by the PLC program.

Minimum I/O Response Time

The **minimum** I/O response time (T_{MIN}) is the total of the following terms:

$$T_{\text{MIN}} = T_{\text{IN}} + T_{\text{SL-IN}} + T_{\text{SL-CI}} + T_{\text{RT-IN}} + (T_{\text{PLC}} - T_{\text{RF}}) + T_{\text{RT-OUT}} + T_{\text{SL-CO}} + T_{\text{SL-OUT}} + T_{\text{OUT}}$$

where:

T_{IN} : The Input Unit's ON (OFF) delay

T_{MIN} : The minimum I/O response time

T_{OUT} : The Output Unit's ON (OFF) delay

T_{PLC} : The PLC's cycle time

T_{RF} : The PLC's PROFINET IO Unit refresh time

T_{RT} : The PROFINET IO communication time

$T_{\text{RT-IN}}$: The Input Device's communication time

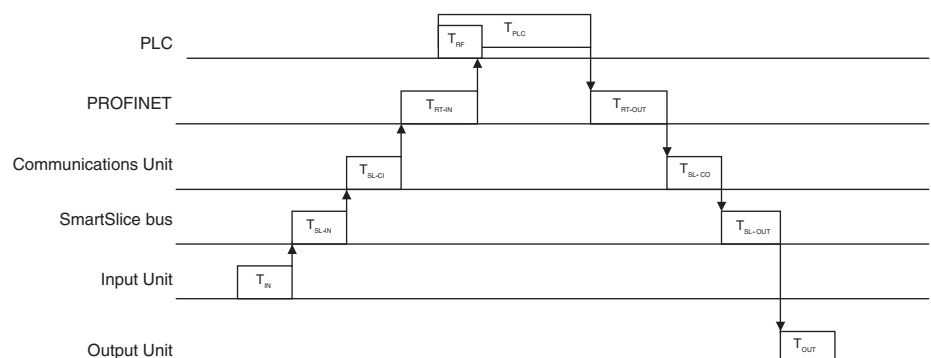
$T_{\text{RT-OUT}}$: The Output Device's communication time

$T_{\text{SL-IN}}$: The SmartSlice bus' communication time (input data)

$T_{\text{SL-CI}}$: The SmartSlice Communication Unit's input data processing time

$T_{\text{SL-CO}}$: The SmartSlice Communication Unit's output data processing time

$T_{\text{SL-OUT}}$: The SmartSlice bus' communication time (output data)



Note Refer to the *GRT1 Series SmartSlice I/O Units Operation Manual* for details on Input Unit's input delay times and Output Unit's output delay times.

Maximum I/O Response Time

The **maximum** I/O response time (T_{MAX}) is the total of the following terms:

$$T_{MAX} = T_{IN} + 2 \cdot T_{SL} + T_{SL-CI} + T_{SL-CO} + 2 \cdot T_{RM} + 2 \cdot T_{PLC} + T_{RF} + T_{OUT}$$

where:

T_{IN} : The Input Unit's ON (OFF) delay

T_{MAX} : The maximum I/O response time

T_{OUT} : The Output Unit's ON (OFF) delay

T_{PLC} : The PLC's cycle time

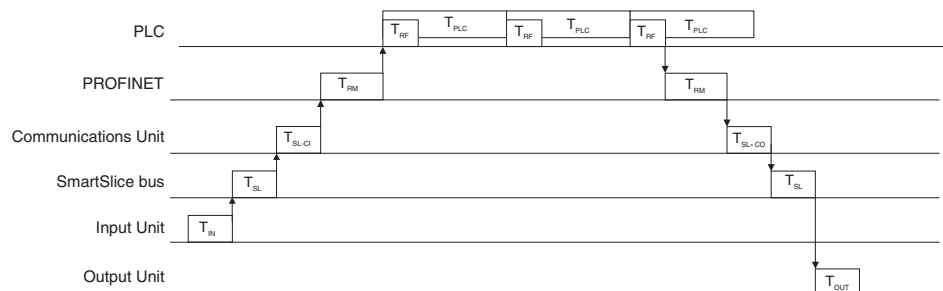
T_{RF} : The PLC's PROFINET IO Unit refresh time

T_{RM} : The entire PROFINET IO communication cycle

T_{SL} : The SmartSlice bus communication cycle time

T_{SL-CI} : The SmartSlice Communication Unit's input data processing time

T_{SL-CO} : The SmartSlice Communication Unit's output data processing time



Note Refer to the *GRT1 Series SmartSlice I/O Units Operation Manual* for details on Input Unit's input delay times and Output Unit's output delay times.

PROFINET IO Communication Cycle Time (T_{RM})

The PROFINET IO communication cycle time is the time from the completion of a IO Device's remote I/O communication processing until remote I/O communication with the same IO Device are processed again. The communication cycle time is used to calculate the maximum I/O response time.

The communication cycle time (T_{RM}) is defined by the user by means of the Update Rate in the configuration of the PROFINET IO Controller Unit. Refer to the *CJ-series PROFINET IO Controller Units Operation Manual* (W12E).

Refresh time (T_{RF})

The refresh time is the time required to exchange I/O data between the PLC's CPU Unit and the PROFINET IO Controller Unit. The PLC's cycle time is increased when an IO Controller Unit is mounted. When an IO Controller Unit is mounted to the CJ1 PLC, the PLC's cycle time (I/O refreshing) is increased by the following amount

$$0.7 + 0.001 \times \text{number of words (ms)}$$

The number of words refreshed is the total number of words in the I/O Area allocated to the IO Devices, including any unused words between the allocated words.

Refer to the *PLC's operation manual* for more details on the refresh time and the PLC's cycle time.

Slice Bus Communication Cycle Time (T_{SL})

The SmartSlice bus communication cycle time is the delay in the SmartSlice I/O System from the end of communication with one I/O Unit until the start of communication with the next Unit.

Communication unit processing time (T_{SL-CI} and T_{SL-CO})

The PROFINET IO Communication Unit processing time is the time required for software processing in the Communication Unit.

Slice Bus Communication Time (T_{SL-IN} and T_{SL-OUT})

The SmartSlice bus communication time is the time required to communicate with an Input Unit (T_{SL-IN}) or Output Unit (T_{SL-OUT}) in the SmartSlice I/O System.

T_{SL} , T_{SL-CI} , T_{SL-CO} , T_{SL-IN} and T_{SL-OUT} strongly depend on the number of SmartSlice I/O Units as well as on the amount of I/O data per SmartSlice I/O Unit. The example below presents an indicative measure for the time required to process PROFINET IO output data.

Measurement tables

The measurement tables shown below in this section give an indication of the PROFINET IO timing. The times are defined as follows:

- The input time is measured as the time between the moment an input is set at one of the Slice I/O Units and the moment the input data arrives at the PROFINET IO Controller.
- The output time is measured as the time between the moment the PROFINET IO Message is sent by the IO Controller and the moment it is physically set at one of the Slice I/O Units.

For the measurements two Slice I/O Unit configurations are considered:

- A small SmartSlice I/O configuration containing a single GRT1-ID4-1 and a single GRT1-OD4-1.
- A large SmartSlice I/O configuration containing the maximum of 64 different GRT1 SmartSlice I/O Units.

Measured input time for 8 ms update rate

	Minimum (ms)	Maximum (ms)	Typical (ms)
2 I/O Units	4.8	18.2	10.7
64 I/O Units	4.8	20.8	12.0

Measured output time for 8 ms update rate

	Minimum (ms)	Maximum (ms)	Typical (ms)
2 I/O Units	5.5	23.3	13.2
64 I/O Units	6.1	23.3	13.2

Measured input time for 16 ms update rate

	Minimum (ms)	Maximum (ms)	Typical (ms)
2 I/O Units	5.8	26.4	14.6
64 I/O Units	6.1	28.1	17.6

**Measured output time for
16 ms update rate**

	Minimum (ms)	Maximum (ms)	Typical (ms)
2 I/O Units	5.1	29.9	15.5
64 I/O Units	5.7	29.9	17.0

Note The measurements have been performed with the registered table enabled (REGS function). This is performed with DIP Switch 1, see section 2-1-5 DIP switches for details.

SECTION 4

Troubleshooting and maintenance

This section describes the troubleshooting procedures and maintenance operations for the PROFINET IO Communication Unit, needed to keep the PROFINET IO network working optimally.

SECTION 4

Troubleshooting and maintenance 69

4-1 Overview	70
4-2 Troubleshooting using the LED indicators	71
4-3 Other errors	76
4-4 Maintenance.....	79
4-5 Replacing the Unit.....	80

4-1 Overview

The PROFINET IO Communication Unit and the Configuration DTM provide extensive means for troubleshooting, which can be used to quickly determine errors in the Unit, in the SmartSlice I/O Unit configuration, and/or in the network.

Troubleshooting on the GRT1-PNT Unit

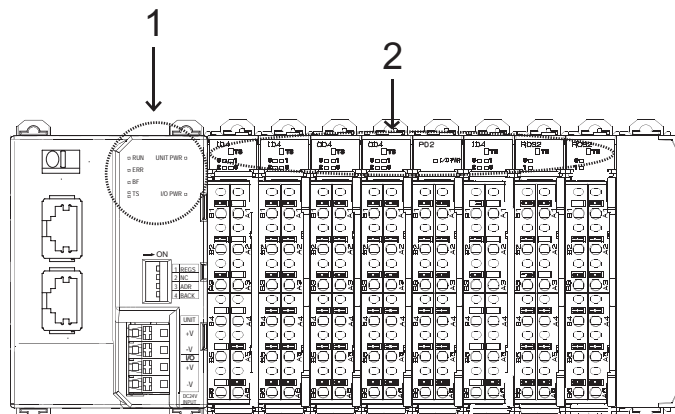
For troubleshooting purposes, the following error indicators can be used:

- LED indicators on the front of the Unit
Two red error LED indicators and four status LED indicators show Unit and SmartSlice I/O system status and errors.
- PROFINET IO errors
The PROFINET IO Configurator or DTMs can be used to find detailed information about the errors on the PROFINET IO network.

This section provides a number of procedures for troubleshooting, based on the error indicators listed above.

4-2 Troubleshooting using the LED indicators

The figure below shows the available LED indicators on the PROFINET IO Communication Unit and on the SmartSlice I/O system attached to it. The GRT1-PNT and the SmartSlice I/O Units are operating normally when all of the LED indicators are lit green.



The LEDs on the Communication Unit (1) have the following functions:

LED	Indicates the status of
RUN	the PROFINET IO Communication Unit
ERR	the PROFINET IO Communication Unit
BF	the PROFINET IO Communication Unit
TS	the SmartSlice I/O System
UNIT PWR	the Unit power supply
I/O PWR	the I/O power supply

The LEDs on the SmartSlice I/O Units (2) have the following functions:

LED	Indicates the status of
TS	this specific SmartSlice I/O Unit

Note Not shown in the figure above is a Turnback Unit. The Turnback Unit also provides I/O PWR, UNIT PWR and TS LED Indicators.

The LED indicators can be used to determine the following categories of errors:

- Power errors
- Startup errors
- SmartSlice I/O Unit errors
- PROFINET IO errors

4-2-1 Power supply errors

Errors in the Power supply of the Unit or the external I/O are indicated by the UNIT PWR and I/O PWR LED Indicators.

Troubleshooting UNIT Power

The UNIT PWR LED Indicator shows whether or not sufficient power is supplied to the PROFINET IO Communication Unit and the SmartSlice I/O Units in order for them to start up and operate properly. A UNIT PWR LED Indicator is provided on the following Units:

- GRT1-PNT PROFINET IO Communication Unit
- GRT1-TBL Left Turnback Unit

The table below shows the LED Indicator options.

Unit Power Error

UNIT PWR	Probable cause	Correction
Not lit	No power or not enough power is being supplied to the Units (See note)	<ul style="list-style-type: none"> • Check whether power is supplied to the Unit Power Connector. • Check that the supplied power is within the required range, i.e.: $24 V_{DC} +10 \% -15 \%$ ($20.4 V_{DC}$ to $26.4 V_{DC}$).
Flashing	The Unit power supply capacity is insufficient.	<ul style="list-style-type: none"> • Check the entire SmartSlice I/O System's power supply requirement and replace the power supply with one that has sufficient capacity.
Lit	No Unit power error. The correct power is supplied to the System.	

Note The PROFINET IO Communication Unit can startup on less power than specified. If this happens, the UNIT PWR LED Indicator may be OFF, whereas other LED Indicators may indicate correct operation. In this situation however, correct operation of the whole SmartSlice I/O System is not guaranteed.

Troubleshooting I/O Power

The I/O PWR LED Indicator shows whether or not sufficient power is supplied to the External I/O Power lines to the SmartSlice I/O Units in order for them to drive the external Outputs on the individual Units. An I/O PWR LED Indicator is provided on the following Units:

- GRT1-PNT PROFINET IO Communication Unit
- GRT1-TBL Left Turnback Unit
- GRT1-PD[] I/O Power Supply Units

The table below shows the LED Indicator options.

I/O Power Error

I/O PWR	Probable cause	Correction
Not lit	No power or not enough power is being supplied to the External I/O of the SmartSlice I/O Units.	<ul style="list-style-type: none"> • Check whether power is supplied to the I/O Power Connector on the GRT1-PNT, the GRT1-TBL or the GRT1-PD2 Unit. • Check that the supplied power is within the required range, i.e.: $24 V_{DC} +10 \% -15 \%$ ($20.4 V_{DC}$ to $26.4 V_{DC}$).
Lit	No I/O power error. The correct power is supplied to the External I/O System.	

4-2-2 Unit system errors

If power supply to the Unit and the SmartSlice I/O Units is correct, the Unit will start initialization at power up. During the initialization process the RUN LED indicator will remain OFF. Once the initialization has been completed correctly, the RUN LED indicator will be ON.

The table below indicates the states which can occur during startup and operation of the Unit.

RUN	ERR	Probable cause	Correction
Not Lit	Not Lit	Unit is initializing	--
	Flashing	Unit has encountered a fatal system error during initialization and is unable to continue.	Replace the Unit.
	Lit	The Unit has been initialised, but encountered fatal error during Operation.	Restart the Unit. If the problem persists, replace the Unit.
Lit	Not Lit	The Unit is Operational. No errors encountered.	
	Lit	Not a valid combination.	

4-2-3 SmartSlice I/O system errors

If power supply to the Unit is correct and the Unit has initialized correctly, problems in the SmartSlice I/O system can be determined using the TS LED indicators on the PROFINET IO Communication Unit as well on the individual SmartSlice I/O Units. When lit or flashing, the TS LED indicator can be either Green or Red.

The tables below lists the TS LED indicator options.

Communication Unit

TS	Colour	Probable cause	Correction
Not Lit	---	Power is not being supplied to the Unit.	Refer to section 4-2-1.
Flashing (1 Hz)	Green	Joining SmartSlice I/O Units to network.	Wait until the SmartSlice I/O Units have been added to the network.
		There is a possible break in the connection between individual SmartSlice I/O Units, or one of the SmartSlice sockets has not been connected properly to its left neighboring connector. The TS LED Indicator on all correctly connected slices are flashing, whereas the TS LED Indicators on the non-correct Units are Not Lit (OFF).	Check the connection between SmartSlice I/O Units at the point where the first Unit is located with its TS LED Indicator OFF. Ensure that all SmartSlice I/O Units are connected correctly to each other.
		The End Unit is not (properly) attached. SmartSlice Communication does not start up. The TS LED Indicator on all SmartSlice I/O Units slices are flashing.	Check the End Unit connection and ensure that it is correctly connected to the SmartSlice system.
	Red	SmartSlice bus communication error occurred.	Check whether the SmartSlice I/O System's base block is connected properly.
		When the registration table function is enabled, the actual configuration does not match the registered configuration.	Correct the configuration and turn the power ON again.
		The total number of I/O points in the SmartSlice I/O Systems exceeds the maximum.	Correct the Unit configuration and number of I/O points and turn the power ON again.

TS	Colour	Probable cause	Correction
Flashing (2 Hz)	Green	Restore operation in progress	Wait until the restore operation is completed.
		Backup operation in progress	Wait until the backup operation is completed.
Lit	Red	Backup operation failed (See Note).	Backup the data again.
		Restore operation failed (See Note).	Reinstall the Unit in which the data was being restored and turn the power ON again.
		SmartSlice I/O Unit configuration error occurred.	Check the following items. <ul style="list-style-type: none"> • Are more than 64 I/O Units (including END-M Unit) connected? • Are more than 128 bytes of I/O data being used? • Has the I/O configuration changed since the I/O configuration table was registered?
	Green	The SmartSlice bus is operating normally.	---

Note Backup/Restore Operation failed: TS LED Indicator will be Lit for 2 seconds.

SmartSlice I/O Unit

TS	Colour	Probable cause	Correction
Not Lit	---	Power is not being supplied to the Unit.	Refer to section 4-2-1.
Flashing (1 Hz)	Red	Communication error occurred.	Check whether the connector is inserted properly.
Flashing (2 Hz)	Green	Restore operation in progress	Wait until the restore operation is completed.
		Backup operation in progress	Wait until the backup operation is completed.
Lit	Red	Unit hardware failure.	Turn the power OFF and then ON again. Replace the Unit if the error recurs.
	Green	The SmartSlice I/O Unit is operating normally.	---

4-2-4 PROFINET IO errors

If power supply to the Unit is correct and the Communication Unit and the SmartSlice I/O Units are operating correctly, problems in the PROFINET IO Connection can be determined using the BF LED indicator (Bus Fail) on the PROFINET IO Communication Unit. The tables below lists the BF LED options.

BF	Probable cause	Correction
Not lit	No PROFINET IO Communication error encountered. The Unit is exchanging I/O data with the Controller Unit.	
Flashing	The PROFINET IO Configuration downloaded to the IO Controller is not correct. There is however communication with the IO Controller Unit.	<ul style="list-style-type: none"> • Verify that the selected configuration matches the physical SmartSlice I/O Unit configuration connected to the PROFINET IO Communication Unit. Check the PROFINET IO Alarm. (see Note) • Check the configuration and the parameter data of the IO Device. • Some SmartSlice I/O Units (such as the GRT1-AD2) support different I/O sizes. Make sure this SmartSlice I/O Unit is configured according the PROFINET IO configuration.
Lit	The PROFINET IO Configuration is not correct. There is no communication with the IO Controller. The SmartSlice I/O Bus did not properly start.	<ul style="list-style-type: none"> • Verify the Unit has the same Device Name as in the IO Controller configuration. • Verify no Device Name is used twice in the network. • Verify the IO Controller Unit is on-line. • Verify the SmartSlice I/O Units are properly connected and the block terminated with the END-M or END Unit.

Note When multiple SmartSlice I/O Units do not match with the PROFINET IO Configuration, the Alarm message will only indicate the first mismatching SmartSlice I/O Unit.

4-3 Other errors

4-3-1 Troubleshooting SmartSlice I/O Communication

This section deals with troubleshooting the SmartSlice I/O communication on the network from a behaviour point of view. The column on the left describes the general perceived problem to the user. The columns on the right list the possible causes and their remedies.

Problem	Probable cause	Correction
The Communication Unit's Unit Power LED is flashing. The I/O Unit repeatedly checks LEDs (TS LED flashing green and red).	The Unit power supply capacity is insufficient.	Check the entire SmartSlice I/O System's power supply requirement and replace the power supply with one that has sufficient capacity.
The Communication Unit's TS LED intermittently flashes green. The TS LED of the I/O Units in front of the bad connection light green, while the TS LED of the I/O Units behind the bad connection are OFF.	The slide connector on the left side of the affected Unit is not connected properly. <div data-bbox="489 840 1404 1086"> </div>	Connect this slide connector properly and turn the power ON again.
The Communication Unit's TS LED flashes green and the I/O Unit's TS LED is ON.	The End Unit is not connected properly. <div data-bbox="534 1209 1356 1444"> </div>	Connect the End Unit properly and turn the power ON again.

4-3-2 Troubleshooting PROFINET IO communication

Problem	Probable cause	Correction
PROFINET IO Controller Unit is configured, but only one of the IO Devices is not exchanging data.	The PROFINET IO configuration of the IO Controller for the Unit is not correct.	<ul style="list-style-type: none"> Verify the selected configuration matches the physical SmartSlice I/O Unit configuration connected to the PROFINET IO Communication Unit. Check the PROFINET IO Alarm. Check the configuration and the parameter data of the IO Device. Some SmartSlice I/O Units (such as the GRT1-AD2) support different I/O sizes. Make sure this SmartSlice IO Unit is configured according the PROFINET IO configuration.
	<p>The SmartSlice bus has one of the following problems at start-up:</p> <ul style="list-style-type: none"> One or more SmartSlice IO Units are missing. Disconnected turn-back cable, END Unit or END-M Unit. <p>The PROFINET IO Configuration for the Unit cannot be compared with the actual configuration. No PROFINET IO Connection is established with the Unit.</p>	Connect the SmartSlice I/O Units and the cables properly and turn the power ON again.
PROFINET IO Controller Unit is configured, but none of the IO Devices are exchanging data.	<p>No power is supplied to the system.</p> <ul style="list-style-type: none"> All LED indicators on the system are OFF. 	<ul style="list-style-type: none"> Verify that power is supplied to the system.
	<p>The PROFINET IO Controller Unit is in OFFLINE mode.</p> <ul style="list-style-type: none"> The IO Controller's NS LED is OFF and the MS LED is ON Red or blinking Red. A PROFINET IO interface error has occurred: see IO Controller Status 2 error flags (IO Controller CIO Word n+6, bit 00 to 03, see Note) for details. 	<p>Determine the mode of the IO Controller Unit: Check the IO Controller Status 1 Word (CIO Word n+5, bit 00 to bit 03, see Note). If Unit is in OFF-LINE mode:</p> <ul style="list-style-type: none"> Verify that the IO Controller does not use the same Device Name or IP address as another Unit on the network. Correct the IO Controller Unit's Device Name or IP address.
	<p>Network cabling is not correct.</p> <ul style="list-style-type: none"> IO Controller NS LED is OFF and/or Unit BF LED indicator is ON. IO Controller Status 2 error flag may provide more information (IO Controller CIO Word n+6, bit 00 to 03, see Note). IO Controller CIO Words n+9 to n+16 show which IO Devices have problems. 	<p>Verify that the network installation is correct:</p> <ul style="list-style-type: none"> Verify that all IO Devices and Ethernet switches are powered up and functioning correctly. Verify that all IO Devices are correctly connected to the network. Check the cable lengths.

Problem	Probable cause	Correction
PROFINET IO Controller Unit is configured. Some, but not all IO Devices exchange data.	Network cabling is not correct. <ul style="list-style-type: none"> IO Controller's NS LED indicator is flashing and/or Unit's BF LED indicator is ON or Flashing. IO Controller Status 2 error flags may provide more information (IO Controller CIO Word n+6, bit 00 to 03, see Note). IO Controller CIO Words n+9 to n+16 show which IO Devices have problems. 	Verify the network installation is correct: <ul style="list-style-type: none"> Verify all IO Devices are powered up and functioning correctly. Verify all IO Devices are correctly connected to the network. Check the cable lengths.
	The IO Controller's configuration is not correct: <ul style="list-style-type: none"> IO Controller NS LED indicator is Flashing. IO Controller CIO Words n+9 to n+16 show which IO Devices have problems. Use CX-ConfiguratorFDT and DTMs to determine IO Device diagnostics. 	Verify that the configuration is correct: <ul style="list-style-type: none"> Verify Device Name of the targeted IO Device matches the configured device name. Verify that the IO Device parameter and configuration settings are correct. Verify no duplicate IP address exist within the network.
PROFINET IO Controller Unit is configured. All IO Device have been in data exchange, but it has now stopped.	No power is supplied to the system. All LED indicators on the system are OFF.	<ul style="list-style-type: none"> Verify that power is supplied to the system.
	The PROFINET IO Controller Unit is in OFFLINE mode. <ul style="list-style-type: none"> The IO Controller's NS LED is OFF and the MS LED is ON Red or blinking Red. A PROFINET IO interface error has occurred: see IO Controller Status 2 error flags (IO Controller CIO Word n+6, bit 00 to bit 03, see Note) for details. 	Determine the mode of the IO Controller Unit: Check the IO Controller Status 1 Word (CIO Word n+5, bit 00 to bit 03, see Note). If Unit is in OFF-LINE mode: <ul style="list-style-type: none"> Verify that the IO Controller does not use the same Device Name or IP address as another Unit on the network. Correct the IO Controller Unit's Device Name or IP address.
	Verify the network installation is correct: <ul style="list-style-type: none"> Verify all IO Devices are powered up and functioning correctly. Verify all IO Devices are correctly connected to the network. Check the cable lengths. 	Network cabling is not correct. <ul style="list-style-type: none"> IO Controller's NS LED indicator is flashing and/or Unit's BF LED indicator is ON or Flashing. IO Controller Status 2 error flags may provide more information (IO Controller CIO Word n+6, bit 00 to bit 03, see Note). IO Controller CIO Words n+9 to n+16 show which IO Devices have problems.
PROFINET IO Controller Unit is configured. All IO Devices are in Data Exchange, but the output data is not set. The input data is correctly updated.	The IO Controller is not sending the Provider Status Good with its Data Exchange messaging: <ul style="list-style-type: none"> In case Provider Status is User Bit Controlled, the CIO bit n.12 is not set to ON. In case Provider Status is PLC Mode Dependent, the PLC is in PROGRAM Mode. 	Depending on the Provider Status Control Setting: <ul style="list-style-type: none"> Correct the Provider Status to Good by setting the CIO n.12 to ON or to set the PLC in RUN/MONITOR mode.

4-4 Maintenance

This section describes the routine cleaning and inspection recommended as regular maintenance.

4-4-1 Cleaning

Clean the PROFINET IO Communication Unit regularly as described below in order to keep it in an optimum operating condition.

- Regularly wipe the Unit with a dry, soft cloth.
- If a spot cannot be removed with a dry cloth, dampen the cloth with a neutral cleaner, wring out the cloth and wipe the Unit.

!Caution

Never use volatile solvents such as paint thinner, benzine or chemical wipes. These substances could damage the surface of the Unit.

4-4-2 Inspection

Be sure to inspect the system periodically to keep it in optimum operating condition. In general, inspect the system once or twice a year, but more frequently if the system is used in high temperature or high humidity environments or dirty/dusty conditions.

Inspection Equipment

Prepare the following equipment before inspecting the system.

Required Equipment

Philips type screwdriver, multimeter, alcohol, and a clean cloth.

Optional Test Equipment

Depending on system conditions, a synchroscope, oscilloscope, thermometer or hygrometer (to measure humidity) might be needed.

Inspection Procedure

Check the items in the following table and correct any that are below standard.

Item		Standard	Equipment
Environmental conditions	Ambient temperature	0 °C to 55 °C	Thermometer
	Ambient humidity	10 % to 90 %	Hygrometer
	Dust/dirt accumulation	None	---
Installation	Are the units installed securely?	No looseness	---
	Are the communication connectors fully inserted?	No looseness	---
	Are the external wiring screws tight?	No looseness	---
	Are the connecting cables undamaged?	No damage	---

4-5 Replacing the Unit

4-5-1 Replacement Precautions

The PROFINET IO Communication Unit is a network device. If the Unit is damaged, it will affect the entire network, so always ensure repairs are undertaken immediately. It is recommended to have a spare PROFINET IO Communication Unit at hand so that repairs may be conducted quickly.

Replacement Precautions

Observe the following precautions when replacing the Unit.

- Please consider to include the GRT1-END-M Memory End Slice in the slice configuration for easy replacement of the Unit (see next section).
- Always turn OFF the power before replacing the Unit.
- Ensure that the new Unit is not faulty.
- When returning a faulty Unit for repair, always attach a detailed fault report to the Unit and return it to the nearest OMRON dealer.

- Note**
- 1 In order to prevent faulty operation be sure to turn off the power to all IO Controller and IO Devices before replacing the Unit.
 - 2 When replacing the Unit, do not reconnect it to the network before carrying out the procedures listed below.

4-5-2 Setting the Unit after Replacement

Setting the Unit again after replacement depends whether the GRT1-END-M Memory End Slice is included in the system.

System with GRT1-END-M

Please make sure the DIP switch 1 (REGS) is OFF of the new Unit before installing. Re-apply the power to the system. The PROFINET IO Communication Unit will automatically get the Device Name from the GRT1-END-M, which was stored when configuring the previous Unit.

After re-applying the power, the PROFINET IO configuration settings will be automatically set by the PROFINET IO Controller. No user actions required.

When using one or more of the following Unit functions for the old Unit:

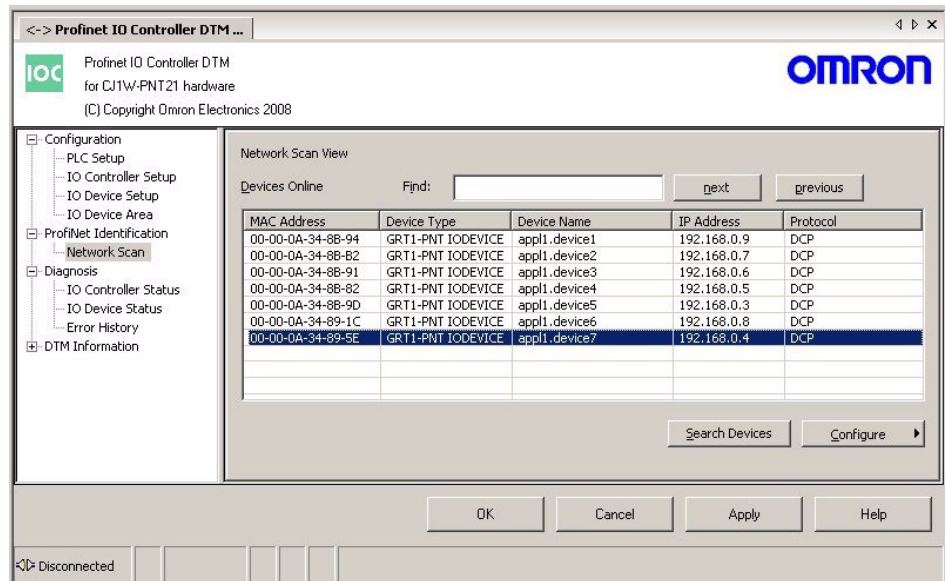
- 1 Table Registration Function, see section 3-2-1 Table registration function
- 2 Backup Function, see section 3-2-2 Backup function
- 3 Automatic Restore Function, see section 3-2-3 Automatic restore function

Execute these operations again for the new Unit.

Re-connect it to the network, and restart operation.

System without GRT1-END-M

Please make sure the DIP switch 1 (REGS) is OFF of the new Unit before installing. Re-applying the power on the system. The PROFINET IO Communication Unit will require the same Device Name as the old Unit. Connect the Personal Computer with the CX-ConfiguratorFDT and DTMs. Re-assign the Device Name using the IO Controller DTM with the PROFINET Identification tab (Network scan).



After re-assigning the correct Device Name, the PROFINET IO configuration settings will be automatically set by the PROFINET IO Controller. No user actions required.

When using one or more of the following Unit functions for the old Unit:

- 1 Table Registration Function, see section 3-2-1 Table registration function
- 2 Backup Function, see section 3-2-2 Backup function
- 3 Automatic Restore Function, see section 3-2-3 Automatic restore function

Execute these operations again for the new Unit.

Re-connect it to the network, and restart operation.

Appendix A

PROFINET IO technology

A-1 Introduction to PROFINET

As a common solution for the industrial communication, the PROFIBUS International organisation introduced the PROFINET Industrial Ethernet standard. PROFINET is the next step for building on the current:

- PROFIBUS DP, the well-known and established fieldbus;
- Industrial Ethernet.

PROFINET is the innovative and open standard for Industrial Ethernet. PROFINET satisfies all requirements for automation technology. With PROFINET, solutions can be implemented for factory and process automation, for safety applications and for motion control. PROFINET is now standardized in IEC 61158 and IEC 61784.

The use of PROFINET minimizes the cost of installation, engineering and commissioning.

PROFINET IO

Distributed field or I/O Devices are integrated through PROFINET IO. This uses the usual IO view of PROFIBUS DP, whereby the IO data of field devices are cyclically transmitted to the process image of the PLC.

The PROFINET IO device model is based on the PROFIBUS implementation, consisting of insertion (slots) and groups of I/O channels (subslots). The characteristics of the field devices are described via a General Station Description (GSD) on an XML basis.

The installation, monitoring and maintenance of PROFINET IO will be familiar to engineers accustomed to PROFIBUS DP. The distributed field devices are allocated to a controller during configuration.

PROFINET CBA

The PROFINET component model has its application in distributed automation systems. This is mainly used for intelligent field devices with programmable functionality as well as controllers. PROFINET CBA divides distributed, complex applications into autonomous units of manageable size.

A distributed automation system based on these autonomous units simplifies the modularization of plants and machines, permitting separate and cross-vendor development.

PROFINET based on a component model is described using a PROFINET Component Description (PCD), which is XML-based.

A-2 PROFINET Communication

PROFINET uses Ethernet and TCP, UDP and IP as basis for the communication between the devices.

TCP/IP and UDP/IP

For non-time critical messaging PROFINET uses standard Ethernet mechanisms over TCP/IP and UDP/IP.

Field devices are addressed using a MAC and IP address. This is similar to the standard Ethernet communication. In these protocols, the networks are identified based on the IP address. Within a single network the MAC address is used for the addressing of the target devices.

This addressing features enables integration with the IT world without limitation. The OMRON I/O Devices can accordingly support the OMRON Ethernet protocols, enabling additional communication with OMRON PROFINET devices.

TCP provides an error-free transmission of data from sender to receiver. It establishes a connection between the two stations before the transmission is complete. This connection is monitored during operation and disconnected after the transmission is complete.

UDP does not guarantee an error-free transmission of data. However, the UDP is connectionless. Each message is an individual transmission. Because of the lack of overhead (connection establishment, monitoring, etc.), this protocol is more suitable for time-critical applications.

RT and IRT

The TCP/IP and UDP/IP communication protocols apply a considerable amount of control overhead which will slow down data transmission speed which is required for PROFINET applications. To facilitate Real-Time capabilities for data exchange, the PROFINET uses a specific protocol of Real-Time (RT) Communication. This protocol cancels some of the flow control and addressing in comparison with the TCP/IP and UDP/IP.

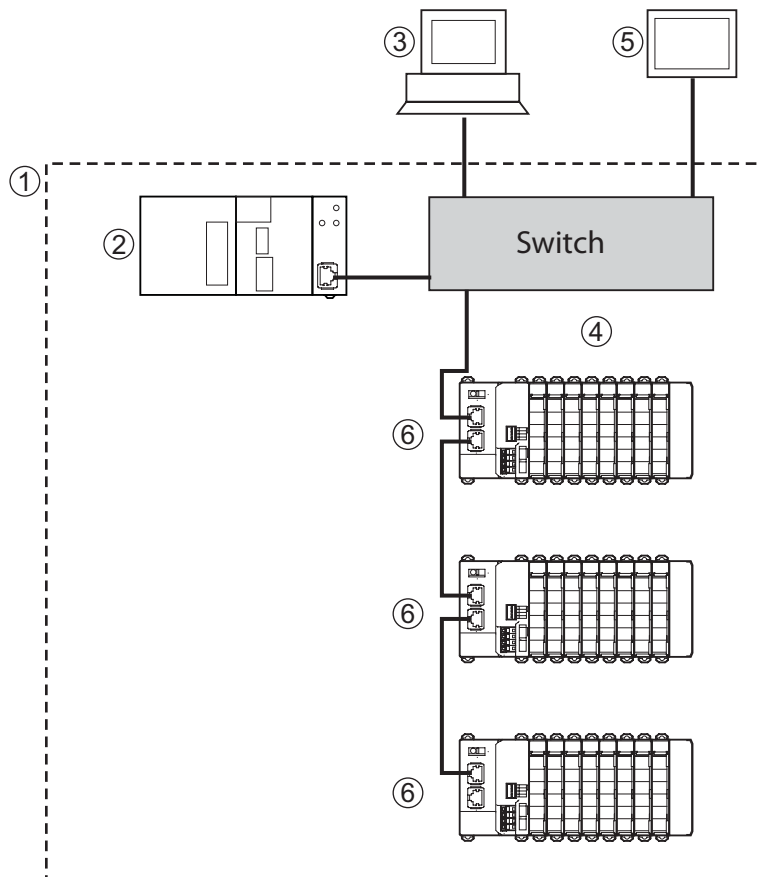
For the prioritized transmission of RT-frames, Real-Time communication uses the VLAN tag as defined in IEEE 802.1Q.

For demanding communication tasks of high performance within PROFINET, for instance Motion Control, the Isochronous Real Time (IRT) has been developed. This communication requires specific hardware to establish integrated switch functionality and cycle synchronization.

A-3 PROFINET Distributed I/O

The focus of PROFINET IO is to have cyclic data exchange between a controller and multiple often simple communication devices. The aim is to have high performance and ease to use. The experience of the PROFIBUS fieldbus has been integrated into the PROFINET IO from user's point of view.

The PROFINET IO distinguishes the following different device roles. Please note a single device can have multiple roles.



Number	PROFINET	PROFIBUS	Comment
1	IO System	DP master system	
2	IO Controller	DP Master	Device that addresses the connected IO units by exchanging input and output signals with them. This controller normally runs the automation program.
3	IO Supervisor	PG/PC Class 2 DP master	Device (e.g. a PC) for commissioning and diagnostics.
4	Ethernet	PROFIBUS	Network infrastructure.
5	User Interface	HMI	Device for operating and monitoring the functions of the system.
6	IO device	DP slave	Device for receiving sensor signals and controlling actuators like valves, switches and frequency converters.

IO Controller

A PROFINET IO Controller is the central device in the PROFINET network. It has the control over the state of the network and processes the data and alarms. The IO Controller typically is a PLC Unit that processes the data and alarms in the user program. It establishes the connection to the devices on the network during system start-up.

IO Supervisor

A PROFINET IO Supervisor is an optional device in the network, which has temporary access to the field devices. It is typically an engineering station for monitoring or commissioning of the system.

IO Device

A PROFINET IO Device is a remotely connected field device, close to the manufacturing process. It is configured by the IO Controller to cyclically interchange process data with the IO Controller. The IO Device can have multiple connections to different IO Controllers / IO Supervisors in the network and will generate alarms if problems occur with the communication or the manufacturing process.

Device Model

The PROFINET IO application layer describes the modules of an IO Device in a similar way as for PROFIBUS DP. A PROFINET IO Device consists of slots for which the modules/submodules can be inserted. The technical data concerning the slots and subslots are defined in the GSD file of a device.

Slot

A Slot is the physical place of insertion of a module in an IO Device. Various subslots are located in the various slots, which contain data for cyclic data exchange.

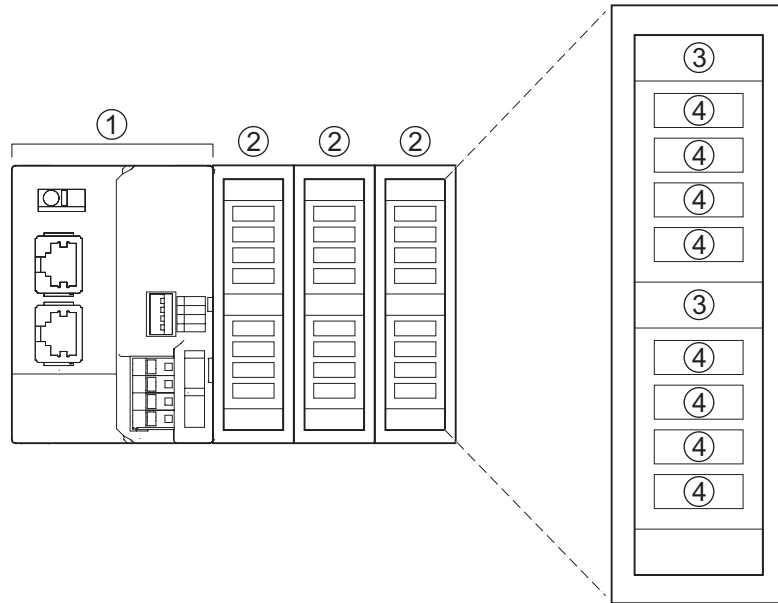
Subslot

Subslots provide an additional addressing layer. They enable grouping of similar channels within a slot. Each slot has to comprise at least one subslot with [1:n] I/O channels.

Index

The index specifies the data related to a specific subplot, to be read or written acyclically.

The device model is shown in the following graph:



Number	Description
1	Communication Unit
2	I/O Module
3	Submodule
4	Channel

Provider/Consumer Model

The data exchange between IO Controller and the IO Devices is carried out based on the provider-consumer model. The provider sends its data to the consumer without a request from the other device. The consumer processes the data. The provider (as the consumer) is either the IO Controller or the IO Device.

The Input Output Provider Status (IOPS) indicates the status of the data source (valid or invalid) for each of the modules as part of the data exchange message. This can be the Output data for the IO Controller and the Input data for the IO Device. The provider status is either bad or good, implying the received data is either invalid or valid for use. For example the Output data of the IO Controller is set to bad in case the PLC is in Program mode.

The Input Output Consumer Status (IOCR) indicates the feedback on the provided data received before. This status (Bad or Good) is indicated in the Input data for the IO Controller and the Output data for the IO Device. As an example when considering the IO Controller Redundancy: an IO Device will only feedback to the active IO Controller it has consumed its output (status Good). The standby IO Controller will get IOCR Bad status as response.

A-4 PROFINET Communication Services

The IO Controller establishes a connection to its IO Devices based on the configuration which has been given by the user. The Application Relation (AR) includes all data needed to achieve this data exchange. A single AR can include multiple Communication Relations (CRs). For implementation of different communication profiles, such as PROFIdrive, the PROFINET IO contains special addressing elements. These elements are called Application Process Identifier (APIs).

The following CRs are possible for each API.

- IOCR, consisting of input, output or multicast
- Record data CR for exchange of acyclic data
- Alarm-CR for communicating alarms and other events

The data exchange between the IO Device and the IO Controller occurs in a poll cycle as configured by the IO Controller. The user is capable to set this update cycle in the IO Controller configuration for each of the IO Devices. This results in mutual monitoring of functional operability (watchdog function). All cyclic data is provided with a status that encodes the validity of the data.

A-5 Alarms

PROFINET IO is capable of sending events within the automation process as alarms. These alarms have to be acknowledged by the application process. These include both system-defined events (i.e. Removal of slices) or user-defined events (i.e. Input voltage out of range).

The following events are distinguished:

Type	Description
Process alarms	Events from the process, which are sent to the control system.
Diagnostics alarms	Events indicating a malfunction of a field device.
Maintenance alarms	Events relating to preventive maintenance to avoid device breakdown.
Manufacturer-specific diagnostics	Events relating to events specific for the manufacturer.

PROFINET defines a standard set of alarm causes, like

Type	Description
Pull and plug alarms	Events related to modular IO Devices, such as the GRT1-PNT. A slice module is removed or plugged in.
Plug wrong submodule	Events indicating an incorrect submodule has been configured or inserted.

Alarms are always identified by the indication of the slot/subslot.

Note Alarm handling Process

The IO Device can handle only one high priority and one low priority alarm at the same time. Until these alarms are acknowledged by the IO Controller all new alarms are discarded.

A-6 FDT/DTM Technology

The FDT/DTM concept specifies the interface between the engineering systems called Field Device Tools (FDT), and the device-specific software components called Device Type Managers (DTM). FDT/DTM is the most recent advancement in Configurators.

The FDT/DTM concept separates the device-dependent functionality (which is in the DTM) from the application. It provides separate interfaces for device configuration, monitoring and maintenance solutions, which before largely depended on the manufacturer of the application. Because of this concept, any type of network can be configured and accessed, provided the appropriate DTMs are available.

An FDT container application facilitates configuration of network devices and parameterizing and/or manipulating their operational modes. All device-dependent functionality is concentrated in the DTM.

FDT container applications can be stand-alone tools or can be part of other engineering tools such as web browsers providing FDT interfaces. Since FDT standardizes the interfaces, it allows devices from different manufacturers to be integrated in any automation system, regardless of the fieldbus system.

CX-ConfiguratorFDT is an example of an FDT container application.

DTMs are provided by the manufacturer of the device. A DTM is comparable to a printer driver, which allows interactive configuration and diagnostics. The DTM provides not only the configuration, manipulation and monitoring functions for a device including the user interface functions, it also provides the connection technology to the device.

A DTM provides all the options for configuration and monitoring of a device, which it can present to the user through its own user interface. The user interface for a DTM is provided using ActiveX windows. In general multi-language user interface windows, including DTM-specific Help files are supported by the DTM.

In general, a device configuration DTM is accompanied by a communication DTM. This specific DTM facilitates device-specific communication, e.g. for downloading a configuration to a PROFINET IO Controller Unit and/or for retrieving monitoring information from a PROFINET IO Controller Unit. It may incorporate the specific communication protocol or rely on other available drivers.

Appendix B

PROFINET IO alarm messages

B-1 Introduction

The GRT1-PNT Communication Unit supports sending PROFINET IO Alarm message for different error conditions. The IO Device supports the following alarm events:

Alarm type	Description
Pull Alarm	When a Slice I/O Unit is removed during normal operation a Pull Alarm event is generated (see note 1).
Plug Alarm	When the (correct) Slice I/O Unit is placed back at the correct position a Plug Alarm event is generated.
Plug Wrong Submodule	In case the configuration downloaded to the PROFINET IO Controller does not match the physical Slice I/O Unit configuration of the Unit a Plug Wrong Submodule alarm event is generated (see note 2).

- Note**
- 1 In case multiple alarm events (more than two) are generated at the same time, it is possible alarm events will be discarded.
 - 2 When multiple Slice I/O Units do not match with the PROFINET IO Configuration, only one Plug Wrong Submodule alarm event is generated for the first mismatching Slice I/O Unit.

B-2 Alarm messages

Byte	Name	Description
0 to 1	Reference	The reference number of the sender.
2	Priority	The priority of the alarm.
3	Alignment	Reserved.
4 to 5	Type	The alarm type: value 0003 Hex: Pull Alarm, value 0004 Hex: Plug Alarm, value 000A Hex: Plug Wrong Submodule.
6 to 9	API	The API.
10 to 11	Slot	The number of the slot having the alarm.
12 to 13	Subslot	The number of the subslot having the alarm.
14 to 17	ModuleIdent	The Ident number of the slot.
18 to 21	SubmoduleIdent	The Ident number of the subslot.
22 to 23	Specifier	The specifier of the alarm. The following bits are defined. Bit: Description: 0 to 10: Sequence number 11: Channel Diag exists (value 1 is exists) 12: Manufacturer Diag (value 1 is exists) 13: SubmoduleDiagState (value 0 is no error) 14: Reserved 15: AR Diag State (value 0 is no error)
24 to 25	Length	The length of additional data for Channel Related Diagnosis. For the GRT1-PNT always set to zero.

Appendix C

Explicit messages

C-1 Basic format of explicit messages

Explicit messages sent from the IO Controller Unit to a GRT1 Series PROFINET IO Communication Unit can be used to read or write any parameter of a specified GRT1 Series PROFINET IO Communication Unit.

The PROFINET IO Communication Units process the commands sent from the Controller and then return responses.

The basic format of each command and response is shown below.

Command Block					
Destination station address	Service code	Class ID	Instance ID	Attribute ID	Data

Destination station address

The station address of the Unit that is sending the explicit messages (commands) is specified as a single-byte hexadecimal number.

Service code, Class ID, Instance ID, Attribute ID

The parameters used for specifying the command, processing object, and processing content.

Note The number of bytes designated for Class ID, Instance ID, and Attribute ID depend on the Controller Unit. When sent from an OMRON Controller, the Class ID and Instance ID are 2 bytes (4 digits), and Attribute ID is 1 byte (2 digits).

Data

Data is not required when the Read command is used.

Response blocks

Normal Response Block			
Number of bytes received	Source station address	Service code	Data

Error Response Block			
Number of bytes received: 0004 Hex (fixed)	Source station address	Service code	Error code

Number of bytes received

The number of bytes received from the source station address is returned in hexadecimal. When an error response is returned for an explicit message, the number of bytes is always 0004 Hex.

Source station address

The station address of the Unit from which the command was sent is returned in hexadecimal.

Service Code

For normal completion, the value when the left-most bit of the service code specified in the command turns ON is stored as shown in the following table.

Function	Command service code	Response service code
Write data	10 Hex	90 Hex
Read data	0E Hex	8E Hex
Reset	05 Hex	85 Hex
Save	16 Hex	96 Hex

When an error response is returned for an explicit message, the value is always 94 Hex.

Data

Read data is included only when a read command is executed.

Error Codes

The explicit message error codes as listed in the following table.

Response code	Error name	Cause
08FF	Service not supported	The Service code is incorrect.
09FF	Invalid Attribute value	The specified Attribute value is not supported. The data written was outside valid range.
16FF	Object does not exist	The specified Instance ID is not supported.
15FF	Too much data	The data is larger than the specified size.
13FF	Not enough data	The data is smaller than the specified size.
0CFF	Object state conflict	The specified command cannot be executed due to an internal error.
20FF	Invalid parameter	The specified operation command data is not supported.
0EFF	Attribute not settable	An Attribute ID supported only for reading has been executed for a write service code.
10FF	Device state conflict	The specified command cannot be executed due to an internal error.
14FF	Attribute not supported	The specified Attribute is not supported.
19FF	Store operation failure	The data cannot be stored in memory.
2AFF	Group 2 only server general failure	The specified command or Attribute is not supported or the Attribute was not set.

C-2 Explicit messages common to all IO devices

Alarm information read

Explicit message	Read / Write	Function	Command					Response
			Service code	Class ID	Instance ID	Attribute ID	Data size	
Alarm Information Read	Read	Reads the SmartSlice I/O Unit's alarm data.	0E Hex	9C Hex	01 Hex	73 Hex	-	32 bytes (See note.)

Note The following tables show the alarm data details.

Word offset	Bit							
	15	12	11	8	7	4	3	0
+0	SmartSlice I/O Node #4		SmartSlice I/O Node #3		SmartSlice I/O Node #2		SmartSlice I/O Node #1	
+1	SmartSlice I/O Node #8		SmartSlice I/O Node #7		SmartSlice I/O Node #6		SmartSlice I/O Node #5	
+2	SmartSlice I/O Node #12		SmartSlice I/O Node #11		SmartSlice I/O Node #10		SmartSlice I/O Node #9	
:	:		:		:		:	
+13	SmartSlice I/O Node #56		SmartSlice I/O Node #55		SmartSlice I/O Node #54		SmartSlice I/O Node #53	
+14	SmartSlice I/O Node #60		SmartSlice I/O Node #59		SmartSlice I/O Node #58		SmartSlice I/O Node #57	
+15	SmartSlice I/O Node #64		SmartSlice I/O Node #63		SmartSlice I/O Node #62		SmartSlice I/O Node #61	

The 4 bits allocated to each SmartSlice I/O Node have the following functions:

Bit 0	Warning (Minor error)
Bit 1	Alarm (Major error)
Bit 2	Reserved
Bit 3	Reserved

Note The Warning/Alarm details depend on the Communication Unit. Refer to the Unit's operation manual.

C-3 Example of using explicit messages

The following example shows how to use explicit messages with a PROFINET IO Communication Unit connected to a PROFINET IO Controller Unit.

Sending a **Unit Maintenance Present Value Read** command to the PROFINET IO Communication Unit.

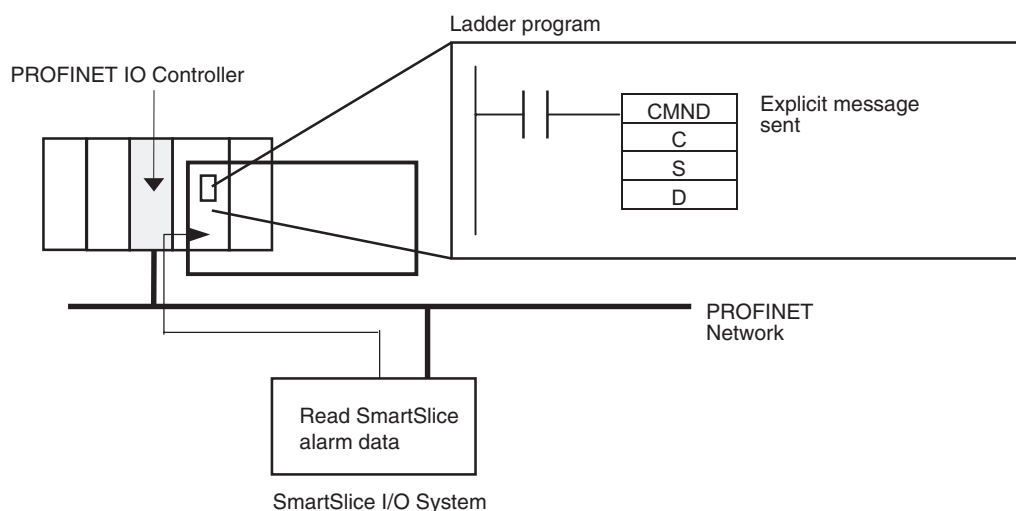
Configuration

PROFINET IO Controller Unit's station address: 00

Unit number: 0

Unit address: 11 Hex

GRT1-PNT Communication Unit's Device Number: 65



Operation

Reads the Alarm data of the connected SmartSlice I/O Unit from the PROFINET IO Communication Unit.

The data is read using the **Explicit Message Send** command (2801).

The command data is written in words starting from D01000 in the PLC and the response data is stored in words starting from D02000.

If the command does not end normally, the end code is stored in D00006 and the **Send** command is re-executed.

Note The maximum length of the **Explicit Message Send** command (2801) when used for sending data over PROFINET IO is limited to 1004 bytes.

Command Details

[CMND S D C]

S: D01000

D (first response word): D02000

C: D00000

Contents of S

Address	Contents (Hex)	Meaning
D01000	28 01	Command code
D01001	41 0E	PROFINET IO Communication Unit Device Number: 65 Service code: 0E Hex
D01002	00 9C	Class ID: 009C Hex
D01003	00 01	Instance ID: 0001 Hex
D01004	73 **	Attribute ID: 73 ** Hex (Set any value for the blank boxes.)

Contents of C

Address	Contents (Hex)	Meaning
D00000	00 09	Number of bytes of command data
D00001	00 2A	Number of bytes of response data
D00002	00 00	Destination PROFINET IO Controller Unit's Device Number: 0
D00003	00 11	Destination PROFINET IO Controller Unit's unit address: 11 Hex
D00004	00 00	Response required Communication port number: 0 Number of retries: 0
D00005	00 3C	Response monitoring time: 6 s

Contents of D Response

Address	Contents (Hex)	Meaning
D02000	28 01	
D02001	00 00	
D02002	00 24	
D02003	41 8E	Response source station Device Number: 65 (41 Hex) Normal completion: 8E Hex
D02004 to D02020	20 00	Number of slave alarm data: 32 (20 Hex) Status of slave #4, Status of slave #3 (2 bits each)
D02005	00 00	Status of slave #8, slave #7, slave #1, slave #2 (2 bits each)
D02006 to D02020	...	(continue)

A

- Add Module, 59
- ADR, 19, 48
 - DIP Switch, 20
- Alarm status area, 53
- Alarms, 90, 97
 - Diagnostics, 90
 - Maintenance, 90
 - Process, 90
 - Pull and plug, 90
 - Return of submodule, 90
- Analog Units, 59
- Application Programming Interface (API), 89
- Application Relation (AR), 89
- Automatic restore, 19–20, 46

B

- BACK, 19, 48
 - DIP Switch, 20
- Backup, 4
 - Trigger, 19
- Basic command / response format, 95
- BF, 6, 18, 71, 75
- Bit-sized SmartSlice I/O Units, 44
- Block, 25
 - Base, 49
 - Main, 49
 - Terminal, 49
- Bus Fail, 75

C

- Channel, 88
- Cleaning, 79
- COM Status word, 60
- Communication cycle time, 66
- Communication Relation (CR), 89
- Communication Unit, 88
 - Status flags, 45
- Compare, 58
- Configuration, 10
- Connector, 6
 - Ethernet, 16
 - Field ground, 16
 - RJ45, 6, 17
- Consumer Status, 88
- Controller redundancy, 36

- Conventions, iii
- Copyright, iii
- CX-ConfiguratorFDT, 37, 54, 91
- Cyclic I/O data exchange, 3

D

- Destination station address, 95
- Device
 - Catalogue, 39, 54
 - DTM, 37
 - Name, 13, 42, 52, 81
 - Number, 42
 - Type Manager, 91
- Diagnosis, 51
- Diagnostics
 - Alarms, 90
 - Manufacturer-specific, 90
- Digital Units, 59
- DIN rail, 6, 23
 - Mounting hooks, 24
- DIP Switch, 16, 19
 - ADR, 20
 - BACK, 20
 - REGS, 19
- Disconnecting, 23
- Dismounting, 23
- Download, 58
 - Configuration, 11
- DTM, 10
 - Installation, 38

E

- EEPROM, 22
- Electrical safety, 6
- EMC, 6
- End plate, 27
- End Unit, 3, 26
- Environment, 6
- ERR, 6, 18, 71
- Error
 - Code, 95
 - Indicators, 70
 - Log, 10
- Ethernet, 3
 - Internal switch, 35
- Expansion block, 25
- External dimensions, 8–9

External I/O, 21

F

Factory setting, 19

FDT Container program, 10

FDT/DTM, 91

FG, 16

Field Device Tools (FDT), 91

Field ground, 16

FINS, 42

FINS/UDP, 4, 10

Flags

Communication Unit status, 45

EEPROM data error, 53

Participating, 45

Status, 45, 52, 62

Unit maintenance, 53

Withdrawn, 45, 50

Front case, 6

Function

Automatic restore, 46, 48

Backup, 46, 48

I/O communication error history, 46

On-line replacement, 46

Table registration, 46

Functional specifications, 6, 9

G

GCN2-100, 21, 25, 31

General Station Description (GSD), 83

Generic IO Device DTM, 11, 58

GRT1-END, 3, 26

GRT1-END-M, 3, 9, 22, 26, 52

GRT1-PD2, 30

GRT1-PNT, 3, 6

GRT1-TBL, 25, 30–31

GRT1-TBR, 21, 25, 31

GSD file, 7, 10, 40, 58

I

I/O

Configuration, 56

Data, 45

Data mapping, 44

Module, 88

Power supply, 29–30

Response time, 65

Word/Bit, 59

I/O PWR, 6, 18, 71

ID

Attribute, 95

Class, 95

Instance, 95

Identifying a Unit, 42

IEC 61158, 83

IEC 61784, 83

IEEE 802.1Q, 84

IEEE 802.3, 17

Index, 87

Indicator, 6

Input, 16

Input Output Consumer Status (IOCR), 88

Input Output Provider Status (IOPS), 88

Inspection, 79

Installation, 6

IO Device, 3

Name, 42

Number, 42

IP address, 55

ISO 877, 17

Isochronous Real Time (IRT), 84

L

LED indicators, 16, 70

Lock, 49

M

MAC address, 42, 84

Maintenance, 79

Alarms, 90

Manufacturer-specific diagnostics, 90

Mapped data

Input, 44

Output, 44

Mapping sequence, 59

Maximum I/O current consumption, 29

Media Redundancy Protocol (MRP), 35

Memory End Unit, 3, 26, 52

Minimum requirements for a PC, 38

Monitoring

GUI, 37

User Interfaces, 10

MRP, 35
 Protocol, 7
 Ring Redundancy, 3

N

Network Scan View, 37, 42
Noise, 23
Note, iii

O

Orientation, 24
Output, 16

P

Parameter
 Backup, 4
 Restore, 4
Participating flags, 45
PCD, 83
Physical configuration, 10
Pin terminal, 29
 Length, 17, 29
PLC
 CIO memory, 43
 Cycle time, 66
 Memory area, 10
 System redundancy, 3
Power
 Consumption, 28
 Recommended supply, 29
 Supply terminals, 16, 21
 Supply, SELV, 29
Precautions, vii–viii
Precise I/O timing, 65
Procedure
 Configuration, 13
 Initial setup, 13
 Installation, 12
Process alarms, 90
PROFIBUS, 83
PROFINET, 83
 CBA, 83
 Component Description (PCD), 83
PROFINET IO, 83
 Communication cycle time, 66
 Communication Unit, 3
 Controller, 3, 65, 86

 Device, 86
 Errors, 70
 Network creation, 37
 SmartSlice I/O Unit, 3
 Supervisor, 86
Provider / consumer model, 88
Provider Status, 88
Pull and plug alarms, 90

R

RD-, 16
RD+, 16
Real-Time
 Capabilities, 84
 Communication, 84
Recommended wire, 17, 29
Redundancy Function Block, 36
Refresh time, 66
Registered configuration, 4
Registered I/O Unit table, 19
Registration table, 19, 46
REGS, 19, 46
 DIP Switch, 19
Removing wires, 30
Replacement, 80
Replacing a Unit, 49
Reset, 58
Return of submodule alarms, 90
RUN, 6, 18–19, 71–73
RUN/MONITOR mode, 13

S

Safe and reliable operation, vii
Screw-less clamp terminal block, 3
Service code, 95
Signal direction, 16
Slot, 83, 86
SmartSlice I/O Unit
 Bit-sized, 44
 Number, 43
 Word-sized, 44
Source station address, 95
Star topology, 33
Status
 Flags, 45
 Word, 44

Strip length, 17, 29
Submodule, 88
Subslot, 83, 86
System, 21

X

XML, 83

T

TCP/IP, 84
TD-, 16
TD+, 16
Topology
 Star, 33
 Tree, 34
Tree topology, 34
Troubleshooting, 70
 I/O power, 72
 UNIT power, 72
TS, 6, 9, 18, 22, 47–50, 71, 73–74
Turnback
 Cable, 21, 25, 31
 Left Unit, 25, 30–31
 Right Unit, 21, 25, 31
 Units, 5
Typical I/O configuration, 2

U

UDP/IP, 84
Unit conduction time monitor, 53
Unit error history, 50
Unit power
 LED, 76
 Supply, 28
UNIT PWR, 6, 18, 71
Unregistered I/O unit, 47
Update rate, 13, 66
Upload, 58

W

Warning, 97
 Status area, 52
Warnings, viii
Watchdog, 89
WDT, 22
Wiring, 13, 28
Withdrawn flags, 45
Word-sized SmartSlice I/O Units, 44

Revision History

Revision history

A manual revision code appears as a suffix to the catalogue number on the front cover of the manual.

Cat. No. W13E-EN-01



Revision code

The following table outlines the changes made to the manual during each revision. The page numbers of a revision refer to the previous version.

Revision code	Date	Revised content
01	20090309	First version
02	20100208	Added Hold/Clear functionality and added Alarms note



Authorized Distributor: