

**CJ1W-PNT21  
PROFINET IO  
Controller Unit**

**OPERATION MANUAL**


**OMRON**


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### **Notice**

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual. The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to property.

 **DANGER** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

 **WARNING** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

 **Caution** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

### **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 headings appear 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.

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### ***Read and Understand this Manual***

Please read and understand this manual before using the product. Please consult your OMRON representative if you have any questions or comments.

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## ***Application Considerations***

### ***SUITABILITY FOR USE***

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this manual.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

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### ***PROGRAMMABLE PRODUCTS***

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

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### ***DIMENSIONS AND WEIGHTS***

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

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Performance data given in this manual is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

### ***ERRORS AND OMISSIONS***

The information in this manual has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.



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# SECTION 1 Precautions

The information contained in this section is important for the safe and reliable operation of the CJ1W-PNT21 PROFINET IO Controller Unit. You must read this section and understand the information contained before attempting to set up or operate a CJ1W-PNT21 PROFINET IO Controller Unit and related systems.

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**Precautions** **X**

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## 1-1 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.


## 1-2 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 CJ1W-PNT21 PROFINET IO Controller 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.

## 1-3 Safety precautions

 **WARNING** Do not attempt to take any Unit apart while the power is being supplied. Doing so may result in electric shock.

 **WARNING** Do not touch any of the terminals or terminal blocks while the power is being supplied. Doing so may result in electric shock.

 **WARNING** Do not attempt to disassemble, repair, or modify any Units. Any attempt to do so may result in malfunction, fire, or electric shock.

 **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.

**⚠ Caution** Execute online editing only after confirming that no adverse effects will be caused by extending the cycle time. Otherwise, the input signals may not be readable.

- Emergency stop circuits, interlock circuits, limit circuits, and similar safety measures must be provided in external control circuits.

**⚠ Caution** 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. Serious accidents may result from abnormal operation if proper measures are not provided.

**⚠ Caution** Confirm safety at the destination node before changing or transferring to another node the contents of a program, the PLC Setup, I/O tables, I/O memory, or parameters. Changing or transferring any of these without confirming safety may result in injury.

**⚠ Caution** Tighten the screws on the terminal block of the AC Power Supply Unit to the torque specified in the operation manual. The loose screws may result in burning or malfunction.


## **1-4 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.


**⚠ Caution** 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.

## 1-5 Application precautions

Observe the following precautions when using the CJ1W-PNT21 PROFINET IO Controller Unit.

-  **Caution** 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 Controller 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 dismounting the CJ1W-PNT21 PROFINET IO Controller 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.
  - Always 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.

**⚠ Caution** Failure to abide by the following precautions could lead to serious or possibly fatal injury. 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.

## 1-6 Conformance to EC Directives

### 1-6-1 Applicable directives

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

### 1-6-2 Concepts

OMRON devices 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 CJ1W-PNT21 PROFINET IO Controller Unit can be requested at your nearest OMRON representative.

**Note** Applicable EMS (Electromagnetic Susceptibility) and EMI (Electromagnetic Interference) Standards in the EMC (Electromagnetic Compatibility) standards are as follows:

PROFINET IO Unit	EMS	EMI
CJ1W-PNT21	EN61000-6-2	EN61000-6-4 (Radiated emission: 10-m regulations)

#### **Low Voltage Directive**

Always ensure that devices operating at voltages of 50 to 1,000 V AC and 75 to 1,500 V DC meet the required safety standards for the PLC (EN61131-2).

### 1-6-3 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 CJ1W-PNT21 PROFINET IO Controller 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 2 Features and specifications

This section provides an introductory overview of the CJ1W-PNT21 PROFINET IO Controller for the CJ-Series, its functions and how to set up and configure it for a PROFINET IO network.

### SECTION 2

#### Features and specifications **1**

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## 2-1 Overview of CJ1W-PNT PROFINET IO Controller

The CJ1W-PNT21 PROFINET IO Controller is a Unit that can be installed on a CJ1 PLC system. The Unit provides a communication means through a PROFINET IO network to OMRON and non-OMRON PROFINET IO Devices. The figure below shows a typical I/O configuration.

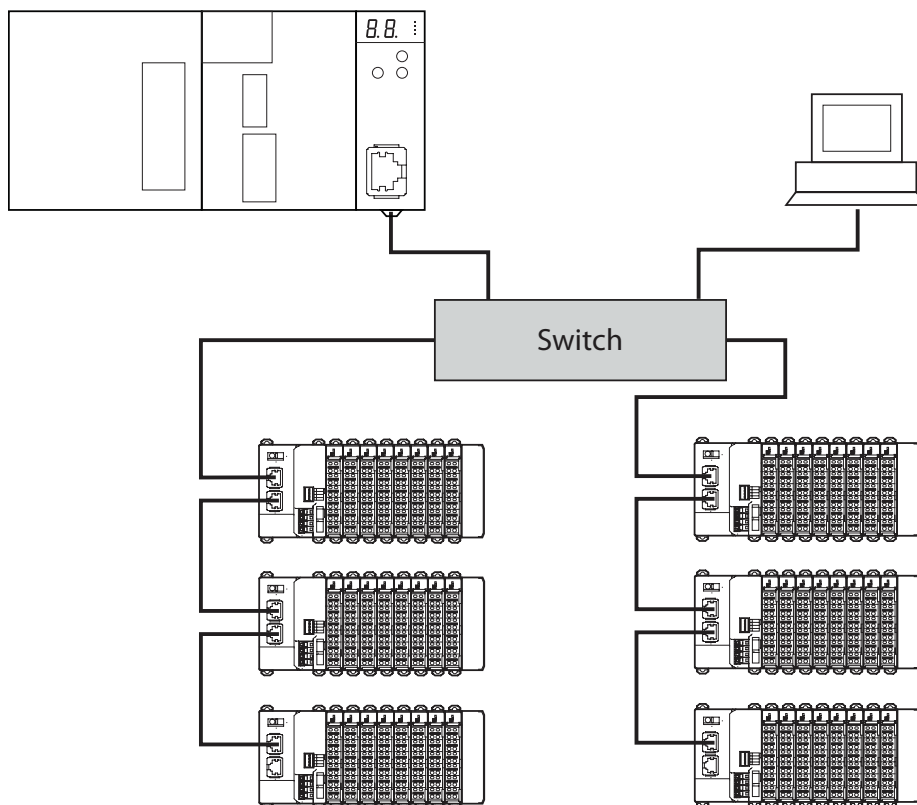


Figure 2.1: CJ1W-PNT21 connected to IO Devices through PROFINET



## 2-2 CJ1W-PNT21 PROFINET IO Controller Unit

### 2-2-1 Features

#### PROFINET IO Controller Unit

The CJ1W-PNT21 PROFINET IO Controller Unit is a CPU Bus Unit, which can be installed on a CJ1 PLC System. The CJ1W-PNT21 controls the data exchange between PROFINET IO Devices and a CJ1 PLC system over a PROFINET IO network. For an overview of the PROFINET IO technology refer to Appendix A PROFINET IO Technology.

#### CPU Bus Unit

A total of up to 16 CPU Bus Units can be mounted on a CPU or Expansion Rack. The total of 16 includes one or more PROFINET IO Controller Units in addition to all other CPU Bus Units on the rack.

#### Unit Control and Status

In total 25 control and status words are exchanged between the PROFINET IO Controller Unit and a dedicated CIO memory area, of which the location is related to the Unit Number of the PROFINET IO Controller Unit. The CIO words provide status and diagnostics information on the Unit itself, the PROFINET IO network and PROFINET IO Devices.

#### I/O Data

The maximum size of the I/O data exchanged between the CJ1W-PNT21 and the PLC is 7168 words. The I/O data can be distributed over two input areas and two output areas. Each of the input and output areas can be mapped to any location in the DM Area, CIO Area, WR Area, HR Area, or the EM banks.

#### I/O Data Exchange

The PROFINET IO Controller initiates and maintains cyclic I/O data exchange with its assigned IO Devices. In addition to the I/O data exchange, parameter data and status information in a PROFINET IO Device can be accessed via the PROFINET IO Controller Unit by acyclic messaging.

#### FINS/UDP Interface

The PROFINET IO Controller Unit is provided with a FINS/UDP Interface enabling the PROFINET IO Controller to access SmartSlice I/O Units using FINS messaging. Additionally, any device supporting a UDP interface (such as a Personal Computer using CX-Server Lite) can access the CJ1 PLC System allowing remote stations to configure and monitor the PROFINET IO Controller and the CJ1 PLC System. The maximum length of the FINS message is 1500 bytes.

#### Facilitating IO Controller Redundancy

To ensure a highly reliable implementation of the application, the PROFINET IO Controller Unit and all PROFINET IO Devices offer the possibility of PLC controller redundancy. To facilitate redundancy, two IO Controllers (one active and one standby) in a networked connection CX-ConfiguratorFDT of I/O Devices, ensures a fast change from active to standby PLC / IO Controller in case of a single device or network malfunction.

#### Configuration

Before the PROFINET IO Controller Unit is able to control the PROFINET IO Devices, it must first be configured using the configuration program CX-ConfiguratorFDT. Without this configuration, the Unit will not be able to start any data exchange, neither send any acyclic messages.

#### Troubleshooting Functions

The PROFINET IO Controller Unit provides a variety of troubleshooting functions for prompt recovery in case of errors:

- Extensive self-diagnostic functions at startup.
- Data exchange flags indicating whether I/O data is being exchanged with the IO Devices.
- Alarm flags indicating if new IO Device Alarm data is available.

- Various status and error flags indicating the status of the Unit and the PROFINET IO network.
- An error log for recording error history data.

**2-2-2 Specifications**

**Functional specifications**

Item	Specification	
Installation	Model	CJ1W-PNT21
	Applicable PLC series	CJ-series
	Unit classification	CJ-series CPU Bus Unit
	Mounting position	CPU Rack or Expansion Rack
	Number of Units that can be mounted	16 (restrictions may apply for certain PLC types)
	Applicable unit numbers	0 to F (hex)
	Current consumption	420mA at 5V DC from the PLC power supply.
	Dimensions (WxHxD)	31 x 90 x 65 mm
	Weight	100 gram (typical)
Environment	Ambient operating temperature	0 °C to +55 °C (no icing or condensation)
	Ambient operating humidity	20% to 90% Relative Humidity with no condensation
	Storage temperature	-20 °C to +75 °C (no icing or condensation)
	Vibration resistance	Conforms to IEC60068-2-6, test Fc 10 to 58.4Hz, 0.25mm-amplitude, 54.8 to 300Hz, acceleration: 29.4m/s <sup>2</sup> in X, Y and Z directions for 120 minutes each. (Total time: 12 linear/sweeps * 10 minutes / sweep = 120 minutes)
	Shock resistance	Conforms to IEC60068-2-27, test Ea.196m/s <sup>2</sup> three times each in X, Y, and Z directions.
	Dielectric strength	600 VAC (between isolated circuits)
	Conformance to EMC and Electrical safety standards	EN6100-6-1: 2001 EN61000-6-4: 2001/CISPR11 EN 61131-2: 1994+a12:2000
Front case	Settings	Unit Number rotary switch, range:0~F (hex) Two rotary switches (reserved)
	Indicators	LEDs indicating Unit status and PROFINET status; <ul style="list-style-type: none"> <li>• Two-digit, 7-segment display</li> <li>• Module Status, MS (Green/Red LED)</li> <li>• Network Status, NS (Green/Red LED)</li> <li>• Data Exchange Status, 100M (Yellow LED)</li> <li>• Network Activity, COMM (Yellow LED)</li> </ul>
	PROFINET IO Connector	1 x RJ45 8-pin Modular Connector (conforming to ISO 8877)

Item		Specification
Memory Area Allocation	CIO Area words allocated for the CPU Bus Unit	Fixed allocation of 25 words per Unit. Start address: CIO 1500 + (25 * Unit number)
	DM Area words allocated for the CPU Bus Unit	Not used
	I/O data allocations	Maximum total size: 7168 words. I/O Data can be allocated to up to 2 input and 2 output areas. Input and output areas can be mapped to CIO, DM, WR, and HR areas, as well to EM banks. Mapping must be defined through the configuration software.
FINS Messaging	Reading IO Device Alarm	The MEMORY AREA READ FINS command can be used to obtain the last received IO Device Alarm message.
	Reading and controlling the error log	Catalogues the history of error events. The Unit supports the following Error Log related FINS commands: <ul style="list-style-type: none"> <li>• ERROR LOG READ</li> <li>• ERROR LOG CLEAR</li> </ul>
FINS Services	FINS/UDP	Supported Maximum packet size is 1500 bytes
Other functions	Error history size and storage	The PROFINET IO Controller Unit supports storage of up to 80 error events, including time stamps, in volatile memory. 16 error events can be logged in non-volatile memory.
	Memory Card backup function	Allows PROFINET IO Controller Unit's Configuration to be backed up as a file to a Memory Card in the CPU Unit. The backed up configuration data can later be restored from the Memory Card into the PROFINET IO Controller Unit.

**Protocol specifications**

Item		Specification
PROFINET interface	Protocol	PROFINET IO
	PROFINET unit type	PROFINET IO Controller
	Isochronous mode	No
	Alarms	Yes, Alarm events from PROFINET IO Devices are stored at and can be forwarded from the CJ1W-PNT21
Transfer specifications	Bitrate	100 Mbps (100Base-TX)
	Automatic detection of transmission speed	No, fixed.
PROFINET IO cable	Type	LAN cable according to PROFINET specification.
	Max transmission distance	100 m (distance between nodes)
PROFINET redundancy	Protocol	PROFINET IO Controller Redundancy.
Configuration	DTM	Included in CX-ConfiguratorFDT
FINS service	FINS/UDP	Supported

External dimensions

CJ1W-PNT21

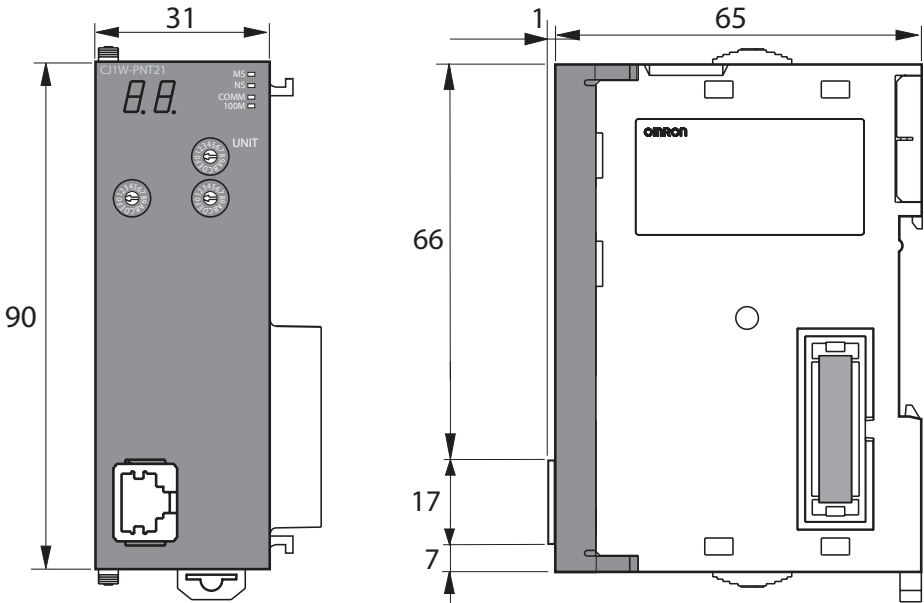


Figure 2.2: CJ1W-PNT21 PROFINET IO Controller Unit external dimensions

## 2-3 CJ1W-PNT21 configuration

### PROFINET IO Configuration Means

The PROFINET IO Controller Unit must be configured before it can exchange I/O data with any of its IO Devices. To configure the unit, information about the IO Devices must be available. OMRON provides two means to provide an IO Controller Unit with IO Device information:

- by DTM
- by GSDML file

### Configuration by DTM

The DTM is an executable component provided by the device vendor to be used in 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 has its own User Interface. It can access online parameters of the IO Device and present that information to the user. It can also load and save the settings, using the features of the FDT Container program. A DTM generally provides the user with the following features:

- PROFINET I/O Configuration
- Configuration of the individual parameters of an IO Device
- Monitoring of an I/O Device

### Configuration by GSDML File

The GSDML file concept is another way of configuration. The GSDML file 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 GSDML file is that - unlike the DTM - it only provides setting options for configuring the PROFINET IO Controller. The GSDML file does not provide the means to access data of the IO Device Units directly.

### CJ1W-PNT21 I/O Data Exchange Configuration

To configure the I/O Data exchange between the IO Controller and the IO Devices, the user must use the Configuration User Interface to define the configuration of PROFINET IO Devices connected to the PROFINET IO Controller Unit. It also allows the user to make parameter settings for individual PROFINET IO Devices.

The I/O Data Exchange Configuration consists of the following parts:

- It is used by the PROFINET IO Controller Unit when mapping the I/O data of individual PROFINET IO Devices onto the PLC memory areas.
- The I/O Data Exchange Configuration holds information that is sent by the PROFINET IO Controller Unit to the PROFINET IO Devices for verification when establishing communication. The I/O Configuration sent by the PROFINET IO Controller Unit must match the physical configuration of PROFINET IO Devices to be able to proceed with I/O data exchange
- Further parameters are sent from the IO Controller to the IO Device to setup the IO Device properly. Parameters are used to setup for instance ranges, alarm limits and other runtime behaviour.

### Monitoring the PROFINET IO Network

The Monitoring User Interface allows the user to read information from the PROFINET IO Controller. The Interface also provides a means to read the Error Log of the PROFINET IO Controller and provide the status of all connected PROFINET IO Devices.

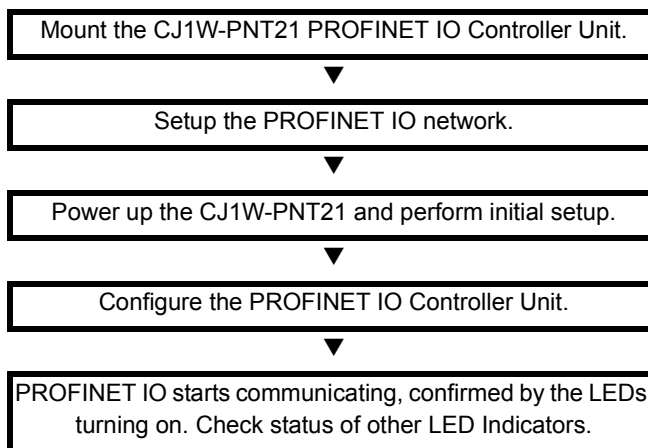
### Downloading the configuration

After setting up the configuration, it must be downloaded to the PROFINET IO Controller Unit.

## 2-4 Basic operating procedure

### 2-4-1 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 in this manual where more explicit information is given.



## 2-4-2 Preparations for use

The following procedure shows the basic steps required before using the PROFINET IO Controller and IO Device Units.

### Initial setup procedure

- 1 Mount the CJ1W-PNT21 Unit in the PLC I/O system on the DIN rail.
- 2 Set the Unit Number of the CJ1W-PNT21 to a unique value.
- 3 Wire the PROFINET IO network by connecting IO Devices to the PROFINET IO Controller Unit.
- 4 Turn ON the power to the PLC and the I/O Devices.
- 5 Make sure the CJ1W-PNT21 is recognized in the I/O-table of the CJ1-PLC.

### Configuration procedure

Use the following procedure to configure the PROFINET IO Controller and PROFINET IO Devices using CX-ConfiguratorFDT, using the IO Controller and IO Device DTM's:

- 1 Turn ON the PLC power supply and the power supplies of the IO Devices on the network.
- 2 Use the PROFINET IO Controller DTM's Network Scan function to assign Device Names to the actual IO Devices in the network.
- 3 In CX-ConfiguratorFDT, create a network and define the parameters and I/O configurations for the PROFINET IO Controller Unit and the allocated IO Devices. Choose the update rate for each IO Device.
- 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 restart of the PROFINET IO Controller Unit, communication with the PROFINET IO Devices will start automatically.





## **SECTION 3 Installation and wiring**

This section shows the CJ1-series PROFINET IO Controller Unit and identifies the controls and indicators of the Unit. This section also contains the procedures for installing and wiring the CJ1W-PNT21 Unit, in addition to the procedures for setting up the PROFINET IO network.

<b>SECTION 3</b>	
<b>Installation and wiring</b>	<b>11</b>
3-1 CJ1W-PNT21 Unit components .....	12
3-2 Installing the CJ1W-PNT21 Unit.....	17
3-3 Initial Setup Procedure .....	19
3-4 Setting up the PROFINET IO network.....	20
3-5 Installation of Configuration Software.....	27

### 3-1 CJ1W-PNT21 Unit components

#### 3-1-1 Overview

The illustration below shows the Status LED indicators with 7-segment display (A), the Unit number selector switch (B) and the PROFINET IO Ethernet connector (C) on the front side of the CJ1W-PNT21 Unit. Each of these components is explained in the following sections.

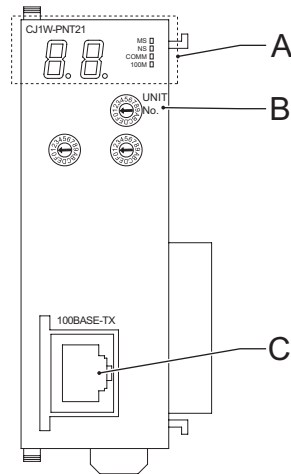


Figure 3.1: CJ1W-PNT21 overview

#### 3-1-2 Ethernet connector

The CJ1W-PNT21 has one Ethernet port.

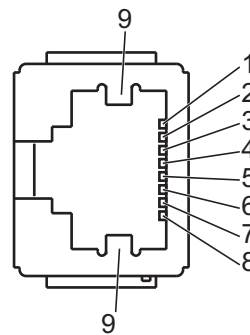


Figure 3.2: CJ1W-PNT21 Ethernet connector

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

Pin	Signal	Abbreviation	Signal direction
7	Not used	---	---
8	Not used	---	---
9	Field Ground	FG	---

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

- Electrical specifications: Conforming to IEEE 802.3 standards
- Connector structure: RJ45 8-pin Modular Connector (conforming to ISO 877). For more information about connectors see the PROFINET Cabling and Interconnection Technology Guideline Order No.: 2.252 available through PI (Profi International).

For the Ethernet infrastructure please follow the following guidelines:

- Shielded twisted-pair (STP) cable: minimum category CAT5 in accordance with ISO/IEC 24702 but only suitable for Conformance Class A. PROFINET-specific cable in accordance with IEC 61784-5-3 is preferable for Conformance Class A. And is mandatory for Conformance Class B/C. For more information see the PROFINET Conformance Class A Cabling Guideline. Order No.: 7.072 available through PI.
- Make sure to follow the PROFINET Installation Guideline for Cabling and Assembly Order No.: 8.072 available through PI.

### 3-1-3 LED indicators

The CJ1W-PNT21 PROFINET IO Controller Unit uses the following LED indicators.

- Four LEDs to indicate status of the Unit and the PROFINET IO network
- Two 7-segment displays to show extra information.

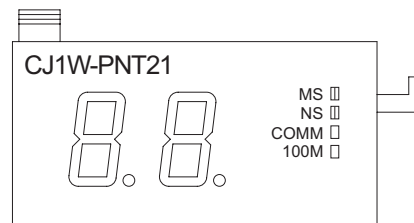


Figure 3.3: CJ1W-PNT21 LED indicators

#### Status indicators specifications

Indicator	Colour	Status	Meaning
MS Module status	Green	ON	Initialization successful, unit is in normal operation.
		Flashing	No connection to the Ethernet Network, but initialization was successful.
	Red	ON	A non-recoverable, fatal error has occurred. (Watchdog timer error, memory error or system error.) Replace the unit if recurring.
		Flashing	A recoverable, non-fatal error has occurred. (Structure error, switch setting error, PLC initialization error, PLC interface error or routing table error.) Correct the error and reset the Unit
--	OFF	Power isn't being supplied or the unit is initialising	

Indicator	Colour	Status	Meaning
<b>NS</b> Network Status	Green	ON	PROFINET IO data exchange with all active devices.
		Flashing	PROFINET attempting to establish data exchange with all configured devices.
	Red	ON	--
		Flashing	The Unit 's PROFINET IO Configuration is not available or incorrect.
	--	OFF	The Unit is in OFFLINE mode. PROFINET Communication is not possible.
<b>COMM</b>	Yellow	ON	Ethernet communication is active.
	--	OFF	Ethernet communication is not active.
<b>100M</b>	Yellow	ON	PROFINET IO data exchange with at least one active IO Device
		OFF	No PROFINET data exchange with any of the active IO Devices.

**Note** Unless otherwise specified the frequency of a flashing LED is 1 Hz (50% duty cycle).

**7-Segment Display** The following table explains the status information of the 7-segment display.

Status	Display	
IO Controller in normal operation	Displays character "I"	Lit
Initialising Unit at startup	Displays character "--"	Lit
Downloading new PROFINET Configuration to the Unit	Displays character "d"	Flashing
The Unit encountered an error	Error code value	Lit
PROFINET output data valid status ON: Output data is valid. Flashing: Output data is invalid.	Left dot	
Reserved	Right dot	

**Error Code** There is no priority in the error codes; all errors will be displayed in the order they occur. All error codes consist of a combination of a letter and a number, so they can be distinguished from the other state indications immediately.

### 3-1-4 Switch settings

**Setting the Unit Number** The unit number is used to identify individual CPU Bus Units mounted on a PLC. The unit number must be unique for each CPU Bus Unit. Selecting a non-unique number for a CPU Bus Unit will prevent the PLC System from starting correctly.

CJ1W-PNT21

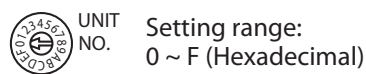


Figure 3.4: CJ1W-PNT21 Rotary switch

- 1 Turn OFF the power supply before setting the Unit number.
- 2 Set the rotary switch to the (new) Unit number. Use a small flathead screwdriver to make the setting, taking care not to damage the rotary switch. The unit number is factory-set to 0.
- 3 Turn ON the power again.

**Note** Always turn OFF the power to the PLC CPU before changing the Unit number setting. The Unit only reads the Unit number setting during initialization after power-up, not after a software reset.

**Note** If the unit number is set for the first time or is changed, an I/O table must be created for the PLC. For more information regarding creating the PLC I/O table please consult the manual W393 SYSMAC CJ Series Programmable Controllers Operation Manual.

The lower two rotary switches are reserved for future use.

### Unit Number and CPU Bus Unit Word Allocations

With CJ-series PLCs, data areas for CPU Bus Units are automatically allocated in the CIO and DM Areas. The PROFINET I/O Controller Unit uses these areas for receiving control data from the CPU Unit and for notifying the CPU Unit about its status. The addresses in the allocated areas for the CPU Bus Unit are important when creating the user program for using the PROFINET I/O Controller Unit. This must be considered when setting the unit number.

The contents of the allocated CIO and DM Words are discussed in detail in 4-2 Allocated CIO Area Words. The tables below show the relation between the unit number and the allocated CIO Area and DM Area words.

Unit No. (decimal)	Allocated words	Unit No. (decimal)	Allocated words
0 (0)	CIO1500 to CIO1524	8 (8)	CIO1700 to CIO1724
1 (1)	CIO1525 to CIO1549	9 (9)	CIO1725 to CIO1749
2 (2)	CIO1550 to CIO1574	A (10)	CIO1750 to CIO1774
3 (3)	CIO1575 to CIO1599	B (11)	CIO1775 to CIO1799
4 (4)	CIO1600 to CIO1624	C (12)	CIO1800 to CIO1824
5 (5)	CIO1625 to CIO1649	D (13)	CIO1825 to CIO1849
6 (6)	CIO1650 to CIO1674	E (14)	CIO1850 to CIO1874
7 (7)	CIO1675 to CIO1699	F (15)	CIO1875 to CIO1899

<b>Unit No. (decimal)</b>	<b>Allocated words</b>	<b>Unit No. (decimal)</b>	<b>Allocated words</b>
0 (0)	D30000 to D30099	8 (8)	D30800 to D30899
1 (1)	D30100 to D30199	9 (9)	D30900 to D30999
2 (2)	D30200 to D30299	A (10)	D31000 to D31099
3 (3)	D30300 to D30399	B (11)	D31100 to D31199
4 (4)	D30400 to D30499	C (12)	D31200 to D31299
5 (5)	D30500 to D30599	D (13)	D31300 to D31399
6 (6)	D30600 to D30699	E (14)	D31400 to D31499
7 (7)	D30700 to D30799	F (15)	D31500 to D31599

The CJ1W-PNT21 does not use the DM Area.

## 3-2 Installing the CJ1W-PNT21 Unit

### 3-2-1 Handling precautions

When installing the PROFINET IO Controller Unit on the PLC system, observe the following handling precautions.

- Always turn OFF the power supply to the PLC before mounting or dismounting a Unit or connecting or disconnecting cables.
- Provide separate conduits or ducts for the I/O lines and network cables to prevent noise from high-tension lines or power lines.
- When wiring leave the label on top of the Unit attached. Removing the label prior to wiring may result in malfunction if foreign matter enters the Unit.
- Remove the label after completing the wiring to ensure proper air circulation. Leaving the label attached may result in malfunction.

### 3-2-2 Mounting the CJ1W-PNT21

The PROFINET IO Controller Unit can be mounted to any slot in either a CJ-series CPU Rack, or Expansion Rack. The CJ-series PLC supports up to 3 Expansion Racks, in addition to the CPU Rack.

The figure below shows the number and the positions of the slots to which PROFINET IO Controller Units can be mounted. The CJ1W-PNT21 can be mounted using the sliders on the top and bottom of the Unit. In a single CJ1 PLC system, up to 16 PROFINET IO Controller Units can be mounted. If the CJ1W-PNT21 is mounted in combination with other CPU Bus Units (e.g., Ethernet Units), the maximum number of CPU Bus Units that can be mounted is 16.

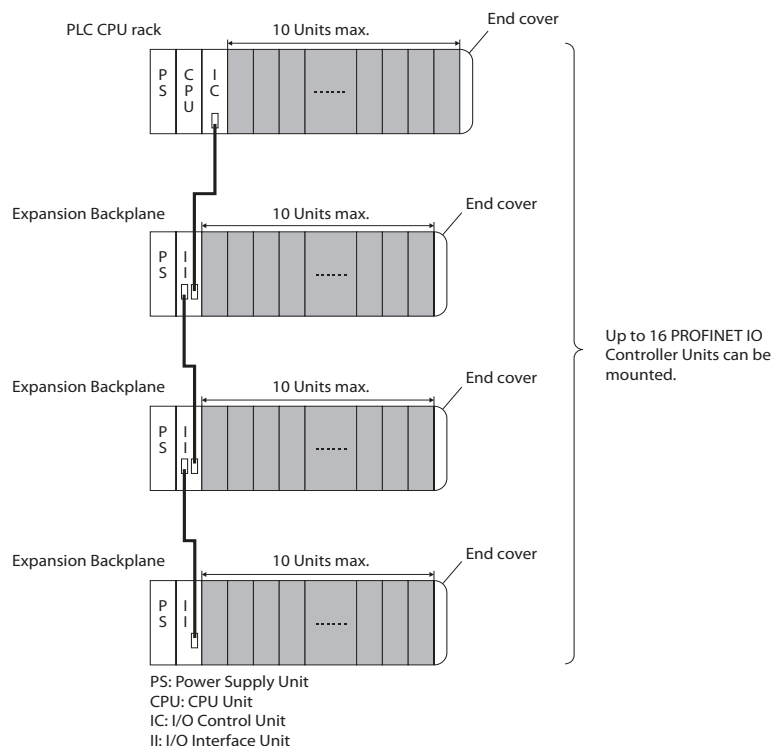


Figure 3.5: CJ-series CPU Rack and Expansion Racks

**Note** The maximum current consumption of the CJ1W-PNT21 PROFINET IO Controller Unit is 420 mA. Make sure that the total current consumption of all the Units connected to the same CPU Backplane or Expansion Backplane does not exceed the output capacity of the Power Supply Unit.

Mounting Procedure

Mount the CJ1W-PNT21 PROFINET IO Controller Unit to the PLC using the following procedure.

- 1 Carefully align the connectors to mount the PROFINET IO Controller Unit.

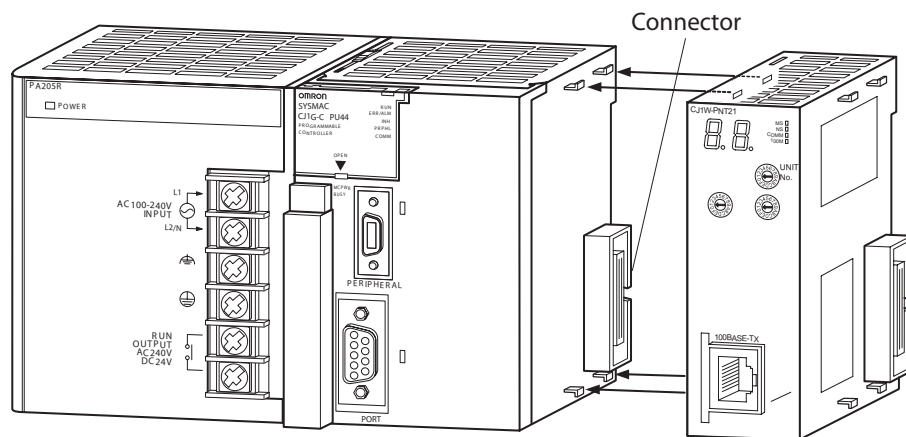


Figure 3.6: Aligning the PROFINET IO Controller

- 2 Lock the Unit into position by moving the yellow sliders on the top and bottom of the Unit until they click into position.

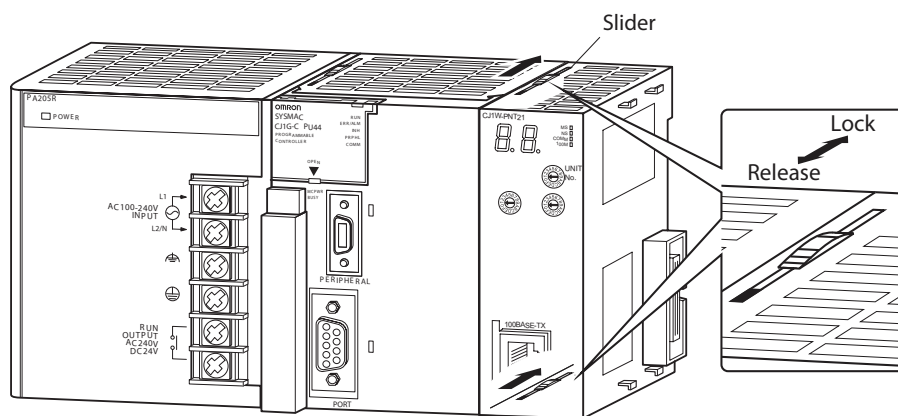


Figure 3.7: Locking the PROFINET IO Controller

**Note** If the sliders are not securely locked, the PROFINET IO Controller Unit may not function correctly.

To dismount the Unit, move the sliders in the opposite direction (“Release”).



## 3-3 Initial Setup Procedure

After mounting the PROFINET IO Controller Unit to the PLC System the Initial Setup Procedure must be applied. The Initial Setup Procedure allows the Unit to start up properly and to be configured for operation.

- Before the PLC's power supply is turned on a unique Unit number must be set.
- An I/O table must be created in the PLC, to register the Unit on the PLC CPU.
- If forwarding of FINS messages is used, the CJ1W-PNT21 needs a FINS Routing table. This must be created.

### 3-3-1 Creating a I/O table

An I/O table identifies any Units connected to the PLC and to allocate PLC memory areas to each of these Units. The I/O table is stored in the PLC CPU and loaded at start up. If any change is made to the Unit configuration of a CJ-series PLC, the I/O table must be created again to identify the Units to the CPU Unit.

To create the I/O table, connect a PC with CX-Programmer or CX-Integrator installed to the PLC.

For details regarding creation of the I/O Table using CX-Programmer or CX-Integrator, refer to the CX-Programmer User's Manual or CX-Integrator User's Manual.

After creating the I/O table, the Unit is ready to be configured for first use on the PROFINET IO network.

### 3-3-2 Creating a FINS Routing table

A FINS Routing table is used to forward FINS messages from one network to another. The CJ1W-PNT21 supports FINS/UDP communication and can be used to forward FINS-messages.

A FINS Routing table must be created if message transfer via other communication units is required, like the CJ1W-ETN21 (Ethernet Communication Unit), CJ1W-SCU (Serial Communication Unit) or CJ1W-DRM21 (DeviceNet Communication Unit). It is very important to assign a valid network number to the CJ1W-PNT21.

If a FINS Routing table exists but there is no entry for the CJ1W-PNT21, the CJ1W-PNT21 will operate normally. However, forwarding FINS messages through the CJ1W-PNT21 will not be possible.

### 3-4 Setting up the PROFINET IO network

#### 3-4-1 Network structure

A PROFINET IO network can be setup as a line, star, tree or ring network. When using the CJ1W-PNT21 unit in any of these networks, the following precautions apply:

- Always be aware that any additional Ethernet communication through the PROFINET network may influence the PROFINET IO Communication.
- It is recommended to physically separate the PROFINET IO network from other Ethernet-based communication networks (e.g. IT infrastructure) to assure reliable I/O data exchange.
- Severely overloading the CJ1W-PNT21 with data traffic may cause the Unit to temporarily block the Ethernet port, interrupting all traffic including PROFINET IO communication.

##### 3-4-1-1 Line

A line topology comprises multiple IO Devices connected in series. Many IO Devices, such as the Omron GRT1-PNT IO Device Unit have an Ethernet switch integrated in the Unit offering an easy way to interconnect all Devices.

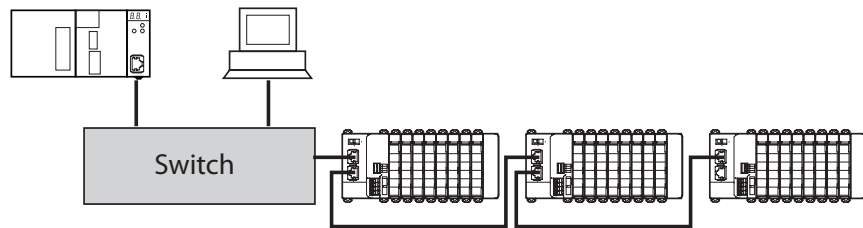


Figure 3.8: Ethernet line topology

Advantages of the line topology:

- In most control systems, the line topology requires the lowest cabling effort.
- A line topology resembles a traditional field bus structure (comparable e.g. to PROFIBUS-DP).
- A basic system can be built without additional Ethernet switches.

Disadvantages of the line topology:

- Communication paths through many switches affect transmission times.
- A malfunction or power disruption of a single Device will result in disconnection of part of the network.

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

### 3-4-1-2 Star

The star topology is the most common topology for Ethernet networks. A central switch allows for communication between all connected devices.

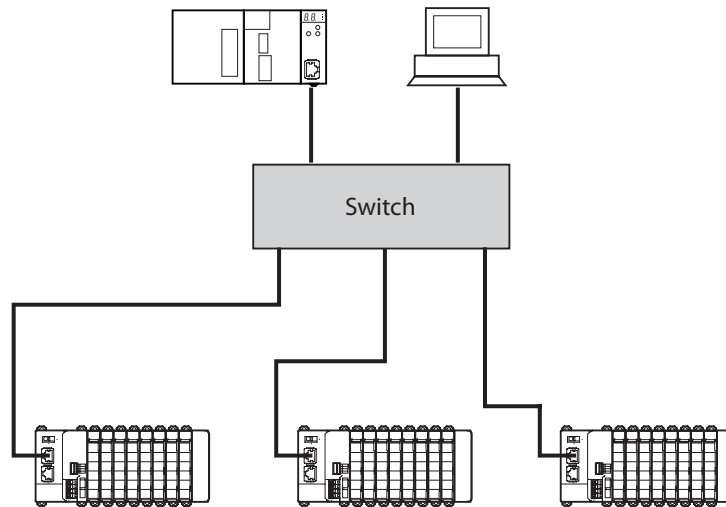


Figure 3.9: Ethernet star topology

Advantages of the star topology:

- Flexible adding and removing of devices without changes in existing connections.
- Easy diagnostics of the network by fault isolation.
- Reduced data traffic per connection.

Disadvantages of the star topology:

- Additional cabling effort and cost.
- Failure or power disruption of the switch will fail the complete network.

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

3-4-1-3 Tree

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

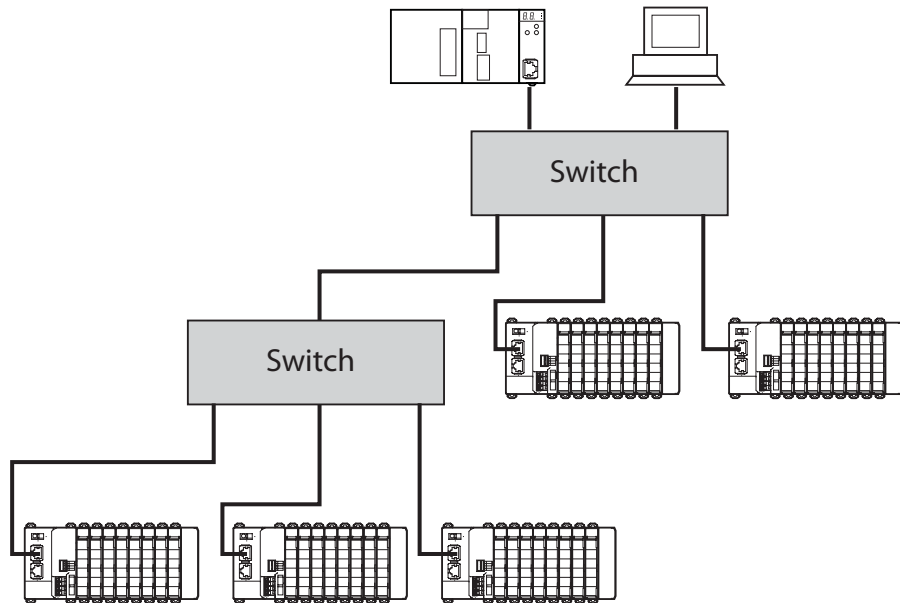


Figure 3.10: Ethernet tree topology

Advantages of the tree topology:

- Flexible adding and removing of devices without changes in existing connections.
- Easy diagnostics of the network by default isolation.
- Further reduced data traffic per connection than when in star topology.

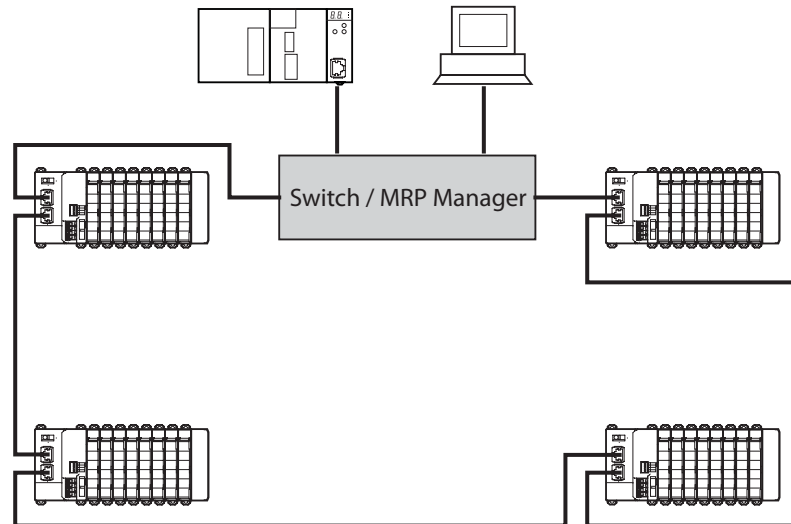
Disadvantages of the tree topology:

- Additional cabling effort and cost.
- Failure or power disruption of one switch will fail a part of the network.

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

3-4-1-4 Ring

The ring topology is achieved by extending a line topology back to its starting point. A network redundancy ring protocol such as PROFINET MRP (see Appendix A MRP Ring Redundancy) must be supported by all devices that form the ring. This allows monitoring the state of the network and reconfiguring the communication paths in case of a disturbance.



Advantage of a ring topology:

- Malfunction of a single IO Device will not result in disconnection of part of the network as the network redundancy mechanism will automatically maintain the connection with the other devices.

Disadvantage of a ring topology:

- Malfunction or power disruption to the MRP manager will result in disconnection of the entire network.
- High data traffic per connection.

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

3-4-2 MRP Ring Redundancy

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

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

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

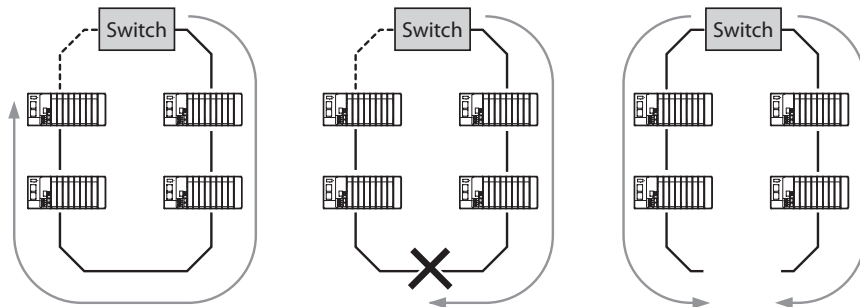


Figure 3.11: MRP ring redundancy

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

### 3-4-3 PROFINET IO Controller redundancy

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

Both the active and the standby IO Controller exchange data with all IO Devices in the network. However, only the active IO Controller is in control of the outputs of the IO Devices.

The I/O data sent from the IO Controller to the I/O Device and vice versa includes data state information. This data-state information is used to signal to the receiving side that the I/O Data is valid or invalid. In case of invalid the receiving side will discard the data.

For IO Controller redundancy, the PROFINET IO Device must be capable of handling relations to multiple IO Controllers. It is up to the IO Device to handle the situation where both IO Controllers signal that the output data is valid. Normally the first IO Controller that signalled that the output data is valid will be in control of the outputs of the IO Device. OMRON can therefore only guarantee proper IO Controller redundancy operation if implemented with GRT1-PNT IO Devices.

In case of malfunction of the active IO Controller the Function Block will transfer control to the standby PLC system. To avoid momentary changes in output data during this control change the Data Hold parameter of each IO Device should be set sufficiently high for the standby IO Controller to take over seamlessly. The appropriate Data Hold value should be determined experimentally.

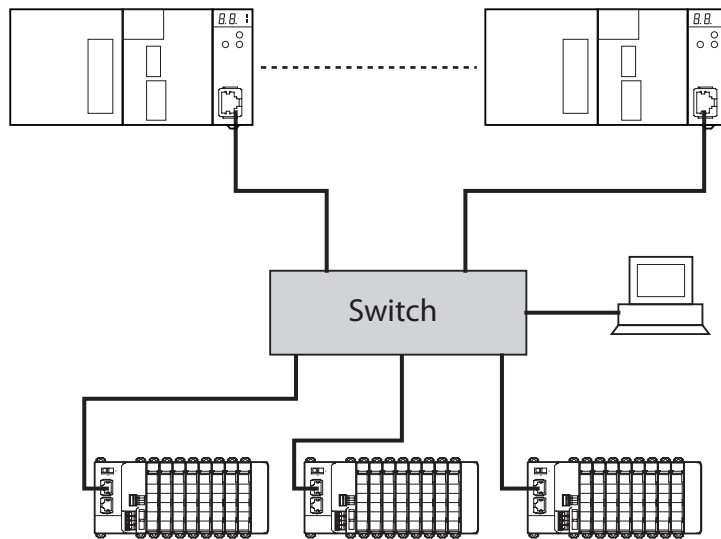


Figure 3.12: PROFINET IO Controller redundancy

### 3-4-4 Network and Controller redundancy

When combining the PROFINET MRP ring redundancy and the IO Controller redundancy a control system with a high availability can be achieved. Single points of failure should have no influence on the operation of the application. A system with both PROFINET MRP ring redundancy and IO Controller redundancy could be set up like the picture below.

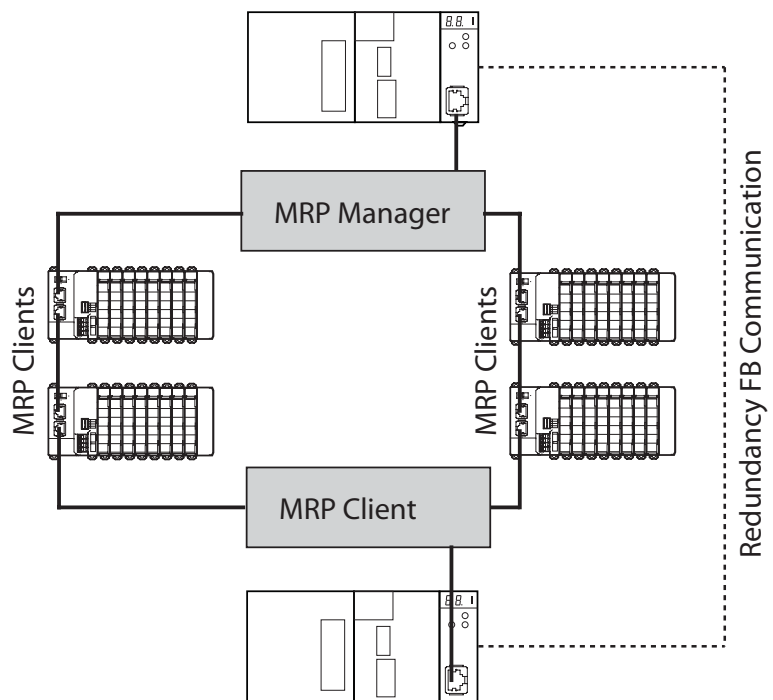


Figure 3.13: Network and Controller redundancy

### 3-4-5 Establishing the PROFINET IO network

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

- 1 Select the Network Components (see previous section) and build the network.
- 2 Connect the Personal Computer to the Ethernet network. Note that the PROFINET Scan Tool (for assigning the IO Device names) can only operate when connected to the Ethernet network.
- 3 Start the CX-ConfiguratorFDT software and install the appropriate GSDML files and DTM's for the connected IO Devices.
- 4 Scan the PROFINET network with the PROFINET Scan View included in the CJ1W-PROFINET IO Controller DTM. Give the detected IO Devices an appropriate name according to their position and /or function. It is possible to give a IO device a temporary IP-address but it will be set/changed later by the IO Controller.
- 5 Add the PROFINET IO Controller as parent in the Network View. Configure the communication parameters to connect to the IO Controller:
  - Set an IP address in the PROFINET IO Controller by using the Network Scan View.
  - Enter the same IP address in the DTM.
  - Confirm the on-line connection by putting the DTM on-line.
  - Set the PROFINET Names of the PROFINET IO Devices by using the Network Scan View.
- 6 Build up the network within CX-ConfiguratorFDT. Add the IO Devices to the Tree of the network by dragging and dropping from the Device Catalogue. Assign the I/O modules for each individual IO Device. Use the exact names given to the IO devices with the network scan tool. Make sure that the IP address for each item on the network is unique.
- 7 Allocate the modules of the IO Devices to the intended PLC memory areas.
- 8 Download the configuration to the IO Controller.
- 9 Confirm proper operation by checking the Monitoring GUI of DTM and LED status of the Unit.

**Note** A common mistake when implementing IO Controller redundancy, is to download the same configuration to both IO Controllers, thereby creating an IP address conflict as well as duplicating the symbolic name. This should be avoided.



## 3-5 Installation of Configuration Software

In order to operate the PROFINET IO system the PROFINET IO Controller needs to be configured for communication with the PROFINET IO Devices. For this purpose OMRON provides the CJ1W-PNT21 DTM via the OMRON web site <http://technicalsupport.europe.omron.com/>

After installation the DTM will run in the FDT Container, allowing the user to set up the I/O configuration and to set the parameters of the CJ1W-PNT 21.

### 3-5-1 Installation requirements

The following are the minimum requirements for a PC to install the CJ1W-PNT21 DTM configuration software:

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

### 3-5-2 Installation procedure

#### DTM Installation

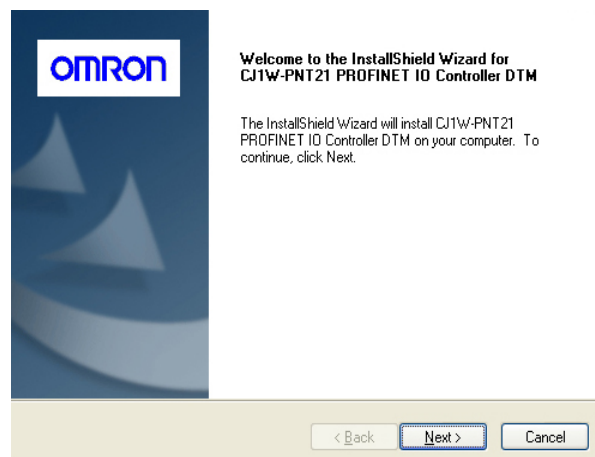
This section explains how to install the PROFINET IO Controller DTM software.

- 1,2,3... 1 Exit all other Windows-based programs.
- 2 Double-click the file  
**CJ1W-PNT21\_PROFINET\_IO\_Controller\_Setup.exe.**  
The setup program for the CJ1W-PNT21 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 CJ1W-PNT21 DTM the Device Catalogue in the FDT Container needs to be updated, to show the new CJ1W-PNT21 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 CJ1W-PNT21 DTM will be shown in the list of available devices. It can now be used to setup a PROFINET IO network and configure the PROFINET IO 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 PROFINET IO Device DTM's to be used.

## 3-5-3 GSDML Files support

Apart from the configuration of OMRON PROFINET IO Devices by a DTM, OMRON provides the possibility to use GSDML files to allow configuration of third-party PROFINET IO Device Units, if a DTM is not provided.

To accommodate GSDML files in a FDT-container OMRON supplies a PROFINET IO Generic Device DTM. The GSDML files of the PROFINET IO Devices must be imported in CX-ConfiguratorFDT. The Generic device DTM will recognize the GSDML files and make them available for configuration with the PROFINET IO Controller.

The section Set-up using the GSDML file discusses the configuration of the PROFINET IO CX-ConfiguratorFDT using this GSDML file.

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

For example: A GSDML file for the GRT1-PNT PROFINET IO Device is available for download (**GSDML-V2.1-OMRON-GRT1-PNT-20081205.xml**) through the OMRON Web site: <http://technicalsupport.europe.omron.com/>. However, configuring with the DTM is the preferred method.

### 3-5-3-1 Installation procedure

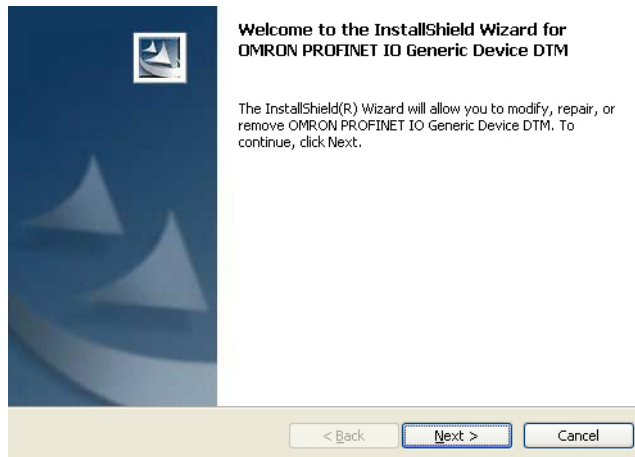
This section explains how to install the PROFINET IO Generic Device DTM software.

- 1,2,3... 1 Exit all other Windows-based programs.
- 2 Double-click the file **OMRON PNIOGenericDeviceDTM setup.exe**. The setup program for the PROFINET IO Generic Device 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 PROFINET IO Generic Device DTM the Device Catalogue in the FDT Container needs to be updated. This makes PROFINET IO devices that supply a GSDML file for configuration visible in the device catalogue. 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 GSDML file based PROFINET IO Devices will be shown in the list of available devices. It can now be used to setup a PROFINET IO network and configure the PROFINET IO Controller Unit.



## SECTION 4 Configuration Software

This section presents an overview of the Configuration software and gives insight in the main aspects of defining a PROFINET IO configuration.

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## 4-1 CX-ConfiguratorFDT

Omron CX-ConfiguratorFDT is the versatile network configuration tool for networks such as PROFIBUS and PROFINET. It is based on FDT/DTM technology. CX-ConfiguratorFDT is Omron's standalone FDT-container. For the various networks Omron provides device specific DTM's.

To configure PROFINET Omron delivers three different DTM's:

- CJ1W-PNT21 PROFINET IO Controller DTM.  
This DTM is used to configure the IO-Controller to perform data-exchange and to set up the memory locations for the I/O data-exchange. Furthermore, the DTM provides online diagnostics functions.
- GRT1-PNT SmartSlice PROFINET IO Device DTM.  
This DTM is used to configure the GRT1-PNT SmartSlice system. The type and number of units inserted in the SmartSlice system can be configured. This defines the amount of I/O data that is exchanged with the PROFINET IO Controller. All parameters of the SmartSlice buscoupler and the separate SmartSlice units are directly accessible.
- Generic IO Device DTM.  
This DTM interprets standard PROFINET IO GSDML files. The DTM can only be used to configure the I/O Data exchange between the PROFINET IO Controller and PROFINET IO Devices. The DTM only contains very limited online diagnostics functions and online parameter setup is not possible.

This section provides information about the use of the CJ1W-PNT21 PROFINET IO Controller DTM and the Generic IO Device DTM. For the use of the GRT1-PNT SmartSlice PROFINET IO Device DTM please refer to the manual of the GRT1-PNT PROFINET IO Communication Unit (W13E-EN).

## 4-2 CX-ConfiguratorFDT Main Window

At first start up, the main application window of CX-ConfiguratorFDT opens with a New Project and the Device Catalogue is opened automatically. The Device Catalogue can also be opened from the menu.

The figure below shows the opened CX-ConfiguratorFDT main window for a project already containing a defined network, and with the Device Catalogue window opened.

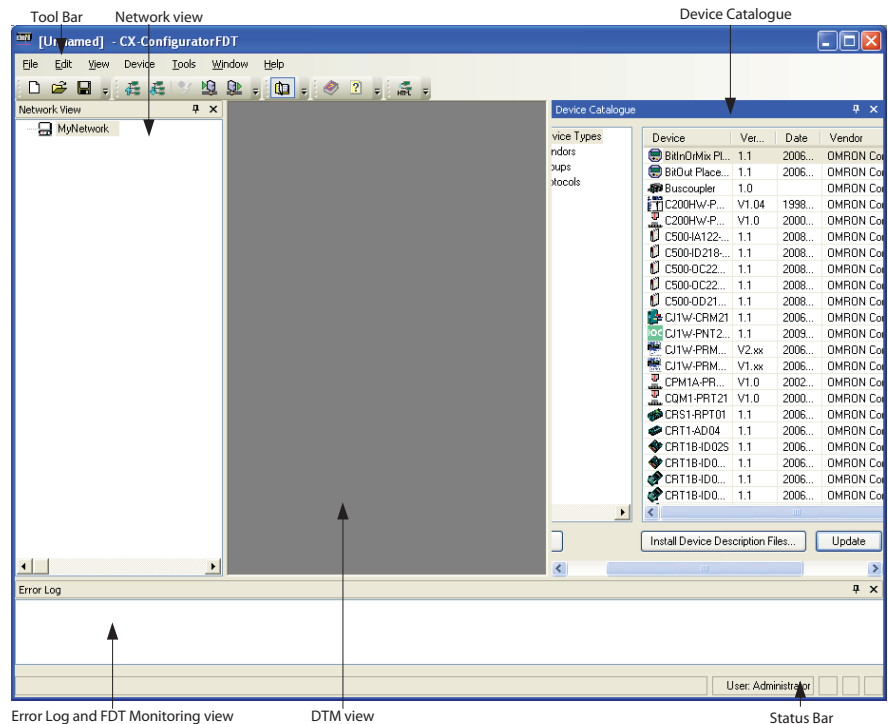


Figure 4.1: CX-ConfiguratorFDT main window

The main components in this window are:

- The Network view.
- The DTM / Catalogue view.
- The Error Log view.
- The FDT Monitoring view (not shown in the figure above).
- The Main menu.
- The Tool Bar and the Status Bar.

### Network View

The Network view displays the structure of the PROFINET network in a tree format. The tree has at least three levels:

- The Network Level
- The Master Level
- The Slave Level

The highest level of the tree is the project. The next level is the network controller level. On this level one or more Controller or Master devices can be allocated. For example PROFINET IO Controllers. The third level contains the device DTM's. These can only be the devices that can connect to that particular network master. In this case IO Device DTM's.

The PROFINET IO network must be assembled in the Network view, that is the various DTMs are added to the network in the Network view. From the Network view the individual DTM User Interfaces can be opened and accessed.

CX-ConfiguratorFDT supports context menus in the Network view, which pop up when right clicking a device DTM. The contents of the context menu depends on the functionality supported by the DTM.

**DTM / Device Catalogue Window**

The DTM / Device Catalogue window holds the Device Catalogue and every opened DTM User Interface. The window is a Multiple Document Interface (MDI) window allowing one or more user interface windows to be opened, resized and moved.

**Error Log view**

The Error Log view at the bottom of the CX-ConfiguratorFDT application window displays the error messages reported by the DTMs. To each error message, a Time stamp, a Date stamp and the DTM name are added. The contents of the Error Log view can be cleared, or copied to the clipboard for pasting to other applications. When starting CX-ConfiguratorFDT the Error Log view is opened by default.

**FDT Monitoring view**

The FDT Monitoring view at the bottom of the CX-ConfigurationFDT application window displays the FDT-DTM communication function calls between CX-ConfiguratorFDT and the DTMs. A Time stamp, a Date stamp, the type of information, and the DTM name are added to the message. The sequential order of the messages can be used to troubleshoot problems that may occur. When starting CX-ConfiguratorFDT the FDT Monitoring view is not opened by default, but can be opened through the View - FDT Monitoring menu option.

**Main Menu**

The main menu of CX-ConfiguratorFDT provides all the necessary functionality to handle a complete project. The table below lists all main menu and sub menu items.

Menu	Command	Short Key	Description
File	New	CTRL-N	Creates a new Project
	Open	CTRL-O	Opens an existing Project
	Save	CTRL-S	Saves the current Project to a file
	Save as...	---	The save as command is the same as the Save, but the Filename Specification Window is always displayed.
	Import / Export	---	Imports or Exports Project data to binary or exports to HTML format and launches the browser.
	Info...	---	Opens an edit window to add or edit Project information
	Recent Files	---	Lists the recently used Project files.
Edit	Exit	---	Exits CX-ConfiguratorFDT
	Cut	CTRL-X	Cuts devices and copies them to the clipboard
	Copy	CTRL-C	Copies devices to the clipboard
View	Paste	CTRL-V	Copies devices from the clipboard to the cursor position.
	Full screen	CTRL-ALT-F	Switches the window to full screen view on the main display
	Network view	---	Hides or un-hides the Network view
	Device Catalogue	---	Hides or un-hides the Device Catalogue
	Statusbar	---	Hides or un-hides the Statusbar
	Error Log	---	Hides or un-hides the Error logging window



Menu	Command	Short Key	Description
	FDT Monitor	---	Hides un-hides the FDT monitoring view
Device	Add...	---	Opens the Device Catalogue Add windows, from which devices can be added to the selected network tree.
	Upload Parameters from Device	---	Uploads the parameters from a device to its associated DTM
	Download Parameters to Device	---	Downloads the parameters from a DTM to its associated device.
	Import/Export	---	Imports or Exports Project data to binary or exports to HTML format and launches the browser.
	Info...	---	Opens an edit window to add or edit Project information or opens the properties window of the selected DTM.
Tools	Customize	---	Opens the Customize window to set the Toolbars and Commands.
	Options...	---	Opens the Option window to set General options, User accounts / passwords and Frame Properties.
Window	Tabbed mode	---	When checked the windows are displayed using tab groups. When unchecked the windows are displayed using MDI style.
	Dockable	---	Switches between dockable and not-dockable style for the window which has the focus.
	Hide	---	Hides the window which has the focus.
	Floating	---	Switches between floating and not-floating style for the window which has the focus.
	Auto Hide	---	Auto hides the tool window which has the focus.
	Auto Hide All	---	Auto hides all tool windows currently displayed.
Help	Contents	---	Opens the Online Help System displaying the contents tab.
	Index	---	Opens the Online Help System displaying the index tab.
	About CX-Configurator-FDT	---	Opens the About box and gives access to edit licence key.

**Tool Bar** The tool bar provides quick access buttons to the user for frequently used menu commands.

**Status Bar** The status bar displays the current user role, that is the login level. In case the Error Log view has been closed, the status bar will additionally display a symbol to indicate that new errors are available in the Error Log view. Double-clicking the symbol will open the Error Log view.

### 4-2-1 Device Catalogue

#### Device Catalogue Main Components

The Device Catalogue is one of the main components in CX-ConfiguratorFDT. Its main functions are:

- Maintain a list of installed DTM and GSDML files.
- Provide convenient sorting and categorizing of the list.
- Allow updating the list, after installation of new DTM's or GSDML files.
- Provide detailed information on selected DTM's.

The main layout of the Device Catalogue is shown below:

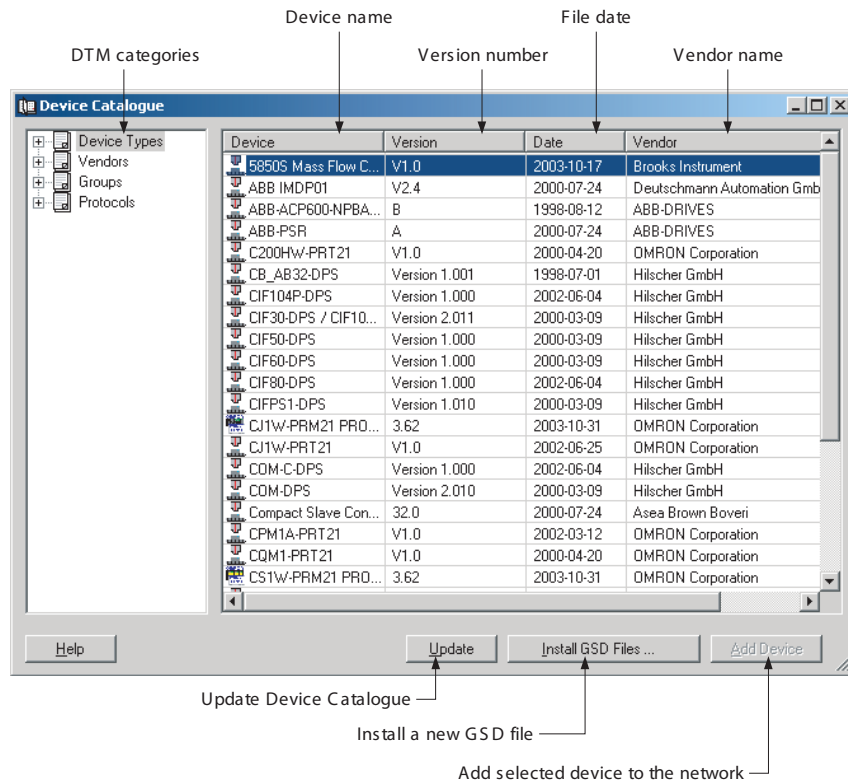


Figure 4.2: Device catalogue

**Invoking the Device Catalogue**

The Device Catalogue window is opened by either selecting the corresponding icon in the CX-ConfiguratorFDT toolbar or by selecting View - Device Catalogue from the menu. Both options have a toggle function; selecting the option again will close the Device Catalogue.

**DTM view Layout**

The left view allows selection of specific groups of DTMs to be displayed. The right view lists the DTMs, which are installed on the PC and which are available for setting up a network. A selection of DTMs is made by selecting a specific group in the left view.

**Note**

The list makes no distinction between normal DTMs and GSDML files which have been loaded through the Generic IO Device DTM. When both DTM and GSDML are available for one device, it is recommended to use the DTM.

**DTM List Window**

The list items in the right view are described in the following table.

Column	Description
Device	The Device column contains the names of the DTMs, as provided by the DTM or the GSDML file. If the device is defined by a GSDML file, the Generic IO Device DTM reads out the GSDML file entry "Model Name". The string provided by this variable is the name displayed in the list.
Version	The version number defines the revision number of the device. If the device is defined by a GSDML file, the Generic IO Device DTM reads out the GSDML file entry "Revision". The string provided by this variable is the version number displayed in the list.

Column	Description
Date	For DTMs, Date is the date associated with the revision. For GSDML file based slaves, the date listed in this column is the date the GSDML file was last modified.
Vendor	The Vendor name is provided by the DTM or the GSDML files.

**DTM Group Selection Window**

The left view allows selection of specific groups of device DTMs with common attributes, e.g. Vendor name, Protocol type etc. If a group is selected, all device DTMs which belong to that group will be listed in the right view. The table below lists the possible groups that can be selected.

List Item	Description
Device types	Sub groups, which can be selected are: <ul style="list-style-type: none"> <li>• Communication DTMs, for example PROFINET IO Controller devices</li> <li>• Gateways, for example to another network type</li> <li>• Modular devices</li> <li>• Other devices, for example slave devices</li> </ul>
Vendors	Sub groups, which can be selected are all available vendors. This information is provided by each DTM. It allows the user to select a group of devices from one vendor.
Groups	Sub groups are the device types, for example digital I/O, analog I/O and so on.
Protocols	Sub groups which can be selected are all the communication protocols found in the Device Catalogue.

- Note**
- 1 The sub groups are displayed by clicking on the + sign next to each main group.
  - 2 Selecting the main group displays all devices in the group.

**Additional Information**

**DTM** In order to obtain more information of a specific DTM, right-click the DTM in the list, and select DTM Information from the pop-up menu. This opens a window with additional DTM information. The figure below provides an example for the CJ1W-PNT PROFINET IO Controller DTM.

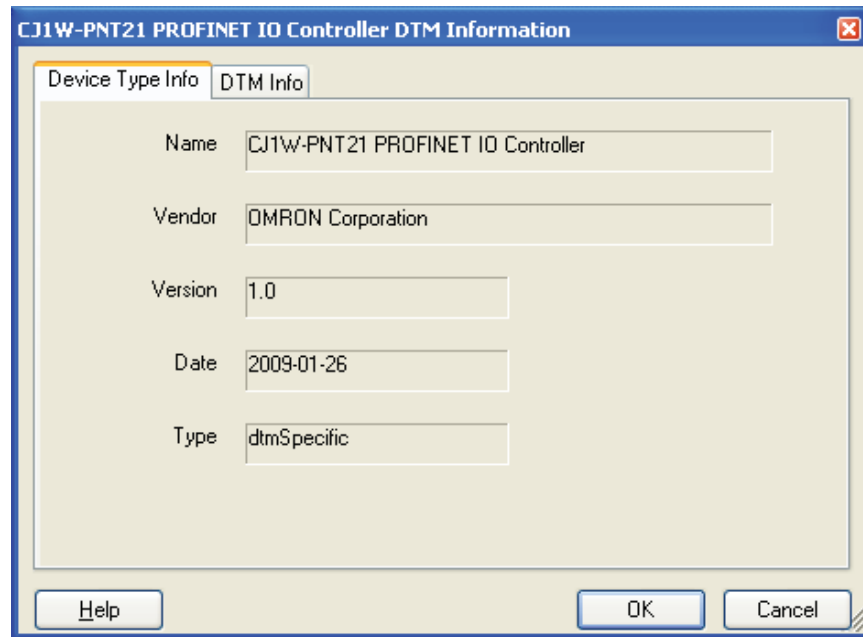


Figure 4.3: Additional DTM information

### 4-2-1-1 Installing GSDML Files

The Device Catalogue allows the installation of new GSDML files into the GSDML directory for the Generic IO Device DTM. Selecting the **Install Device Description Files...** button displays the standard Windows File selection window. After selecting the GSDML file, and clicking the **Open** button in the File selection window, the GSDML file will be copied to the GSDML file directory under CX-ConfiguratorFDT.

After copying the GSDML file, a warning window will be displayed, indicating that the Device Catalogue needs to be updated. To update the Device Catalogue select the **Yes** button in the warning window.

**Note**

- 1 Updating the Device Catalogue after copying the GSDML file can only be done if there is a new project opened, with no DTMs allocated to the network in order to prevent corruption of an existing network in case a GSDML file is removed or replaced.
- 2 The **Install Device Description Files...** option allows installation of more than one file at the same time.

### 4-2-1-2 Updating the Device Catalogue

If a new DTM has been installed, it will not automatically be included in the Device Catalogue. To add newly installed DTMs to the list, the Device Catalogue must be updated by clicking the **Update** button at the bottom of the Device Catalogue window.

#### Updating the Device Catalogue

Updating the Device Catalogue may take some time, depending on the number of DTMs installed. A dialogue window with a progress bar will be shown during the update process. After updating the Device Catalogue, the list is stored on hard disk. The next time CX-ConfiguratorFDT is started the updated list will be used.

### 4-2-1-3 Adding Devices to the Network

Setting up a network in CX-ConfiguratorFDT involves adding and configuring single device DTMs. The device DTMs as listed in the Device Catalogue can be added to the network in three ways:

1 Using the context menu

A context menu will pop up when selecting the CJ1W-PNT21 PROFINET IO Controller DTM and then right clicking the mouse. By selecting the menu option Add Device, a simplified Device Catalogue is displayed showing only the DTMs which are allowed to be added to the PROFINET IO Controller DTM.

2 Using the Drag & Drop function

A Device DTM listed in the standard Device Catalogue window can be dragged and dropped from the Device Catalogue to a desired position in the Network view.

3 Using the Add Device button

A device DTM selected in the Device Catalogue can be added to a selected Master DTM in the Network view by clicking the Add Device button in the Device Catalogue window.

### 4-2-2 Saving and Opening Projects

A project file, containing various DTMs, can both be saved to and opened from hard disk. To save a project file select the **File - Save** or **File - Save As...** menu option. This will display the standard Windows File selection window, allowing the user to enter a file name.

The Project File is saved with the extension \*.CPR.

Saving the data is initiated from CX-ConfiguratorFDT, but every DTM must support the save function as well. The settings of each DTM is saved in the Project file.

A Project file can be opened by choosing the **File - Open** menu option. This will open the standard Windows File selection window, after which the Project file can be selected and opened.

**Note**

When opening a Project file, the network tree view is automatically constructed. However, for performance reasons, the DTMs are not directly instantiated to speed up the construction of the tree.

A Project File can also be opened from Windows Explorer. Double-clicking a file with extension \*.CPR will invoke CX-ConfiguratorFDT and open the selected file.

### 4-2-3 Exporting to HTML

CX-ConfiguratorFDT provides automatic generation of project documentation upon command of the user. The documentation is generated in HTML format, and can cover either single DTMs or the whole project. After generation of the HTML document, it will automatically launch the default Internet browser, to display the result.

#### Exporting Project to HTML

To export the project information to HTML either:

- Select the **File - Export Project as HTML** option from the main menu, or
- Select the **Export to HTML** option from the context menu

First select the project level in the Network view, and then right click the mouse to display the context menu.

In both cases a window will pop up displaying the progress of the export process.

After exporting the information, the default browser is launched, showing the result of the export process. The HTML file contains links to open the information pages for the individual DTMs. The amount of the information displayed depends on the individual DTMs. The displayed information can range from only the device type and version information to up to all possible settings and selections made for the device.

**Exporting DTM Information to HTML**

To export single DTM information to HTML execute the following steps:

- 1,2,3... 1 Select the DTM in the Network view.
- 2 Right click the DTM to bring up the context menu.
- 3 Select the Export to HTML option from the context menu.

A window will pop up displaying the progress of the export process. When finished, CX-ConfiguratorFDT will launch the default browser to display the result. In this case, however, no links will be available to other DTMs in the network.

**4-2-4 Error Logging and FDT Monitoring**

CX-ConfiguratorFDT provides two logging windows at the bottom of the application window. Both windows are used for displaying events.

**Error Log view**

The Error Log view displays error messages reported by the DTMs and by the CX-ConfiguratorFDT FDT container application. All messages include the Time and Date of occurrence as well as the DTM Name, as shown in the Network view.

**Purpose of the Error log**

The purpose of the Error Log view is error reporting and troubleshooting. The contents of the window can be copied to the clipboard, for pasting to another application or into an E-mail. The errors and the sequence in which they occur may hold additional clues in case of problems.

**Error Log Format**

The format used in the Error Log view is:

Time: <Time> Date: <Date> - <DTM name> <message>

The message displayed, originates from the DTM in which the error occurred.

The figure below shows an example of an error message sequence. This example sequence is generated after attempting to change a slave address to that of another slave already assigned to the same Master Unit

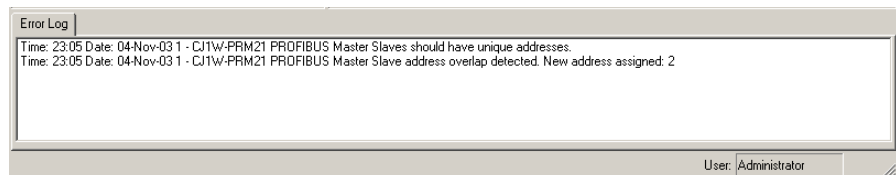


Figure 4.4: Error log

Right-clicking in the Error Log view displays a context menu providing the options listed below.

**Error Log view Context Menu**

Menu Item	Description	Equivalent menu command
Clear all entries	Clears the entire Error Log view	---
Copy to clipboard	Copies the entire contents of the Error Log view to the clipboard.	---
Hide	Hides the Error Log view	View - Error Logging

**FDT Monitoring view**

The FDT Monitoring view displays the communication between the FDT Container application (i.e. CX-ConfiguratorFDT) and any of the DTMs. The communication is listed as a sequence of function calls from the CX-Profibus to a DTM and vice versa.

**Note** The FDT Monitoring view is hidden by default. After starting CX-ConfiguratorFDT, the window will be displayed, by selecting the **View - FDT Monitoring** option from the main menu.

The purpose of the FDT Monitoring view is troubleshooting in case problems occur with third party DTMs. The contents of the window can be copied to the clipboard, to allow it to be pasted into another document or into an E-mail. The messages themselves as well as the sequence of messages may hold additional clues in case of problems.

The format used in the FDT Monitoring view is:

Time: <Time> Date: <Date> - <Information Type> <message>

The message may include the name of the DTM involved in the communication. The figure below shows an example of an FDT Monitoring message sequence. This example sequence is generated when opening a CJ1W-PNT21 PROFINET IO Controller Unit DTM.

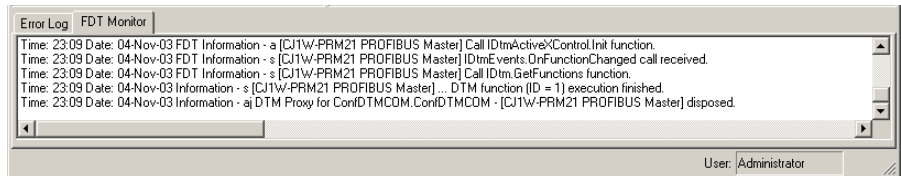


Figure 4.5: FDT monitor

Right-clicking in the Error Log view displays a context menu providing the options listed below.

**Error Log view Context Menu**

Menu Item	Description	Equivalent menu command
Clear all entries	Clears the entire FDT Monitoring view	---
Copy to clipboard	Copies the entire contents of the FDT Monitoring view to the clipboard.	---
Hide	Hides the FDT Monitoring view	View - FDT Monitoring

### 4-3 CJ1W-PNT21 PROFINET IO Controller DTM

**CJ1W-PNT21 PROFINET IO Controller DTM** To allow configuration and data monitoring from within CX-ConfiguratorFDT a CJ1W-PNT21 PROFINET IO Controller DTM is installed. The DTM shows up in the Device Catalogue under the following name:

DTM Name	Functions
CJ1W-PNT21 PROFINET IO Controller	<ul style="list-style-type: none"> <li>I/O Configuration of PROFINET IO Controller Unit.</li> <li>Monitoring of PROFINET IO Controller Unit.</li> <li>Provide an Acyclic communication channel with PROFINET IO Devices.</li> </ul>

The PROFINET IO Controller DTM has three main user interface components.

- DTM Configuration User Interface  
This user interface facilitates configuration of the IO Controller Unit.
- DTM PROFINET Identification.  
This user interface facilitates detection of IO Devices and configuration of IO device Names.
- DTM Diagnostics User Interface  
The DTM Diagnostics User Interface facilitates Unit status determination, IO Device status determination, and changing the Unit's PROFINET operational mode.

This section provides an overview of the PROFINET IO Controller DTM, and discusses the user interfaces.

#### 4-3-1 DTM User Interface

##### Opening the DTM

To open the CJ1W-PNT21 IO Controller DTM:

- Select and double-click the IO Controller DTM in the Network view.
- Select and right-click the IO Controller DTM in the Network view. Next, select Configuration from the context menu.

The IO Controller DTM Configuration User Interface, which is displayed in the CX-ConfiguratorFDT DTM view is shown below.

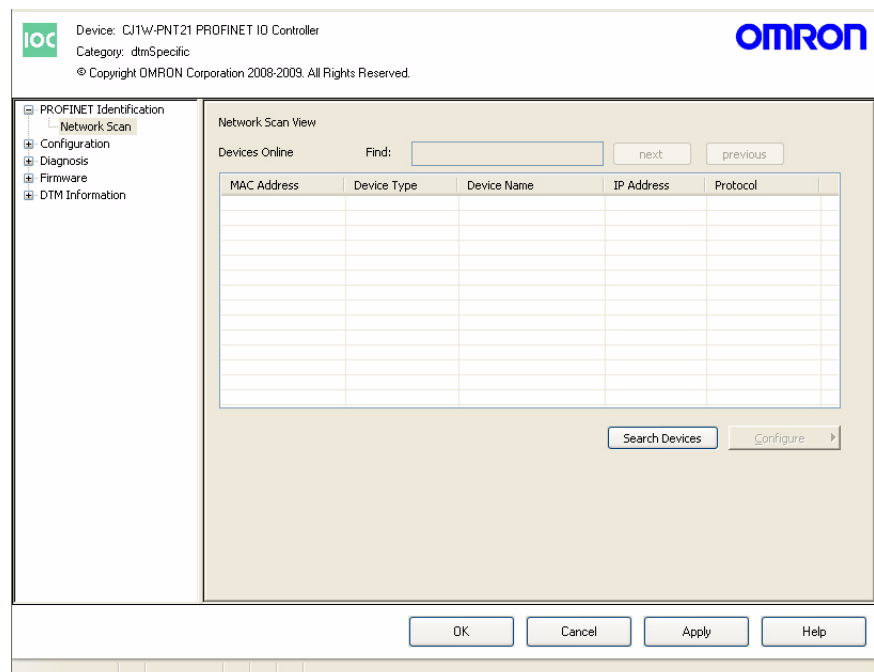


Figure 3.6: DTM user interface



**Master DTM Configuration User Interface**

The IO Controller DTM Configuration User Interface contains five main items.


- PROFINET Identification
- Configuration
- Diagnosis
- Firmware
- DTM Information

The five items are discussed below.

**Configuration Interface Buttons**

The IO Controller DTM Configuration User Interface contains four general buttons. The table below shows the name and the action for each button.

Button	Action
OK	Evaluate, and save the changes made (if any) and close the user interface. <b>Note:</b> If any invalid settings have been made, a warning message will be displayed, allowing cancellation of the command.
Cancel	Closes the user interface without saving. <b>Note:</b> If any changes were made, a warning message is displayed, allowing cancellation of the command.
Apply	Evaluate changes and save them.
Help	Launch context sensitive Help for the Active tab.

 **Caution** Changes made by the user are saved in the DTM only, and not in the Project. This is indicated by the asterisk next to the DTM in the Network view. The next time in the same session the GUI is opened, the changes will still be there. To save the changes permanently, for example to hard disk, click the **File - Save** option from the main menu of CX-ConfiguratorFDT.

**4-3-2 PROFINET Identification**

The PROFINET Identification item is used to detect and setup the names of the PROFINET IO Devices on the network. The PROFINET Identification item has only one sub-item:

- Network Scan

The sub-item is described in the section below.

**4-3-2-1 Network Scan**

In the Network Scan sub-item the following settings and operations must be done prior to starting PROFINET IO Communication.

- 1 Acquire an overview of all IO Devices connected to the network.
- 2 Make the IO Devices or IO Controller LED's flash to be able to identify the Unit.
- 3 Set the Device Name for each of the IO Devices and IO Controllers connected to the network.

It is required for the PC to have an Ethernet connection to the Network to perform these operations. The Network Scan screen is shown below.

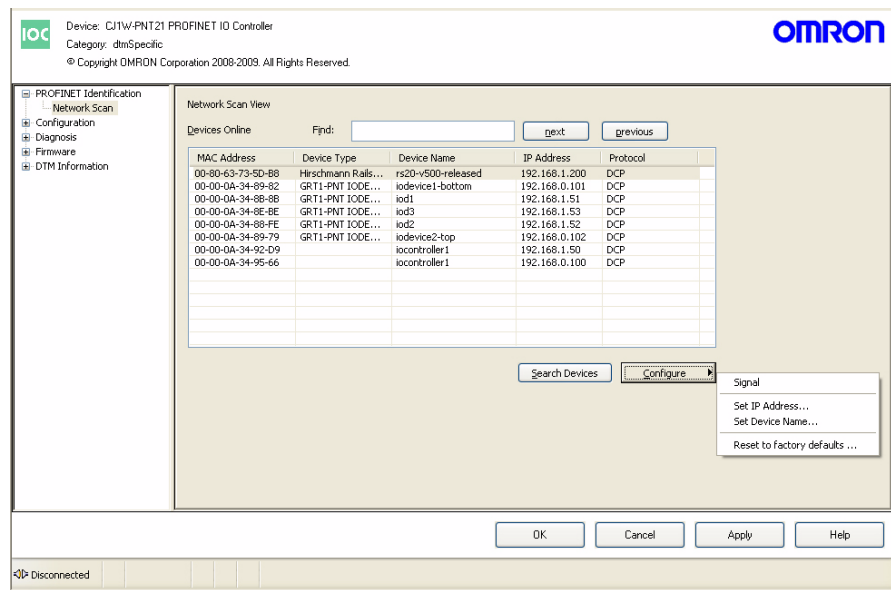


Figure 4.7: Network scan

**Search Devices Button**

To populate the Network Scan View follow the next sequence:

- 1 Press the **Search Devices** button to scan the network and get an overview of all the PROFINET devices connected to the Ethernet network.
- 2 Locate the IO devices at their physical location by making the IO Controllers and IO Devices flash their LED's.
- 3 Give each IO Device its PROFINET IO Device name.

The Controls have the following function:

Control	Description
Search Devices	The <b>Search Devices</b> button initiates a scan of the network and shows all found PROFINET IO Devices in the Network Scan View. For each device the MAC Address, Device Type, the currently assigned name and IP Address are displayed. The PROFINET Name and the IP Address can be adjusted from within this view.
Signal	When selecting "Signal" the selected IO Device or IO Controllers will flash its LEDs for 3 seconds. This can be used to locate the IO Controller or IO Device.
Set IP Address	An IP Address can be temporarily set to access the IO Device over TCP/IP with a device-specific tool. When the IO Controller opens a connection to the IO Device the IP Address is over written by the IP Address set in the IO Controller's configuration file. The IP Address can also be set temporarily for the IO Controller, however this can only be done when there is no configuration file in the IO Controller.

Control	Description
Set Device Name	The Device Name is used by the IO Controller to recognize the IO Device on the network, to download parameters to the IO Device and initiate I/O Data communication. Setting the Device Name is mandatory. According to the PROFINET specification the name may only contain lower case characters, dashes and numbers. During entry of the Device Name the characters entered are checked and corrected for possible illegal characters.
Reset to factory defaults.	The selected IO Device is reset to factory default settings. This normally means no Name and no IP Address (0.0.0.0)

- Note**
- 1 It is required for the PC to have an Ethernet connection to the Network to perform these operations.
  - 2 Be sure to set the Device Name of the IO Device to exactly the same value as set in the IO Controller's IO Device setup sub-item.

**Find field**

In the Find field a selection of the found IO devices can be made. The search string can be used with wildcard characters (like \*). The search is done on all fields of the Device Online list.

### 4-3-3 Configuration

The Main item "Configuration" (see figure below) provides the following four sub-items:

- PLC Setup
- IO Controller Setup
- IO Device Setup
- IO Device Area

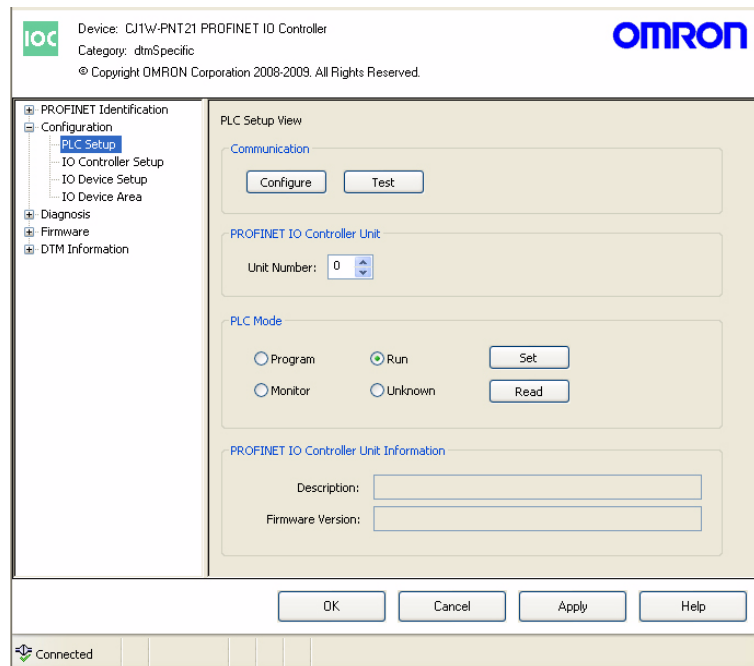


Figure 4.8: PROFINET IO Controller Configuration

Each sub-item is described in the sections below.

4-3-3-1 PLC Setup

The PLC Setup sub-item provides the controls to establish communication between the PC and the PROFINET IO Controller Unit. The PLC Setup allows setting of the unit number to identify the PROFINET IO Controller Unit on the PLC system. The PLC Setup also invokes the CX-Server interface to setup and test the communication between the PC and the PLC to which the Unit is attached.

The PLC Setup has the following Components:

**PROFINET IO Controller Unit**

The PROFINET IO Controller Unit box contains the settings the user must make before setting up the communication and before testing the communication.

Control	Description
Unit number	Set this to the value of the Unit Number Selector switch on the front of the Unit. This number is used in the communication between the PC and the PLC to transmit the messages to the targeted PROFINET IO Controller Unit

**Communication**

The Communication box contains a Configure and a Test button.

**Configure Button**

The **Configure** button invokes the CX-Server communications settings dialogue. CX-Server is the driver software providing the communications functionality between a PC and the PLC CPU, and forms the basis for Omron's CX-One programs.

CX-Server is provided with CX-ConfiguratorFDT, but it may already be installed on the PC, if other programs, for example CX-Programmer have been installed.

**Note**

The CX-Server is designed to manage the communication between the PC and the PLC and also to configure the connected PLC.

**Test Button**

The purpose of the **Test** button is to verify the communication setup, after CX-Server has been configured. If the PC and the PLC are connected, selecting the Test button will invoke a FINS request message to the PROFINET IO Controller Unit via the PLC, to read its name and firmware version. If the request succeeds, both items will be displayed in the PROFINET IO Controller Unit Information Box.

If the FINS request fails (no response), an error message will be displayed in the Error Log view. In this case the Firmware version field will revert back to its default contents, i.e. "---".

**PROFINET IO Controller Information Box**

The PROFINET IO Controller Information Box contains information obtained from the PROFINET IO Controller Unit, after pressing the test button.

Item	Description
Description	Displays the name of the Unit, that is CJ1W-PNT21.
Firmware Version	Displays the firmware version of the PROFINET IO Controller Unit.

**PLC Mode Box**

The PLC Mode Box contains information and gives the user the opportunity to change the PLC-mode. The status and buttons are greyed out when the PROFINET IO Controller DTM is in the offline mode. When in the online mode

clicking the **Read** button will read the current PLC mode. Selecting the required PLC mode and pressing the **Set** button will set the PLC to the required mode.

**4-3-3-2 IO Controller Setup**

The IO Controller Setup item contains settings regarding the behaviour of the PROFINET IO Controller Unit. The IO Controller Setup item is shown below.

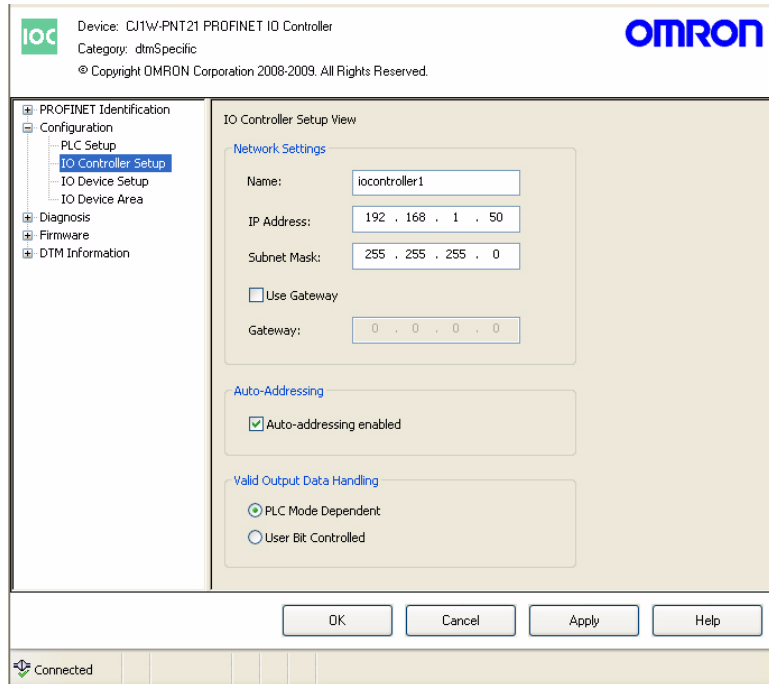


Figure 4.9: IO Controller setup

**Network Settings Box**

The Network Settings Box contains the fields to enter the PROFINET IO-Controller’s Name, IP Address and Subnet Mask. This information is required to let the PROFINET IO Controller connect to the PROFINET IO network.

Item	Description
Name	This string is the PROFINET IO name of the Unit.
IP Address	This is the IP Address the PROFINET IO Controller Unit will use to setup communication to PROFINET IO Devices and on which the PROFINET IO Controller will be accessible from the Ethernet network. The last number of the IP Address for the PROFINET IO Controller Unit can not be higher that 126.
Subnet Mask	This is the Subnet Mask that will be used with the above IP-Address.
Use Gateway	This is currently not supported.

**Auto-Addressing Box**

The Auto-Addressing function influences the I/O Mapping process when adding and removing I/O modules or when editing an existing I/O Mapping.

Control	Description
Auto Addressing enabled	The IO Controller DTM performs the I/O data mapping by allocating the I/O data in ascending order of IO Device address and selected I/O modules. Memory allocation gaps will be optimized for efficiency.
Auto Addressing disabled	New I/O modules are appended to the existing mapping. Changed I/O modules will be re-allocated to the end of the list. This may create gaps in the memory allocation.

**Valid Output Data Handling Box**

The Valid Output Data Handling Box defines the behaviour of the PROFINET IO Controller Unit on the PROFINET network in case a PLC mode change occurs. Check boxes define how the Unit should behave in case the PLC mode is changed from RUN / MONITOR mode to PROGRAM mode, or vice versa.

Control	Description
PLC Mode Dependent	The PROFINET IO Controller will mark its output data as invalid when the PLC is in Program mode. When the PLC is in Run/Monitor mode the PROFINET IO Controller will mark the output data as valid.
User Bit Controlled	The PROFINET IO Controller will mark its output data as invalid when bit 12 in the Software Switches 1 word is OFF. When bit 12 in the Software Switches 1 word is ON the PROFINET IO Controller will mark the output data as valid. The Software Switches 1 word is located at address CIO 1500 + (25 x Unit number).

The PROFINET IO Controller uses for this the Provider Status field in the PROFINET Output Data message. This Provider Status field is set valid or invalid by the Producer. The Consumer will interpret the Provider Status field. If the Provider Status field is set to invalid the Consumer will discard the received Output data. For more information about Provider Status field and the Output Data status see Appendix A.

**4-3-3-3 IO Device Setup**

At startup the PROFINET IO Controller configures the relations with the PROFINET IO devices. The PROFINET IO Controller will query the IO devices by name. After finding the PROFINET IO Device on the network the PROFINET IO Controller will issue an IP address to the IO device. This IP address will be used to configure the relation between the PROFINET IO Controller and the IO Device.

The following settings must be entered:

- The Device Name the IO Controller searches for
- The IP Address needed for configuration
- The Update Rate of the Connection
- Watchdog and DataHold Factors

The Device Name entered must be equal to the name that was given to the IO Device in the network Scan in the PROFINET Identification screen. If there is a mismatch the IO Controller can not establish a connection. The name entered in the Network Scan is not automatically copied to the IO Device Setup list.

The IO Device Setup item is shown below.

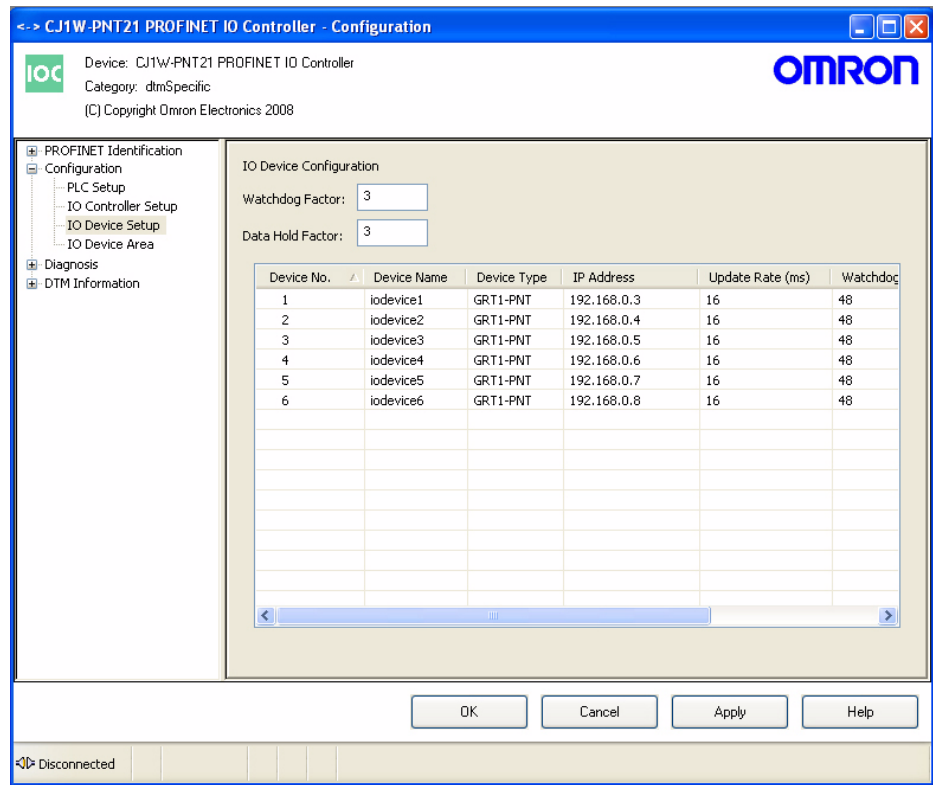


Figure 4.10: IO Device setup

Item	Description
Device No.	The Device No. is the number used by the PROFINET IO Controller DTM to reference the IO Device within the configuration. For instance in the Diagnostic screen IO Devices are represented by number.
Device Name	The Device Name is the name the PROFINET IO Controller will search for at startup. This name must be exactly the same as the name entered in the IO Device. Note that according to the PROFINET specification only lower case characters, dashes and numbers are allowed.
Device Type	The Device Type is supplied by the Device DTM and can not be altered.
IP Address	The IP Address is issued by the PROFINET IO Controller to the IO Device with the corresponding IP address. The IO Device is then reachable on the network by this IP Address.
Update Rate (ms)	The Update Rate is the time interval in milliseconds between subsequent Input Data and Output Data exchanges between the PROFINET IO Controller and the IO Device. The Update Rate can be set per IO Device.
Watchdog Factor	The Watchdog Factor is a multiplication factor on the Update Rate to define the watchdog timeout. If an update of I/O Data takes longer than the Watchdog Time the connection is considered to be terminated. A new connection attempt will be made by the PROFINET IO Controller.

Item	Description
Data Hold Factor	The Data Hold Factor is a multiplication factor on the Update Rate to define the datahold timeout. The Data Hold Time is the time that an IO Device will keep its Outputs set to the last known state after a successful data exchange. If the Data Hold Time elapses, the Outputs of the IO Device will turn to a safe state as defined by the configuration of each device. The Data Hold Factor must be equal to or larger than the Watchdog Factor
Watchdog Time (ms)	The Watchdog Time is the multiplication of the Update Rate and the Watchdog Factor.
Data Hold Time (ms)	The Data Hold Time is the multiplication of the Update Rate and the Data Hold Factor.

4-3-3-4 IO Device Area

The IO Device Area displays the mapping of the I/O data of the allocated IO Devices onto the PLC memory areas. The mapping can be made automatically or be changed by the user prior to downloading. The figure below shows the IO Device Area, more in particular the Output Allocation tab.

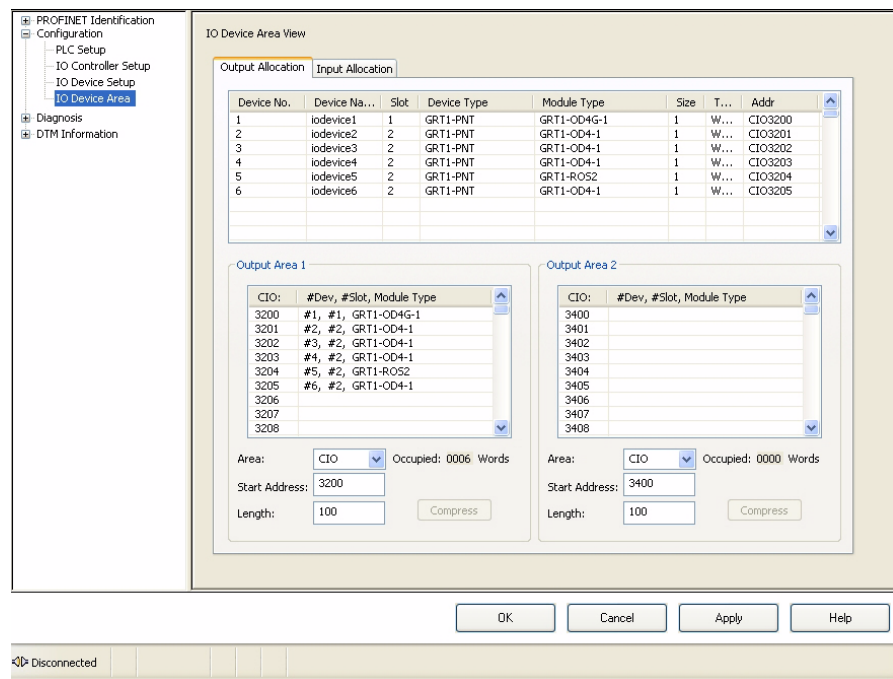


Figure 4.11: IO Device area

Allocation Areas

The IO Device Area allocation tabs define how the I/O data of each of the slave devices is mapped onto the PLC memory. The Slave area tab contains two tabs, one for Output Allocation and one for Input Allocation. Each tab contains an overall module list showing all the output or input data per slave, along with the Module names, sizes, data types and start addresses. This data is transferred to the Master DTM by each of the allocated slave DTMs. If no IO Devices have been allocated or configured the list will be empty.

Module List Box

The Module List Box list contains the following information (the table applies to the lists in the Input and Output Allocation tabs, see also the above figure).



Column	Description
Device No.	The Device No. is the number used by the PROFINET IO Controller DTM to reference the IO Device within the configuration.
Device Name	The Device Name is the name assigned to the IO device to which this I/O data belongs to.
Slot	The Slot number is the position in which this particular module is inserted. The information is supplied by the IO device DTM.
Device Type	The Device Type is supplied by the IO Device DTM.
Module Type	The Module Type is supplied by the IO Device DTM.
Size	The Size of the module.
Type	The Datatype of the module.
Address	The Address is the PLC Address with which the I/O Data of the module is exchanged.

**I/O Mapping Box**

Each Output/Input Allocation tab also contains two areas onto which the I/O data can be mapped. The areas are subsequently mapped onto the PLC memory. By default all data is mapped to Area 1, in ascending order of the IO Device Number.

**Note**

- 1 When mapping, the modules are copied from the module list to the mapping Area. The module list acts as a resource for the two Mapping Areas. To change the mapping of a module drag and drop it from the module list to the Mapping Area.
- 2 When adding or removing slaves and modules, while Auto Addressing has been enabled, the modules in the Areas will be re-mapped, usually also resulting in I/O data being re-mapped. Therefore it is recommended to define all slaves and modules, before setting up the PLC memory mapping configuration.



**Caution**

The default mapping of areas onto the PLC memory is the same default mapping as used in the CJ1W-DRM21 Devicenet Master/Slave Unit and in the CJ1W-PRM21 PROFIBUS Master unit. Care should be taken to avoid data overlap, if such a Unit is part of the same PLC CPU system as the CJ1W-PNT21 PROFINET IO Controller Unit

**Mapping Area Control**

Each mapping Area in the Allocation tab is equipped with four controls and an information field located below the Area. The controls and information field are listed and explained in the table below

Control	Description
Area	Selects the PLC memory area to which the associated I/O Area will be mapped. Possible options are: <ul style="list-style-type: none"> <li>• Not Used (List must be empty).</li> <li>• CIO</li> <li>• DM</li> <li>• WR</li> <li>• HR</li> <li>• EM Bank 0 to 12 (Decimal)</li> </ul> (See Note 1)
Start Address	In this field the user can enter the start address in the PLC memory of the mapped data block.

Control	Description
Length	The length box allows the user to select the number of visible rows. The minimum and the default value is 100 words. The Length value can be set to up to 7168 words.
Occupied	This field displays the actual length of the data block (not necessarily the same as the amount of data contained by it). This length includes both data as well as any gaps between modules. Gaps may only be there if the Auto-Addressing option in the Master Setup tab is disabled (See also Note 2).
Compress Button	Pressing the Compress button will compress the Area list associated with it, that is gaps from the mapping list are removed by moving all mapped I/O modules as close as possible to the beginning of the memory area. (See Notes 3 and 4).

- Note**
- 1 If the selected PLC memory area, onto which the data must be mapped, is not supported by the PLC CPU a warning message will be displayed upon downloading the configuration.
  - 2 If an invalid setting is made the Occupied length value changes its colour to red. Upon saving the changes, in addition, a warning message will be displayed. Examples of invalid settings are:
    - The start address and length definitions of the data block cause it to exceed the memory area in the PLC.
    - The data mapping of two or more I/O Areas (Output and/or Input) overlap each other partly or totally in the PLC memory.
  - 3 The **Compress** button will be disabled, that is greyed out, when Auto-Addressing has been enabled.
  - 4 Before compressing, the IO Controller DTM will display a warning message prompting the user for confirmation of the action.

**Changing Mapped Data Allocations**

By default, the data is mapped to Area 1 in both the Output and Input Allocation tabs. It is however possible to map a part of the data to the second area in the same tab. For example, an application may require to store all byte data in one location and all word data in another. Moving data mapped in one Area to another Area is done from the module list. The procedure is as follows:

- 1,2,3...**
- 1 Find and select the module to be mapped from module list.
  - 2 Left-click the module and drag it, while holding the Left mouse button, to the desired Area. This can be the end of the list or any empty space in the list in which it will fit (See Note).
  - 3 Release the mouse button. The module data is copied to the desired Area and appended to the already existing list. The corresponding entry in the originating list is now deleted.
  - 4 Finally the PLC memory address, to which the module is mapped, is now updated in the module list.

- Note**
- 1 If Auto-Addressing is enabled (see IO Controller Setup tab in this section) any remaining empty spaces will be removed by compression of the list. Modules allocated to a higher address will be moved to a lower address to fill up the gaps.
  - 2 If Auto-Addressing is disabled, compressing the list can be accomplished by pressing the **Compress** button (only after all modifications to the mapping have been made).

### 4-3-4 Diagnosis

The Diagnosis item shows the status of the IO Controller and the registered IO Devices. The Diagnosis item has the following three sub-items.

- IO Controller Status
- IO Device Status
- Error History

To display the Diagnosis information the PROFINET IO Controller DTM must be Online with the PROFINET IO Controller Unit. All information can be acquired once by pressing the **Manual** button in the Refresh box.

The information can also be refreshed continuously by setting the refresh option to **Automatic** by checking its check box.

#### 4-3-4-1 IO Controller Status

The IO Controller Status has four separate boxes showing information concerning the status of the IO Controller and the status of the Ethernet connection. Further, information is shown of the status of the Unit's status and the status of the registered IO Devices.

The picture below shows the IO Controller Status.

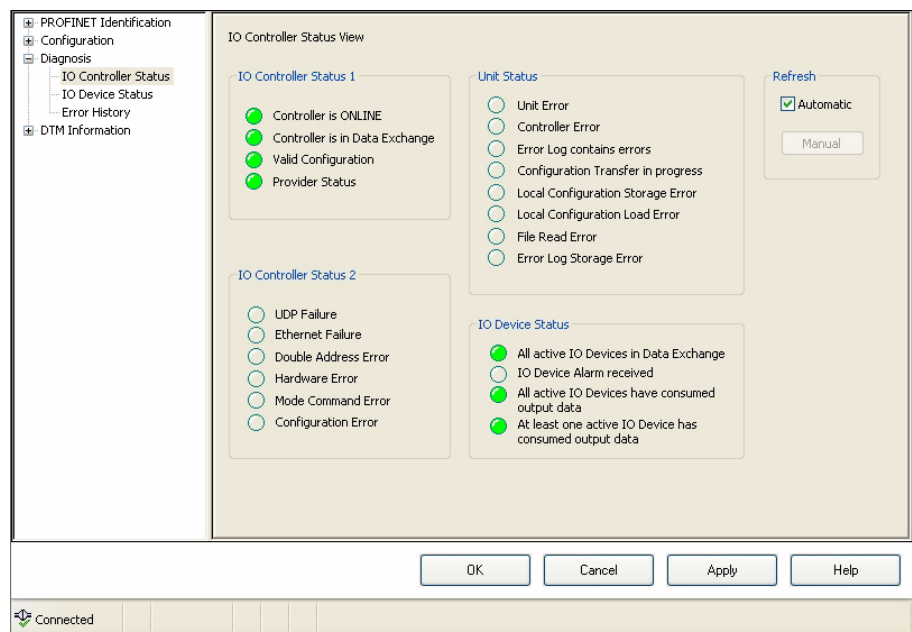


Figure 4.12: IO Controller status

The status information is read from the IO Controller Status words 1 and 2, in the Unit Status word and in the IO Device Status word. These words are located in the CIO Control and Status area at CIO 1500 + 25 \* Unit Number.

#### 4-3-4-2 IO Device Status

The IO Device Status presents an overview of the IO Devices that are in active Data Exchange or have the New Alarm flag raised. To view more information about the alarm a selection can be made in the Selected IO Device box.

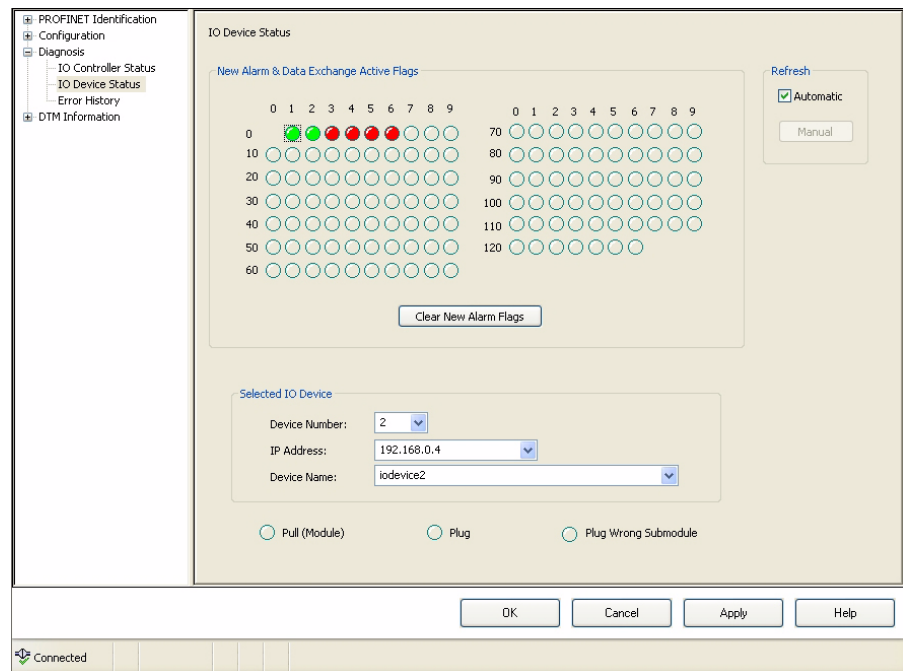


Figure 4.13: IO Device status

The New Alarm & Data Exchange Active Flags are a combination of the IO Device New Alarm and Data Exchange Active flags area's, which are located in the CIO Control and Status area at CIO 1500 + 25 \* Unit Number.

In the Selected IO Device box a selection can be made by Device Number, IP Address or Device Name. If the selected Device has a Plug, Pull or Plug Wrong Submodule Alarm, this will be indicated.

### 4-3-4-3 Error History

The Error History shows the Error Log of the PROFINET IO Controller Unit. For troubleshooting refer to this Error Log.

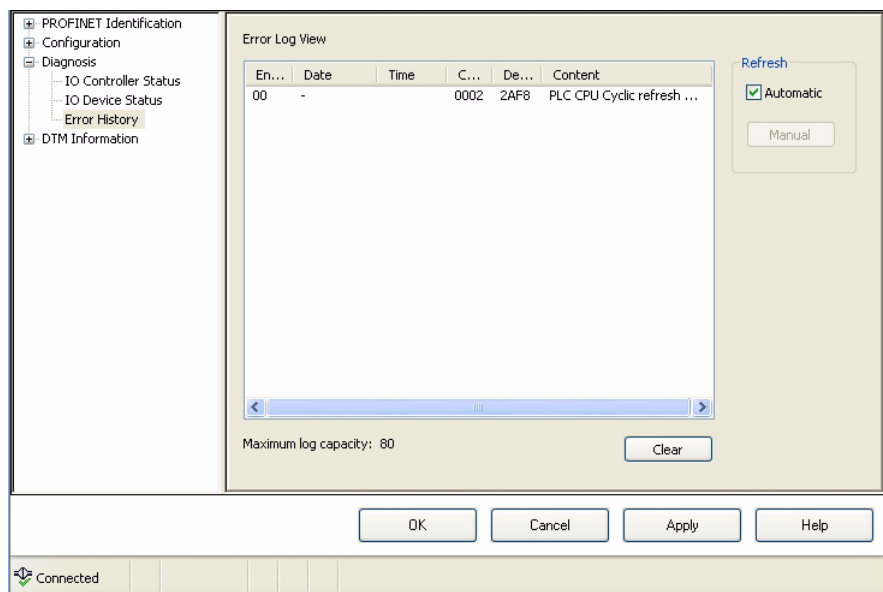


Figure 4.14: Error history


### 4-3-5 Firmware Upgrade

In the rare occasion a firmware upgrade is needed for the CJ1W-PNT21 PROFINET IO Controller this can be done in the Firmware Upgrade item. The IO Controller DTM must be set online to perform the upgrade.

The Current Firmware Version box shows the current firmware version of the IO Controller.

- 1 Click the **Browse** button and select the new firmware file from the standard Windows File Selection window.
- 2 When the firmware file is opened by clicking the **Open** button, it will be checked for consistency. The new version number is shown in the Upgrade Firmware Version box.
- 3 The firmware upgrade process is started with the **Upgrade Now** button and the Progress is shown in the progress bar.
- 4 When the firmware upgrade is completed, the new version can be read out by going online with the CX-ConfiguratorFDT. The version will be visible in the Current Firmware Version.

Detailed information on the Firmware Upgrade process will be delivered with the new firmware file.

 **Caution** Do not turn off the power to the IO Controller during firmware upgrade. This may cause fatal and irreversible damage to the IO Controller. Always follow the directions supplied with the firmware file for upgrading the IO Controller Unit.

## 4-4 Generic IO Device DTM

There are two means to represent a PROFINET IO Device for configuration in CX-ConfiguratorFDT.

- 1 The GSDML file basically describes a IO Device by showing the selectable modules an IO device can contain and its settable parameters. However, online configuration is not possible with a GSDML file.

A GSDML file is mandatory for every PROFINET IO Device, in order to enable any IO Controller to be configured for communication with the IO Device.

A PROFINET GSDML file is comparable to a PROFIBUS GSD file. However, a PROFINET GSDML file is in XML format while a PROFIBUS GSD file is in plain ASCII text format.

- 2 A DTM (Device Type Manager) is a program that runs in a FDT (Field Device Tool) container. It fulfils the basic function of a GSDML file by supplying the module and parameter information to the IO Controller. In addition it can also go directly online with the actual IO Device and allow online configuration. To accommodate the user, normally a DTM has intuitive screens to help the user configuring the IO Device.

The module and parameter information is passed to the IO Controller DTM so it can be used to build a configuration file. When this file is downloaded into the IO Controller it can perform I/O Data-exchange with the IO Devices.

### 4-4-1 Installing GSDML file

#### Install Device Description File

The **Device Catalogue** window contains a **Install Device Description File** button. Clicking the button opens a file selection box from where different types of files can be imported. For the moment only GSD-files for PROFIBUS devices and GSDML files for PROFINET IO Devices can be selected.

The GSDML files are stored in a separate sub-directory under CX-ConfiguratorFDT. Upon updating the Device Catalogue, the Generic IO Device DTM will scan this sub-directory and present an entry in the Device Catalogue for each of the GSDML files found.

Upon adding the GSDML based IO Device to the network, an instance of the Generic IO Device DTM is created in PC memory, used for reading the GSDML file contents and for providing the user interface necessary to make the settings for the associated slave device.

### 4-4-2 Configuration User Interface

#### Opening the Configuration DTM

To open the configuration DTM:

- Select and double-click the IO Device DTM entry in the Network view or,
- Right-click the IO Device DTM in the Network view, and select **Configuration** from the context menu.

The IO Device DTM Configuration User Interface, which is displayed in the CX-ConfiguratorFDT DTM view is shown below. The figure shows the user interface for an PROFINET IO Device Unit. By default the Configuration tab is opened.

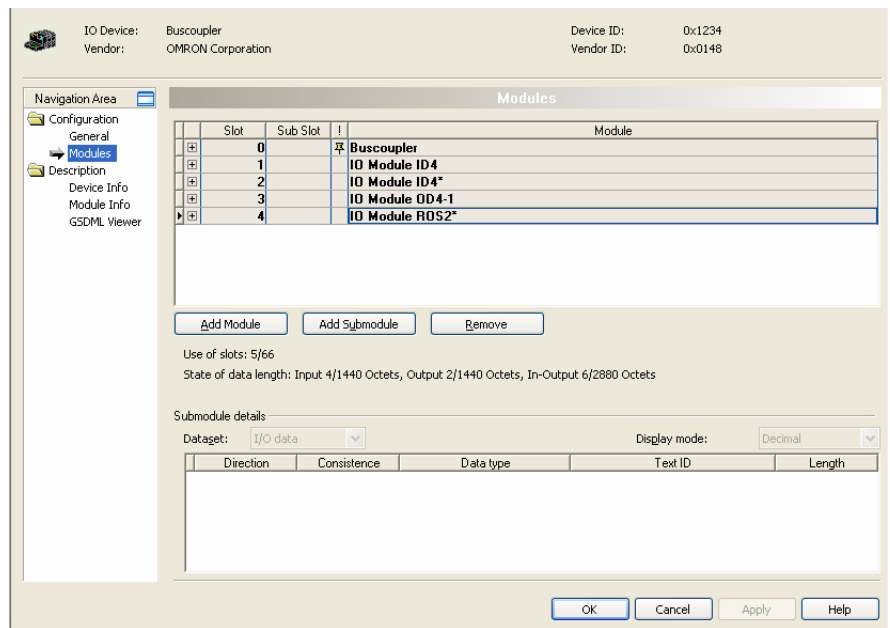


Figure 4.15: Generic IO Device

In general, the Configuration User Interface for the Generic IO Device DTM contains two items. The upper part always displays the IO Device and Vendor name plus the Device ID and Vendor ID.

The main and sub-items are:

**Configuration and Description item**

- 1 Configuration item with the following two sub-items:
  - General, showing only general information.
  - Modules, displaying the module selected in the IO Device from where the IO Device can be configured.
- 2 Description item, showing information about the IO Device, with the following sub-items:
  - Device Info, showing information of the device.
  - Module Info, displaying information about the modules selected for the device.
  - GSDML viewer, displaying the content of the GSDML file. Note that the contents of a GSDML file are XML based.

**General sub-item**

The General sub-item shows information the IO Controller DTM assigns to the IO Device at startup of PROFINET IO communication, such as the PROFINET IO Name and IP Address.

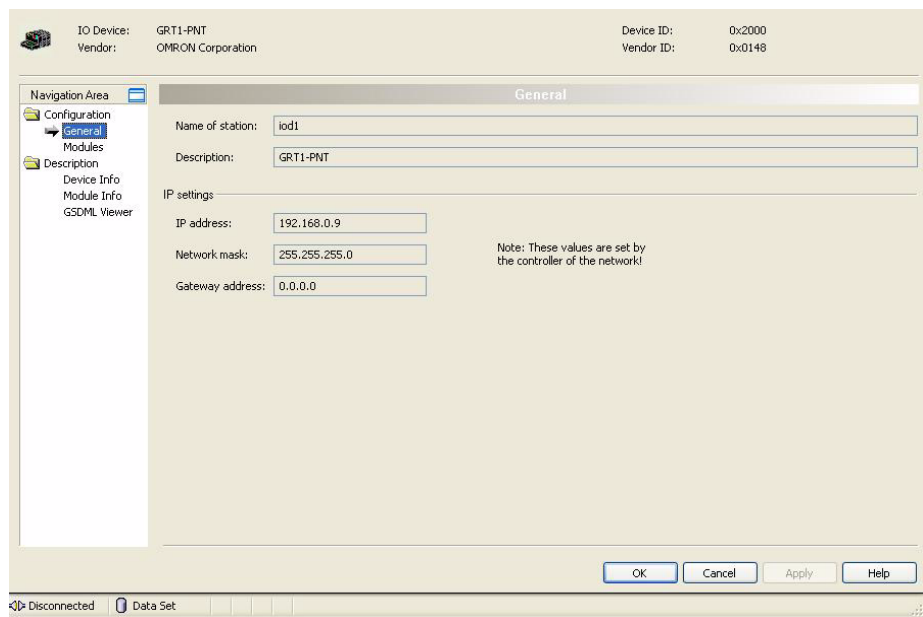


Figure 4.16: General information

The user can not set any items in this screen.

**Modules sub-item**

In the Modules sub-item the user needs to enter the actual module configuration of the IO device. It must be exactly match the modules used by the IO Device or the IO Device should accept the module configuration as its actual configuration.

A list of available modules is read from the GSDML file of the IO Device. The figure below shows an example of a module selection for a Omron GRT1-PNT PROFINET IO device.

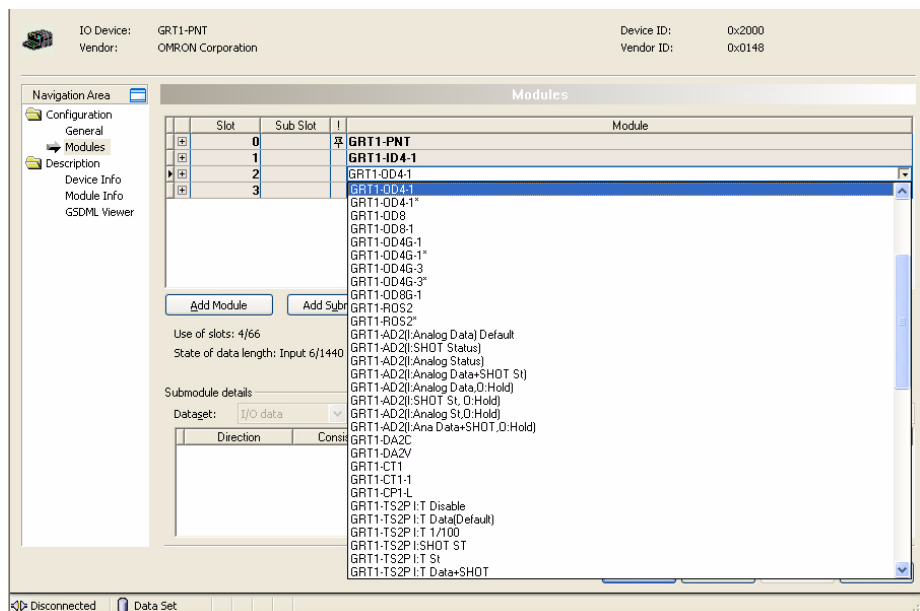


Figure 4.17: Selecting modules

**Defining the I/O Configuration**

To define the I/O configuration the user must select each I/O module in the same sequence as they are physically connected to the IO Device, while observing the following prerequisites:



- Digital Units can occupy 2 or 4 bits of I/O data. Adjacent digital Input Units or Output Units must be assembled into 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 following 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 again selecting 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 Master Unit.
- Analog Units normally occupy 1, 2 or 3 words.

To further explain the mapping sequence, an example is given below. The example is based on the Omron GRT1-PNT PROFINET IO Device.

**Example**

To illustrate how the Digital and Analog SmartSlice I/O Units are mapped to I/O words, and how to do the implementation using the GSD File, consider the table below:

SmartSlice	Selected I/O Module	I/O Word/Bit
GRT1-PNT	COM Status	Input Word #1
GRT1-ID4-1	GRT1-ID4-1	Input Word #2 / Bit 0~3
GRT1-ID4-1	GRT1-ID4-1*	Input Word #2 / Bit 4~7
GRT1-OD4-1	GRT1-OD4	Output Word #1 / Bit 0~3
GRT1-ROS2	GRT1-RO2*	Output Word #1 / Bit 4~5
GRT1-ID4-1	GRT1-ID4-1*	Input Word #2 / Bit 8~11
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 column and the I/O words onto which the modules are mapped in the right-most column.



## **SECTION 5 Allocated CIO and DM Words**

This section describes the words allocated to the CJ1W-PNT21 PROFINET IO Controller Unit in the CIO and DM Areas. These words facilitate controlling the Unit and accessing the Unit and network statuses.

<b>SECTION 5</b>	
<b>Allocated CIO and DM Words</b>	<b>61</b>
5-1 Overview of Word Allocations .....	62
5-2 Allocated CIO Area Words .....	64

## 5-1 Overview of Word Allocations

The words shown in the following diagram are allocated according to the unit number setting. For each CPU Bus Unit, there are 25 words allocated in the CIO Area and 100 words allocated in the DM Area.

First word allocated in the CIO Area:  $n = \text{CIO } 1,500 + (25 \times \text{unit number})$

First word allocated in the DM Area:  $m = \text{D}30,000 + (100 \times \text{unit number})$

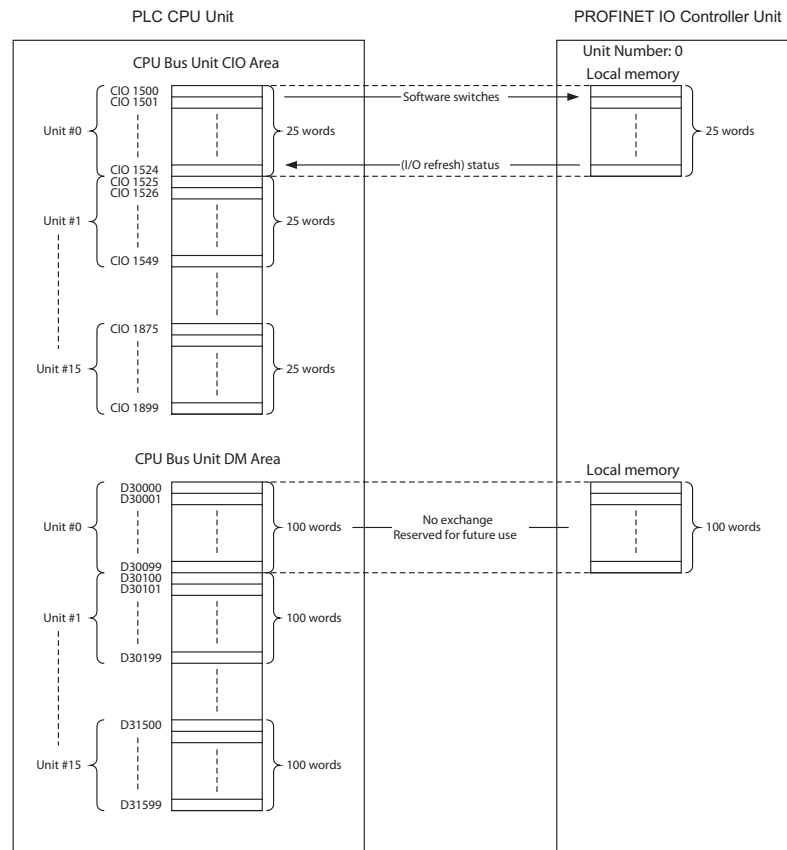


Figure 5.1: Memory allocations overview

**Note** The allocated DM words are not used by the PROFINET IO Controller Unit. However, exchange of data to the allocated DM words is reserved for future use, and it is therefore not recommended to use the allocated DM words for other purposes.

### 5-1-1 CIO Area Word Allocations

Software switches, PROFINET IO Controller Unit status, and Slave Status data are allocated in the CIO Area according to the unit number, as shown below. Software switches are bits used as commands from the PLC CPU to the PROFINET IO Controller Unit to enable executing Unit functions.

Unit No. (decimal)	Allocated words	Unit No. (decimal)	Allocated words
0 (0)	CIO1500 to CIO1524	8 (8)	CIO1700 to CIO1724
1 (1)	CIO1525 to CIO1549	9 (9)	CIO1725 to CIO1749
2 (2)	CIO1550 to CIO1574	A (10)	CIO1750 to CIO1774

<b>Unit No. (decimal)</b>	<b>Allocated words</b>	<b>Unit No. (decimal)</b>	<b>Allocated words</b>
3 (3)	CIO1575 to CIO1599	B (11)	CIO1775 to CIO1799
4 (4)	CIO1600 to CIO1624	C (12)	CIO1800 to CIO1824
5 (5)	CIO1625 to CIO1649	D (13)	CIO1825 to CIO1849
6 (6)	CIO1650 to CIO1674	E (14)	CIO1850 to CIO1874
7 (7)	CIO1675 to CIO1699	F (15)	CIO1875 to CIO1899

**5-1-2 DM Area Word Allocations**

The DM area words which are allocated for the PROFINET IO Controller Unit are not used, i.e. no data is exchanged between an allocated DM area and the Unit. However, the allocated area is reserved for use in a future extension of the Unit. Therefore, using this area for user data is not recommended.

<b>Unit No. (decimal)</b>	<b>Allocated words</b>	<b>Unit No. (decimal)</b>	<b>Allocated words</b>
0 (0)	D30000 to D30099	8 (8)	D30800 to D30899
1 (1)	D30100 to D30199	9 (9)	D30900 to D30999
2 (2)	D30200 to D30299	A (10)	D31000 to D31099
3 (3)	D30300 to D30399	B (11)	D31100 to D31199
4 (4)	D30400 to D30499	C (12)	D31200 to D31299
5 (5)	D30500 to D30599	D (13)	D31300 to D31399
6 (6)	D30600 to D30699	E (14)	D31400 to D31499
7 (7)	D30700 to D30799	F (15)	D31500 to D31599

## 5-2 Allocated CIO Area Words

For each CPU Bus Unit, the CJ-series PLC allocates up to 25 words in the CIO area. First word  $n = \text{CIO } 1500 + (25 \times \text{Unit number})$ .

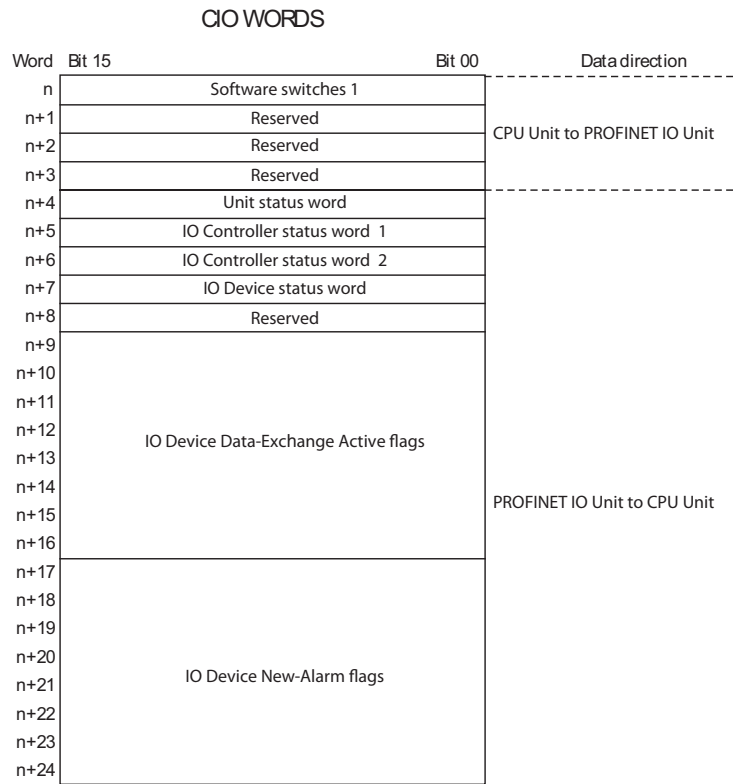


Figure 5.2: CIO words

CIO Word n+1 to n+3 and CIO Word n+8 are reserved for future use, and can't be used because the CJ1W-PNT21 clears these words every PLC cycle. The other CIO Words are explained in the following sections.

### 5-2-1 Software Switches 1 (Word n)

The switches of Software Switch 1 execute a function when turned ON by the user (in any PLC mode). The Unit state is not restored after a Power-Down of the PLC.

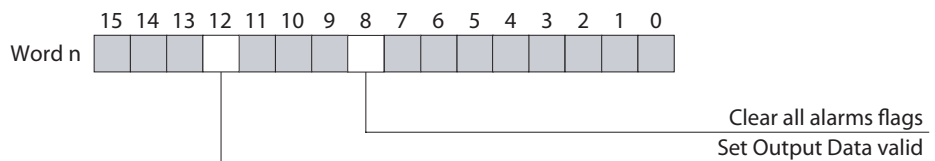


Figure 5.3: Word n

Bit	Name	Status	Unit operation
01~07	Reserved	---	These bits are ignored in the unit. If set, they will be turned OFF by the Unit the next PLC cycle.
08	Clear all alarm bits	The clear alarm bits switch will clear all alarm flags for all IODs. It is rising edge triggered. The unit will set the switch to OFF when all alarm flags are cleared.	
		OFF --> ON	Clear alarm bits for all IODs.
		ON --> OFF	No action.
09~11	Reserved	---	These bits are ignored in the unit. If set, they will be turned OFF by the Unit the next PLC cycle.
12	Set Output Data Valid (See Note)	OFF	Mark all output data sent by the IO Controller as invalid. IO Devices will ignore the data.
		ON	Mark all output data send by the IO Controller as valid. IO Devices will accept the data and process it.
13~15	Reserved	---	These bits are ignored in the unit. If set, they will be turned OFF by the Unit the next PLC cycle.

**Note** The Set Output Data Valid switch controls the Provider Status in the Output Data sent from the IO Controller to the IO Device. If the IO Device is receiving Output Data with the Provider Status bit set to invalid then the IO device will discard the Output Data. The Provider Status can be used in a redundant IO Controller setup where the Active IO Controller sends it Output Data with the Provider Status set to valid. The other IO Controller is then in Standby mode and has its Provider Status set to invalid. To change from Active to Standby and vice versa only the Set Output Data Valid switch must be set or reset. The IO Device will only use the output data that is valid. As there is no need to first open connections and sent configurations as this already has been done this change over is very fast. When the Output Data Valid flag is PLC mode dependent, the Output Data Valid flag in this word will be ignored. For more information see Appendix A PROFINET IO technology.

### 5-2-2 Unit Status (Word n+4)

The Unit status word contains fundamental status and error flags concerning the Unit. If needed, further details can be found in the IO Controller and IO Device Status Words. All flags are controlled by the Unit.

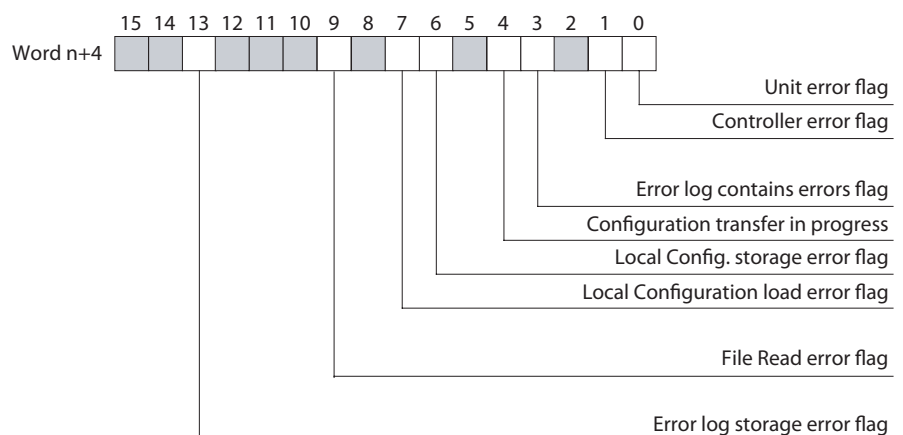


Figure 5.4: Word n+4

Bit	Name	Status	Unit operation
00	Unit error flag	OFF	Bit 00 is turned OFF by the Unit if Bit 01, Bit 03, Bit 06, Bit 07, Bit 09 and Bit 13 in CIO Word n+4 are OFF
		ON	The Unit error flag combines the status of all error flags in CIO Word n+4. The bit flag is turned ON by the Unit if Bit 01, Bit 03, Bit 06, Bit 07, Bit 09 or Bit 13 in CIO Word n+4 is ON.
01	Controller error flag	OFF	Bit 01 is turned OFF if none of the flags in Master status word 2, i.e. CIO Word n+6 is ON.
		ON	The Master error flag combines the error flags in the Master status 2 Word, i.e. CIO Word n+5. Master status word 2 contains all error flags related to the PROFINET IO Controller functions. Bit 01 is turned ON if any of the flags in IO Controller status word 2, i.e. CIO Word n+6 is ON
02	Reserved	---	This bit is always set to OFF by the Unit.
03	Error log contains new errors	OFF	The bit flag is set to OFF at unit restart or by the Unit if the error log is <ul style="list-style-type: none"> <li>cleared using the ERROR LOG CLEAR FINS command, or</li> <li>read, using the ERROR LOG READ FINS command</li> </ul>
		ON	The bit flag is set to On by the Unit if a new error is added to the error log.
04	Parameter transfer in progress	OFF	When OFF, this bit indicates that no Configuration data transfer is in progress.
		ON	The Parameter transfer in progress indicates: <ul style="list-style-type: none"> <li>Retrieval of internally stored configuration and set-up data.</li> <li>Storing of configuration and set-up data sent by the configuration software in progress.</li> </ul> <p>During this transfer no other transfer of data can be started in parallel.</p>
05	Reserved by system	---	This bit will be set to OFF by the Unit.
06	Local parameter storage error	OFF	When OFF, this bit indicates that the Configuration and setup data has been transferred to the non-volatile memory successfully.
		ON	The local parameter storage error flag will be ON if an error occurred during the storage of the data transferred from the configuration software to the CJ1W-PNT21.nal non-volatile memory. If the error occurred, the data in the non-volatile memory may be corrupted and a new Configuration must be downloaded to the Unit.



Bit	Name	Status	Unit operation
07	Local parameter load error	OFF	The flag will be OFF if the Configuration and setup data has been successfully transferred from non-volatile to volatile memory.
		ON	The Local parameter load error flag will be ON if the internally stored Configuration and setup data is corrupted or erased.
08	Reserved	---	This bit will be set to OFF by the Unit.
09	File read error	OFF	The flag will be OFF if the Configuration and setup data has been successfully transferred from Compact Flash Memory Card in the PLC CPU.
		ON	The File read error flag will be ON if an error occurred during the transfer of the Configuration and setup data from a Compatibles Memory Card in the PLC CPU to the Unit's non-volatile memory. The error can be caused by an error in the File or an error during transfer.
10~12	Reserved	---	This bit will be set to OFF by the Unit.
13	Error log storage error	OFF	When OFF, this bit indicates that the Error log has been transferred to the non-volatile memory successfully.
		ON	The Error log storage error flag will be ON if an error occurred during an attempt to write the Error log to internal non-volatile memory. If the error occurred, the Error log data in the non-volatile memory may be corrupted. Upon a restart the Unit will re-initialise the Error log.
14~15	Reserved	---	This bit will be set to OFF by the Unit.

### 5-2-3 IO Controller status 1 (Word n+5)

The 'IO Controller status 1' word provides all status information related to the CJ1W-PNT21 PROFINET IO Controller function. Any errors in the behaviour of the CJ1W-PNT21 are presented in the 'IO Controller status 2' word.

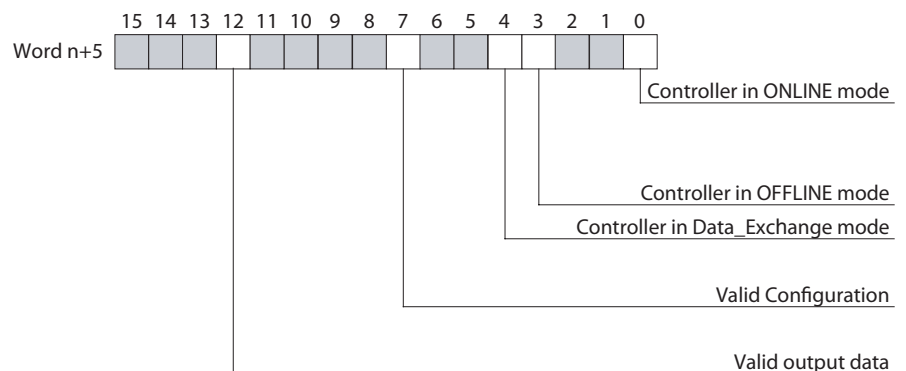


Figure 5.5: Word n+5

Bit	Name	Status	Unit operation
00	Controller in ONLINE mode	The Controller in ONLINE mode flag will be ON if the CJ1W-PNT21 is in ONLINE mode. In this case bit 03 will be OFF. ONLINE means that the CJ1W-PNT21 is currently capable of communicating on the network. The unit can not communicate on the network if hardware errors occur during startup or normal operation.	
		OFF	Unit is currently not in ONLINE mode
		ON	Unit is currently in ONLINE mode.
01~02	Reserved	---	This bit will be set to OFF by the Unit.
03	Controller in OFFLINE mode	The Controller in OFFLINE mode flag will be ON if the CJ1W-PNT21 is in OFFLINE mode. In this case bit 00 will be turned OFF. OFFLINE means that the CJ1W-PNT21 is currently not capable of communicating on the network. The unit can not communicate on the network if hardware errors occur during startup or normal operation.	
		OFF	Unit is currently not in OFFLINE mode.
		ON	Unit is currently in OFFLINE mode.
04	Controller in Data Exchange mode.	If the CJ1W-PNT21 is receiving valid input data from at least one of its allocated active IO Devices, this flag will be ON. If none of the IO Devices is providing valid input data to the CJ1W-PNT21 this flag will be OFF.	
		OFF	None of the IO Devices is providing valid input data to the Unit.
		ON	At least one of the IO Devices is providing valid input data to the Unit.
05~06	Reserved	---	This bit will be set to OFF by the Unit.
07	Unit contains a valid configuration	This flag indicates that the Unit contains valid PROFINET IO Configuration data. With this Configuration data the IO Controller can parameterize the allocated IO Devices and start exchanging IO data.	
		OFF	The unit has not been configured (correctly).
		ON	The Unit is able to use the internally stored configuration data.
08~11	Reserved	---	This bit will be set to OFF by the Unit.
12	Valid output data	This flag indicates whether or not the data sent to the IO Devices is currently marked as valid.	
		OFF	The data sent to the IO Devices is marked as invalid.
		ON	The data sent to the IO Devices is marked as valid.
13~15	Reserved	---	This bit will be set to OFF by the Unit.

#### 5-2-4 IO Controller status 2 (Word n+6)

The 'IO Controller status 2' word combines all error information on the CJ1W-PNT21 PROFINET IO Controller function. The status information is provided in the 'IO Controller status 1' word.

Contents of the 'IO Controller status 2' word (Word n+6):

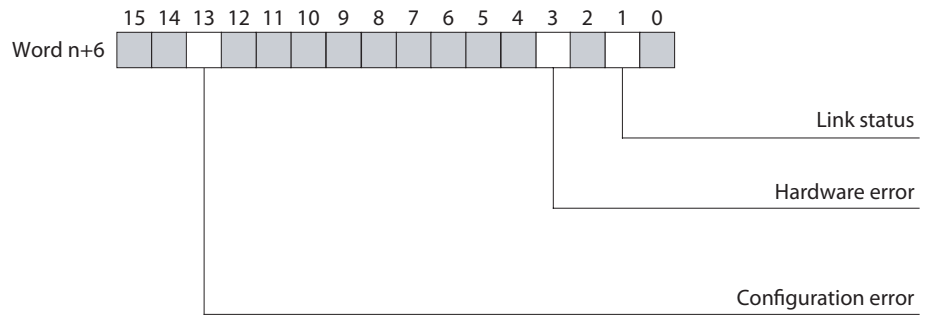


Figure 5.6: Word n+6

Bit	Name	Status	Unit operation
00	Reserved	---	This bit will be set to OFF by the Unit.
01	Link status	The Ethernet Link status of the IO Controller is shown here. If the Unit can not establish a link with another device at 100Mbps full-duplex then this bit will be set.	
		OFF	There is an Ethernet cable connected to the port of the IO Controller and a link was successfully created to an IO Device, switch or other Ethernet device.
		ON	There is no Ethernet cable connected to the port of the IO Controller or a link could not successfully created to an IO Device, switch or other Ethernet device.
02	Reserved	---	This bit will be set to OFF by the Unit.
03	Hardware error	The Hardware error flag will be ON if an error has occurred on the bus, e.g. faults when accessing the Ethernet controller or interrupted data streams, and broken messages.	
		OFF	No hardware errors have occurred.
		ON	Hardware errors have occurred.
04~12	Reserved	---	This bit will be set to OFF by the Unit.
13	Configuration error	The Configuration error flag will be turned to ON if an error has been detected in the contents of the Configuration set.	
		OFF	No Configuration error has been detected.
		ON	One or more Configuration errors have been detected.
14~15	Reserved	---	This bit will be set to OFF by the Unit.

### 5-2-5 IO Device status (Word n+7)

The IO Device status word presents all information on the IO Devices allocated to the CJ1W-PNT21 Controller. Detailed information on the IO Devices can be obtained by reading the alarm messages. Contents of the 'IO Device status' word (Word n+7):

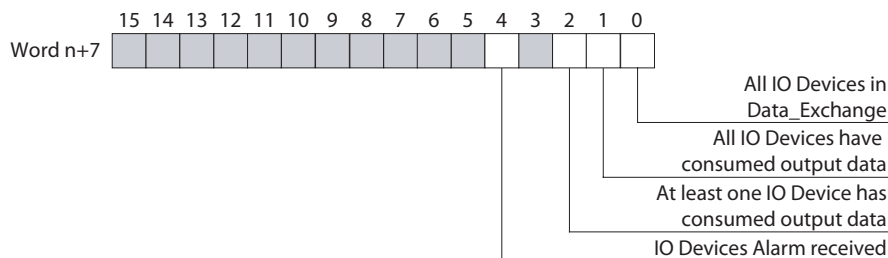


Figure 5.7: Word n+7

Bit	Name	Status	Unit operation
00	All IO Devices are in Data Exchange	If all Active IO Devices allocated to the CJ1W-PNT21 provide valid input data, this flag will be ON. If one of the IO Devices does not provide data or its data is marked as invalid, this flag will be OFF.	
		OFF	<ul style="list-style-type: none"> <li>CJ1W-PNT21 does not receive data from one or more IO Devices</li> <li>CJ1W-PNT21 receives invalid input data from one or more IO Devices</li> </ul>
		ON	CJ1W-PNT21 receiving valid data from all IO Devices.
01	All IO Devices have consumed output data.	If all IO Devices allocated to the CJ1W-PNT21 have processed the sent output data, this flag will be ON. If one of the IO Devices does not process output data this bit will be OFF.	
		OFF	One or more IO Devices have not processed the sent output data.
		ON	All IO Devices have processed the sent output data.
02	At least one IO Device has consumed output data	If at least one of the IO Devices allocated to this IOC has processed the sent output data this flag will be ON. If none of the IO Devices has processed the sent output data this flag will be OFF.	
		OFF	None of the IO Devices have processed the sent output data
		ON	At least one of the IO Devices has processed the sent output data.
03	Reserved	---	This bit will be set to OFF by the Unit.
04	IO Device Alarm received	If an IO Device Alarm has been received by the IO Controller this flag will be ON. It will be OFF if all alarms have been read or cleared.	
		OFF	No new IO Device Alarms have been received.
		ON	One or more new IO Device Alarms have been received.
05~15	Reserved	---	This bit will be set to OFF by the Unit.

### 5-2-6 IO Device Input Valid flags (Word n+9 ~ Word n+16)


The IO Device Data Exchange Active flags indicate for each IO device if it is in Data Exchange mode with the PROFINET IO Controller Unit. The flags are allocated to a block of eight CIO words, and each bit in the block corresponds to a IO Device number as set in the DTM (IO Device Setup tab).

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Word n+9	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	IO Device 01 ~ 15
Word n+10	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	IO Device 16 ~ 31
Word n+11	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	IO Device 32 ~ 47
Word n+12	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	IO Device 48 ~ 63
Word n+13	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64	IO Device 64 ~ 79
Word n+14	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	IO Device 80 ~ 95
Word n+15	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	96	IO Device 96 ~ 111
Word n+16		126	125	124	123	122	121	120	119	118	117	116	115	114	113	112	IO Device 112 ~ 126

Figure 5.8: Word n+9 ~ Word n+16

Bit	Name	Status	Unit operation
01~126	IO Device Input Data Valid	When an IO Device is in Data Exchange with the PROFINET IO Controller Unit to which it has been allocated, it will exchange input and output data with the allocated memory of the PLC CPU.	
		OFF	The IO Controller is not in Data Exchange with the IO Device due to the fact that: <ul style="list-style-type: none"> <li>the corresponding station does not provide data at all.</li> <li>the corresponding station's inputs are invalid.</li> <li>the corresponding station is (another) IO Controller station.</li> <li>the corresponding station is not allocated to this IO Controller.</li> </ul>
		ON	The corresponding station is in Data Exchange with valid inputs.

**Note** The bits for station 0 and 127 are not used.

 **WARNING** ALWAYS make sure the IO Device Data Exchange Active flag is ON before processing the slave's input data. The last data from the slave will remain in the PLC memory if data exchange is stopped,

**5-2-7 IO Device New Alarm flags (Word n+17 ~ Word n+25)**

The IO Device New Alarm flags indicate for each IO device if it has sent a new alarm message to the PROFINET IO Controller Unit. The flags are allocated to a block of eight CIO words, and each bit in the block corresponds to the IO Device number as set in the DTM (IO Device Setup tab).

The New Alarm flag indicates that alarm information should be read with FINS 0101 to retrieve the alarm data and clear the Alarm flag.

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Word n+17	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	IO Device 01 ~ 15
Word n+18	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	IO Device 16 ~ 31
Word n+19	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	IO Device 32 ~ 47
Word n+20	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	IO Device 48 ~ 63
Word n+21	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64	IO Device 64 ~ 79
Word n+22	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	IO Device 80 ~ 95
Word n+23	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	96	IO Device 96 ~ 111
Word n+24		126	125	124	123	122	121	120	119	118	117	116	115	114	113	112	IO Device 112 ~ 126

Figure 5.9: Word n+17 ~ Word n+25

Bit	Name	Status	Unit operation
01~126	IO Device New Alarm	Each bit indicates if the corresponding IO Device has sent new alarm information to the CJ1W-PNT21.	
		OFF	The corresponding IO Device has no new alarm data.
		ON	The corresponding IO Device has sent new alarm information which should be read by the user with FINS 0101. Failing to do so may cause the alarm data to be over written should the device generate another alarm. Alternatively, the New Alarm flag can be cleared using the IO Controller DTM Diagnostics view.

## SECTION 6 FINS Commands and Responses

This section describes the FINS message service communications commands concept as well as the commands supported by the CJ1W-PNT21 PROFINET IO Controller Units.

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## 6-1 FINS Commands and Responses

### 6-1-1 FINS Message Service Communications

**FINS**

FINS (Factory Intelligent Network Services) commands are message service communications commands developed by OMRON for Factory Automation control devices. They do not depend on a particular transmission path, and can be used for reading from and writing to PLC memory or the Unit’s memory, sending or receiving acyclic messages over a network, or for controlling various operations.

The FINS communications can be issued from a CPU Unit, Special I/O Unit, or host computer, and they can also be sent to any of these. The specific commands that can be sent depend on the destination.

When the source of the commands is a PLC CPU Unit, the FINS commands are sent by means of CMND(490). For details on FINS commands, refer to the *Communications Commands Reference Manual (W342)*.

The CJ1W-PNT21 PROFINET IO Controller Units support two types of FINS messages:

- 1 FINS commands targeted at the Unit itself, with the purpose of sending or retrieving data or invoking control actions.
- 2 Facilitating the transfer of FINS commands to or from the PROFINET IO Network. This is known as FINS routing.

The figure below depicts the FINS command structure for the CJ1W-PNT21 PROFINET IO Controller units.

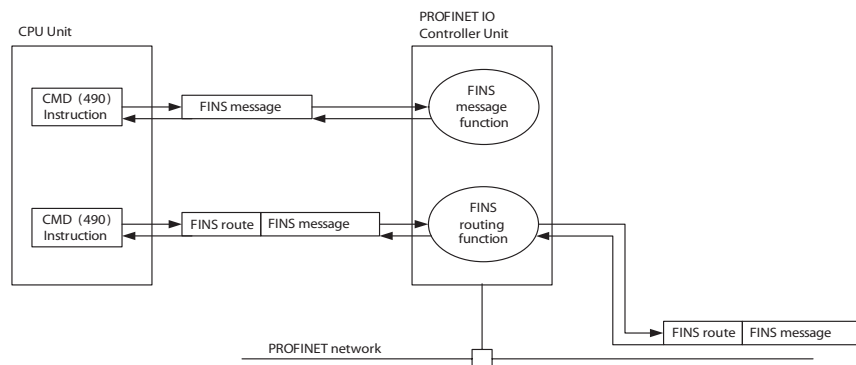


Figure 6-1:FINS command structure

FINS messages are defined through their command and response codes.

**Command Codes**

Command codes are represented by a 2-byte hexadecimal code. FINS commands always begin with a 2-byte command code; any parameters required follow the command code.

**Response Codes**

The response code consists of a 2-byte hexadecimal code indicating the results of command execution. The first byte provides the main response code (MRES), which classifies the results, the second byte provides the sub-response code (SRES), which contains details about the results.

### 6-1-2 Command Code List

The command codes listed in the following table are supported by the PROFINET IO Controller Unit. A PLC program can send these to the Unit.



Command code		Name
MRC	SRC	
01	01	MEMORY AREA READ
21	02	ERROR LOG READ
	03	ERROR LOG CLEAR

### 6-1-3 Response Code List

Response codes are 2-byte codes which indicate the results of command execution. They are returned in the response following the command code. The first byte of a response code is the MRES (main response code), which categorizes the results of command execution. The second byte is the SRES (sub-response code) which specifies the results.

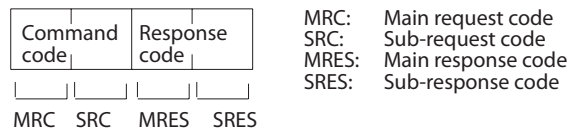


Figure 6.2: Response code

The MRES codes are shown in the following table along with the results they indicate. Refer to *Communications Commands Reference Manual (W342)* for details on response codes including the SRES.

MRES	Execution results
00	Normal completion
01	Master Unit error
02	Slave device error
04	Service not supported
10	Command format error
11	Parameter error
20	Read not possible
22	Status error

**Note** The MRES codes are shown in the following table along with the results they indicate. Refer to *Communications Commands Reference Manual (W342)* for details on response codes including the SRES.

### 6-1-4 Sending FINS using CMND

The CMND instruction can be executed from the user program in a CS/CJ-series PLC. CMND sends “n” bytes of command data beginning with S (the beginning send word for storing command data at the source node) to destination node N. In return, “m” bytes of response data are stored at the source node beginning with D (the beginning receive word for storing response data)

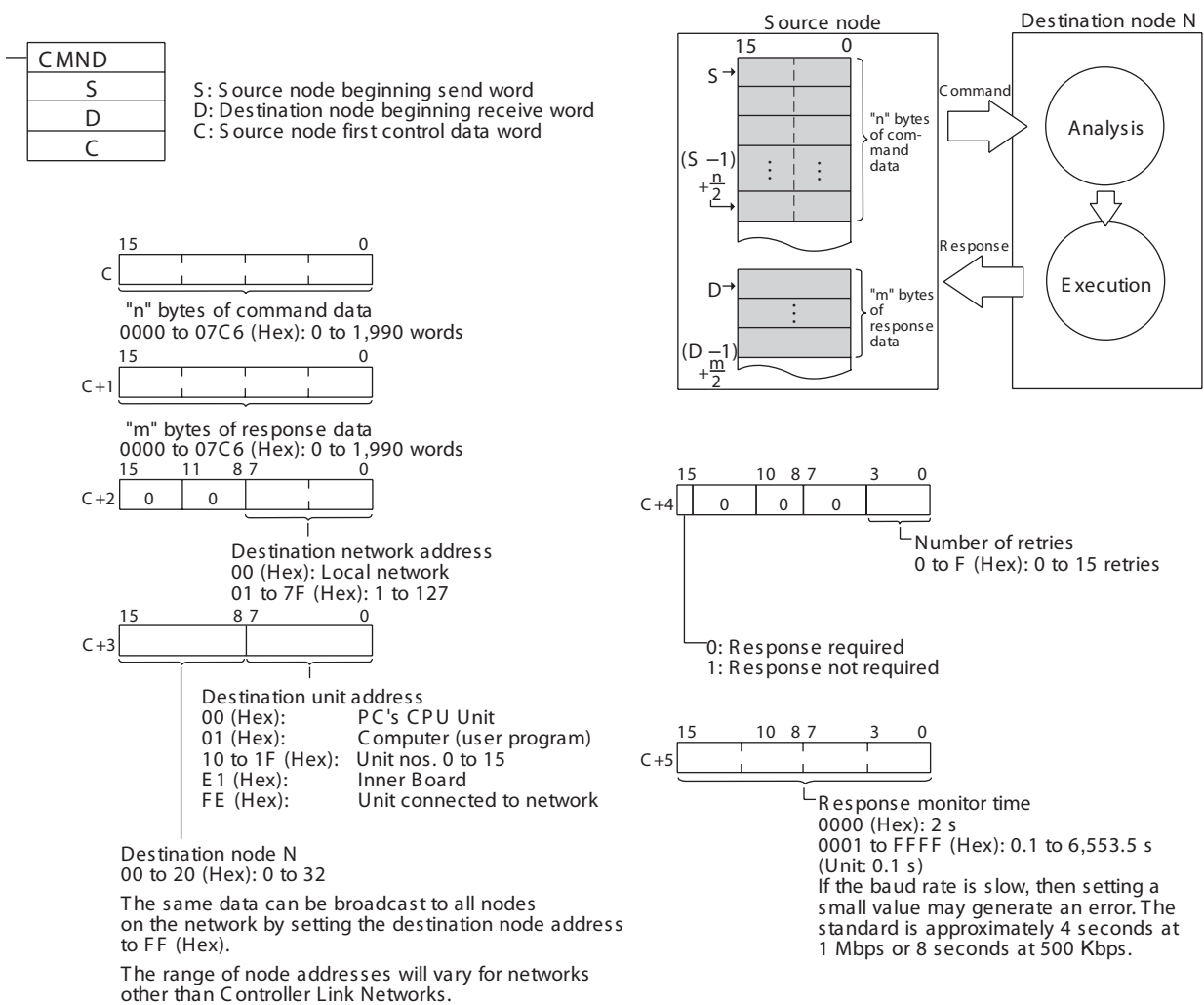


Figure 6.3: CMND instruction

**Note** With the message service, there is no guarantee that a message to a destination node will reach its destination. It is always possible that the message may be lost in transit due to noise or some other condition. When using the message service, it is advisable to prevent this situation from occurring by performing resent processing at the node where instructions are issued. With the CMND instruction, resent processing is performed automatically once the number of retries has been set, so be sure to specify a number other than "0" for the number of retries.

## 6-2 Command / Response Reference

This section describes the FINS commands that can be sent to the PROFINET IO Controller Units and the responses to each command.

The command, response, and (where applicable) the results storage blocks are given with the commands in graphic form as shown in the following diagram. If the data is fixed, it is included in the blocks. If the data is variable, it is described following the blocks. Each box represents 1 byte; two boxes represent 1 word. The following diagram shows 2 bytes, or 1 word

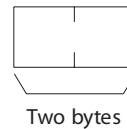


Figure 6.4: Storage block

Response codes applicable to the command are described at the end of the command description.

**Note** If the FINS command was not completed normally, the 2-byte Response code will be unequal 0000, and the Response frame will not contain any further data. Data can only be returned - depending on the command - when the Response code is 0000.

### 6-2-1 MEMORY AREA READ (0101)

The MEMORY AREA READ command is used to read the last Alarm data message the PROFINET IO Controller Unit received from the specified IO Device. The command frame requires three byte data type specifier, specifying the information, and one byte specifying the slave device address.

#### Command Format

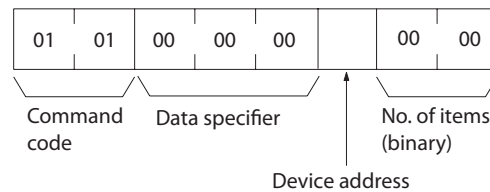


Figure 6.5: Memory Area Read command

#### Response Format

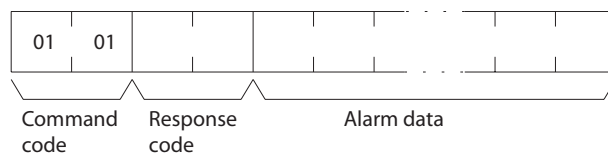


Figure 6.6: Memory Area Read response

#### Parameters

Data specifier code (command)

Defines the data to be retrieved from the Unit. Always set to 00 00 00 (Hex).

Device address (command)

Defines the IO Device's FINS network address. Set to 00 ~ 7D (Hex).

Number of items to read (command)

Defines the number of bytes to read. Set to 00 00 (Hex).

**Response Codes**

The following end codes can be returned by the Unit in response to the MEMORY AREA READ command:

Response code	Description
0000	Normal completion
0101	IO Device not allocated to this CJ1W-PNT21
1001	Command length exceeded
1002	Command length to short
1101	Invalid I/O memory Area Code (non-specified code)
110C	Invalid Start Address code word (non specified code used), Invalid target IO Device FINS station address (exceeds 126).
0001	Status error

**FINS Address**

The FINS Address of a IO Device is the Device No. assigned in the IO Controller DTM, Configuration item, IO Device Setup sub item. The FINS address is used to determine the IO Device.

**6-2-2 Error Log Read (2102)**

Reads a specified number of error records from the error log.

**Command Format**

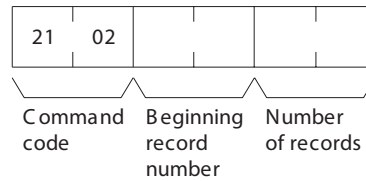


Figure 6.7: Error Log Read command

**Response Format**

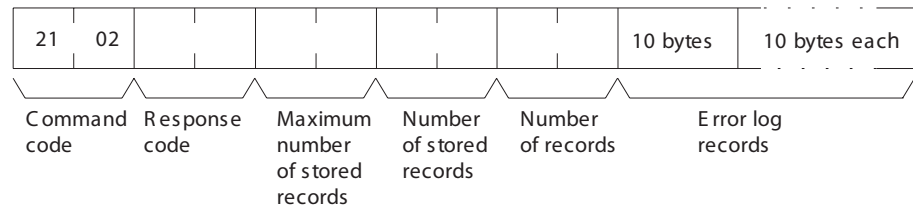


Figure 6.8: Error Log Read response

**Parameters**

First Record Number (Command)

The first record to be read. The first record number can be specified in the range between 0000 and 0050 (0 to 80 decimal) where 0000 is the oldest record in the Error Log, since the last performed ERROR LOG READ command.

Number of Records (Command, Response)

The number of records to read is specified between 0001 and 0050 (1 to 80 decimal) in the command. The response returns the actual number of records read.

Maximum Number of Stored Records (Response)

The maximum number of records that can be stored in the error log. In a PROFINET IO Controller Unit, the maximum number of stored records is fixed at 50 (80 decimal).

Number of Stored Records (Response)

The number of records stored at the time the command is executed.

Error Log Data (Response)

The specified number of error log records from the starting record number is returned in their order of appearance.

The total number of bytes in the error log is calculated as the number of records x 10 bytes/record. Each error log record thus consist of 10 bytes, configured as follows:

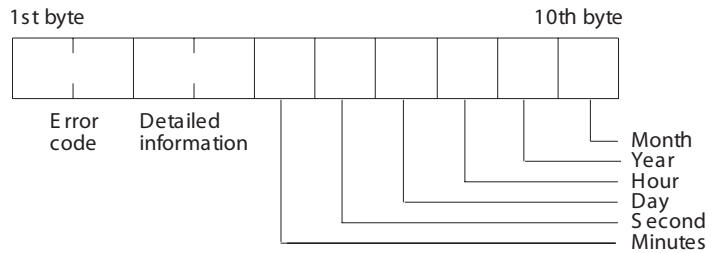


Figure 6.9: Error Log Data

Error Code, Detailed Information

Details of the error stored in the record. Refer to SECTION 7 Troubleshooting and Maintenance for details.

Minute, Second, Day, Hour, Year, Month

Indicate the time at which the error stored in the record occurred.

**Precautions**

The total number of records to be returned is either the number specified in the command, or the number of available new records in the Error Log, whichever is smaller.

If more than one record is read, the records are returned in a oldest-to-newer sequence, i.e. the oldest record is the first in the response message.

**Response Codes**

Response code	Description
0000	Normal completion
1001	Command length exceeded
1002	Command length too short
1103	Beginning record number is out of range
110C	The number of read records is 0

**6-2-3 Error Log Clear (2103)**

Clears the number of records stored in the PROFINET IO Controller Unit error log

**Command Format**

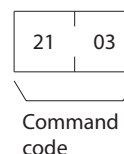


Figure 6.10: Error Log Clear command

**Response Format**

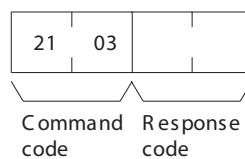


Figure 6.11: Error Log Clear response

**Response Codes**

<b>Response code</b>	<b>Description</b>
0000	Normal completion
250F	Memory writing error. Error Log was not cleared normally.
260B	Can not clear the Error Log. The error cause still exists.

### 6-3 FINS Routing

The CJ1W-PNT21 PROFINET IO Controller not only supports PROFINET IO Communication but also the Omron FINS communication to transfer FINS commands.

FINS commands are message service communications commands. They do not depend on a particular transmission path. They can be used for communications on various networks (Controller Link, Ethernet, etc.) and for serial communications (Host Link). They can be issued from a CPU Unit, Special I/O Unit, or host computer, and they can also be sent to any of these. The specific commands that can be sent depend on the destination. For more information refer to *Communications Commands Reference Manual (W342)*

The FINS communication supported by the CJ1W-PNT21 PROFINET IO Controller is UDP/IP. Also known as the FINS/UDP or the Ethernet connection. Over this FINS/UDP connection for example a HMI terminal can communicate to the PLC to read and write PLC memory.

Also from the PLC program FINS commands can be sent with the CMND command to other PLC's or devices on the network.

An example are the parameters in the SmartSlice Units connected to a GRT1-PNT SmartSlice PROFINET IO Device. The command code to get or set parameters is 2801. For more information refer to *GRT1-PNT PROFINET IO Communication Unit (W13)*

The CJ1W-PNT21 uses the following rules for the FINS-address to IP-address translation when routing FINS commands onto the Ethernet network.

**IO Device Number**

- The FINS-address is compared to the IO Device numbers configured for the IO Controller. Each IO Device number corresponds to an IP-address.

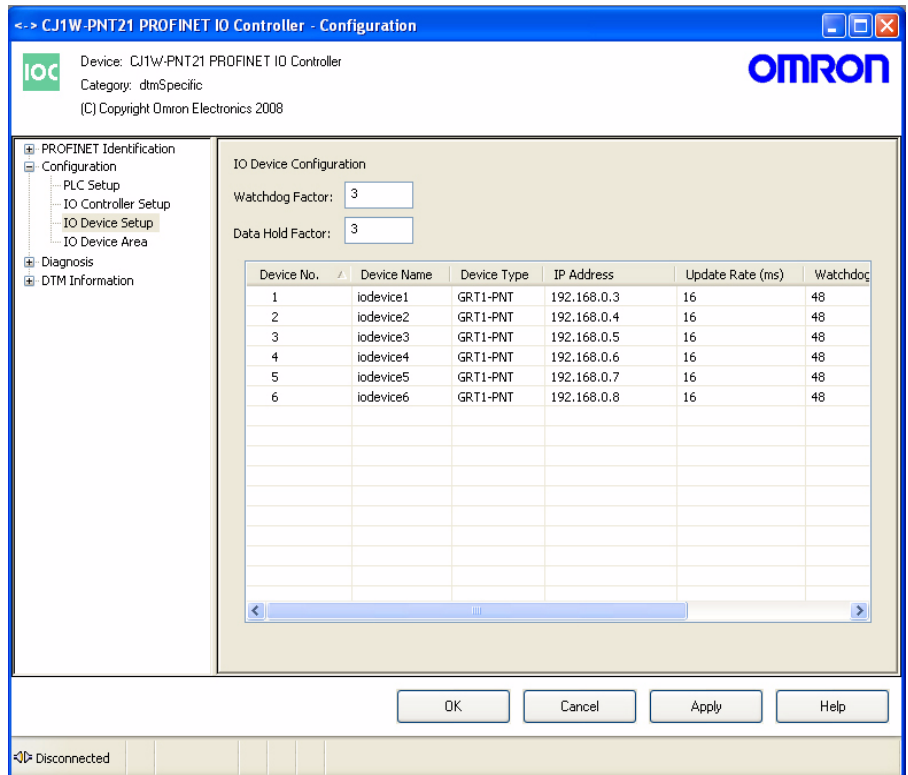


Figure 6.12: FINS Address IO Device

**FINS to TCP/IP Address**

- The FINS address is replacing the last octet of the PROFINET IO Controller's own IP-address. If the IO Controller has the IP-address 192.168.1.5 and the FINS destination address is 45 then the destination IP-address will be 192.168.1.45.

**Address Range**

The order of determining the IP-address from the FINS-address is first IO Device Numbering and then the replacement of the last octet of the IO Controller's own IP-address. The PROFINET IO Controller does not hold an address translation table. As the highest FINS address is 127 and the maximum amount of IO Devices supported is 126 the highest IP-address that can be addressed is 127.

In the example above the highest IP-address is 192.168.1.127.

**Performance**

The CJ1W-PNT21 PROFINET IO Controller's main task is PROFINET IO communication. The FINS communication is performed as a low priority task. This means that the FINS communication performance is low. Also the IO Controller can only handle one FINS-message at a time. Therefore if multiple devices will address the IO Controller at the same time over FINS/UDP then some of them will not be serviced.



## **SECTION 7 Operation**

This section describes how to operate the CJ1W-PNT21 PROFNET IO Controller Unit in a Network. It will discuss setting up a network, configuring all the connected devices and starting the network. Furthermore, it provides information the I/O data exchange performance and it also provides information on how to monitor a network, using the Unit and CX-ConfiguratorFDT.

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## 7-1 Introduction

This section discusses the operational aspects of using the PROFINET IO Controller Unit and the configuration software. The section has been setup, to follow the general process flow of setting up and configuring a network, downloading the configuration, and operating the PROFINET IO network.

### Example

To illustrate the explanations, examples are marked with the word Example in the side line.

## 7-2 Setting up a Network

### Start CX-ConfiguratorFDT

Setting up a network involves setting up a configuration in CX-ConfiguratorFDT and downloading it to the PROFINET IO Controller Unit. To start CX-ConfiguratorFDT, select **Program, OMRON, and CX-ConfiguratorFDT**, from the Start Menu if the default program folder name is used

CX-ConfiguratorFDT will now start, displaying the main window, as shown below:

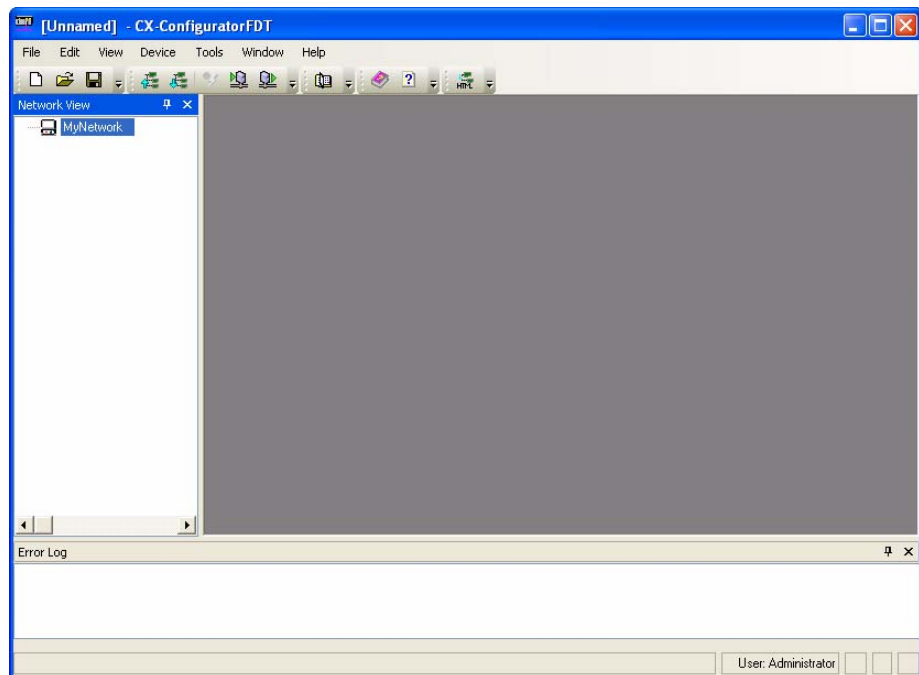


Figure 7.1: CX-ConfiguratorFDT

Before starting the assembly of the network in CX-ConfiguratorFDT, make the following preparation steps.

- 1,2,3... 1 Open the Device Catalogue: Either select the View - Device Catalogue menu option, or press the Device Catalogue button in the Tool Bar. The opened Device Catalogue is shown below

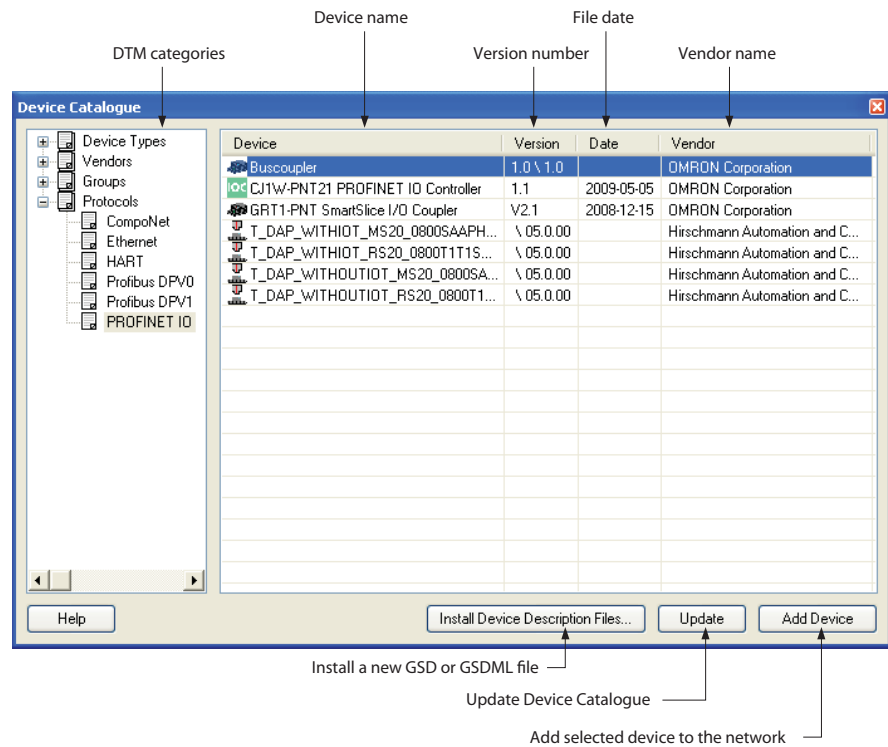


Figure 7.2: Device catalogue

- 2 Check the list of available DTMs, and verify that all the devices that need to be added to the Network - both IO Controllers and IO Devices - are among the DTMs in the list.
- 3 If one or more of the DTMs is missing, these DTMs must first be installed and the Device Catalogue updated.

**Note**

- 1 Non-GSDML file based DTMs are usually provided with their own setup program. Installation of these DTMs must be performed outside CX-ConfiguratorFDT, e.g. from **Windows Explorer**.
- 2 In case of DTM installations outside CX-ConfiguratorFDT, always initiate an update of the Device Catalogue, before assembling a network. Without this update the newly installed DTM will not appear in the list of devices. To **Update** the Device Catalogue, press the Update button in the Device Catalogue main window.
- 3 An Update must also be performed when an already existing DTM is upgraded. Without the update, the old version number will still be shown in the list. Failure to update the Device Catalogue in this case may also result in undesired behaviour, when adding these DTMs to the Network.

**Installing New GSDML Files**

GSDML files can be installed from within the Device Catalogue main window. To do so, follow the procedure below.

- 1,2,3... 1 Press the **Install Device Description File...** button at the bottom of the Device Catalogue main window (refer to figure above). The standard windows **File - Open** window will be displayed.
- 2 In the **File - Open** window browse to the sub-directory containing the GSDML file, select the (one or more) GSDML file(s) and press the **Open** button in the window. The GSDML file(s) will be copied to a sub-directory of the CX-ConfiguratorFDT directory.
- 3 After completing the copy, a window will be displayed, asking the user permission for an update of the Device Catalogue (see figure below). If more GSD files need to be installed, select the **No** button and continue with installation of GSD file. Otherwise, select the **Yes** button.



Figure 7.3: Update Device catalogue

**Note** Updating the Device Catalogue may take several minutes, depending on the number of installed DTMs and Device Description files.

### 7-2-1 Adding Devices to the Network

If the Device Catalogue is up to date, it can be used to setup the network. Setting up a network in CX-ConfiguratorFDT starts with adding single device DTMs to the Network view. First the CJ1W-PNT21 IO Controller DTM must be added to the main branch of the project Network. To do so, one of three procedures as outlined below must be used to add the DTM.

#### Using the Context Menu

- 1,2,3... 1 Select the top of the network to which the DTM must be added, i.e. select **MyNetwork** in the Network view.
- 2 Right click the mouse and a context menu will be displayed.
- 3 From the menu select **Add Device**.
- 4 A simplified Device Catalogue is displayed. The list only contains the devices which can be inserted at the selected network location (see figure below, only Master devices are listed).

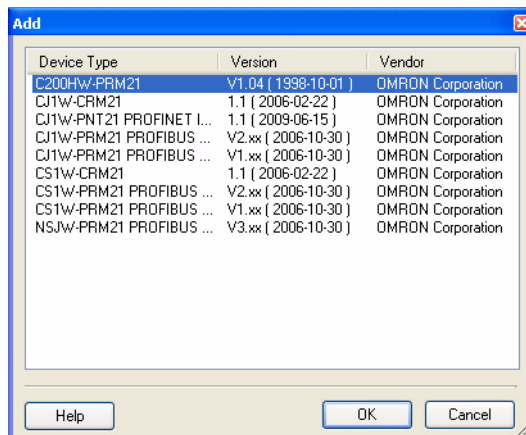


Figure 7.4: Add device

- 5 From the displayed list, select the device DTM to be added and select the **OK** button. The Device DTM will be added to the network

**Using Drag & Drop**

- 1,2,3... 1 Open the Device Catalogue: Either select the **View - Device Catalogue** menu option, or press the Device Catalogue button in the Tool Bar.
- 2 Select a device DTM in the Device Catalogue.
- 3 Left click the mouse and Drag the mouse pointer to the desired location in the network, i.e. **MyNetwork** in the Network view.
- 4 Release the mouse button and the device DTM will be added to that location.

**Note** Master DTMs can only be added to the main branch of the Network. Slave Device DTMs can only be added to Master DTMs. Whether or not a DTM can be added to the branch is indicated by the cursor: indicates no addition, indicates that addition is allowed

**Using the Add Device Button**

- 1,2,3... 1 Select the top of the network to which the DTM must be added, i.e. select **MyNetwork** in the Network view.
- 2 Open the Device Catalogue: Either select the **View - Device Catalogue** menu option, or press the Device Catalogue button in the Tool Bar
- 3 Select the device that must be added to the network.
- 4 Select the **Add Device** button at the bottom of the Device Catalogue window. The device DTM is added to the network.

**Note** If a DTM is selected in the Device Catalogue, which can not be added to the current location in the network, the **Add Device** button will be disabled, which is shown as a greyed out button.

**Note** When adding a CJ1W-PNT21 IO Controller DTM to the network, it is automatically assigned the IP address 192.168.0.100. This address can be changed, after opening the CJ1W-PNY21 IO Controller DTM.

After adding the Master DTM to the Network view, repeat (one of) the procedures as outlined above to add slave DTMs to the Master DTM. In the procedures above, the highest level for adding slave DTMs is the Master DTM.

**Note** When adding IO Device DTMs to the CJ1W-PNT1 IO Controller DTM, they are automatically assigned their FINS and TCP/IP network addresses, in ascending order, i.e. the first IO Device is assigned FINS address 1 and IP address 192.168.0.1, the second gets FINS address 2 and IP address 192.168.0.2, etc. The addresses can be changed in the IO Controller DTM User Interface.

## 7-2-2 Setting IO Device Names

The PROFINET IO addressing is based on IO Device Naming. In order to achieve communication between the IO Controller Unit and its allocated IO Devices, the latter must have the same PROFINET Name set in the configuration as it is set in the IO Device. The PROFINET Name on the IO Devices is set by a specific tool. There are standalone tools but there is also on incorporated in the CJ1W-PNT21 PROFINET IO Controller DTM.

When opening the IO Controller DTM the first item show is the PROFINET identification with the Network Scan sub item.

See the picture below:

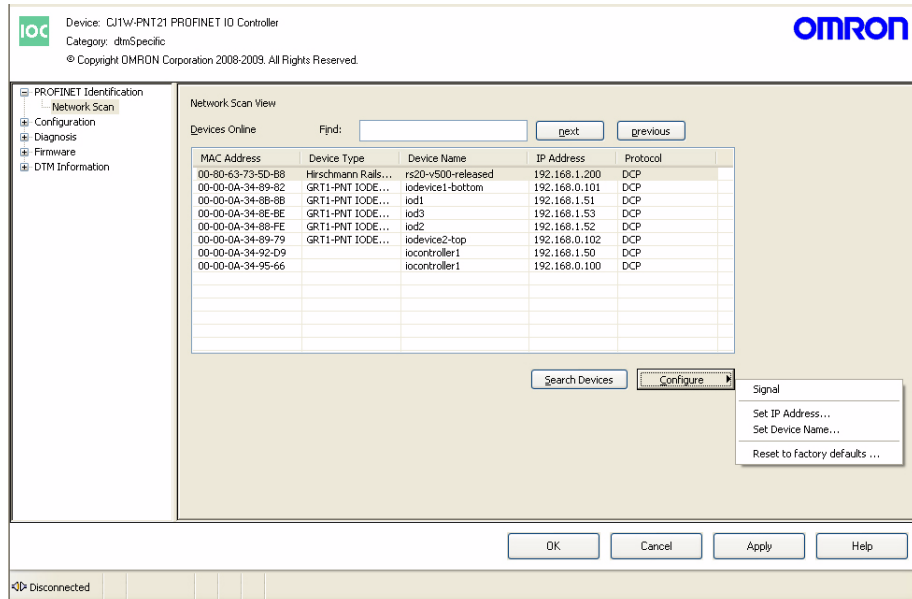


Figure 7.5: Network scan

**Searching Devices**

Pressing the **Search Device** button will let the PC search the connected Ethernet networks for PROFINET IO devices. Therefore the PC must have an Ethernet connection to the PROFINET network.

All PROFINET IO Controllers and IO Devices found will be shown with their:

- MAC Address, which is fixed by the in the device and makes it unique pm the Ethernet network.
- Device Type, is fixed by the Vendor and is often just the product name
- Device Name, is set by the user and is fixed in the device. This name is used by the IO Controller to find the IO Device before setting up connections.
- IP Address the device currently holds. It could be temporary or fixed but For an IO Device it will be over written by a value set in the configuration of the IO Controller.
- Protocol that is used to find the device.

**Configuring Devices**

The **Configure** button will display four other selections that can be performed on the selected PROFINET IO Controller or Device:

- **Signal** will let the LEDs of the selected device flash for 3 seconds. This is useful to physically find the device in the installation. When found the device can get a logical name.
- **Set IP Address...** will set the IP Address of the selected device. The IP Address can be fixed or temporary. But finally the IO Controller will over write the IP address when it establishes a connection to the IO Device. However a temporary IP-Address can come in handy when up- or downloading SmartSlice configurations with the GRT1-PNT PROFINET IO Device DTM when no IO Controller is available.
- **Set Device Name...** needs to be done because a IO Device needs to have a name. This is the only way a IO Controller can find an IO Device on the network. This same Device Name must be entered in the IO Controllers configuration.
- **Reset to factory defaults...** as the title suggests will reset the device to its factory defaults like default name and IP-address 0.0.0.0.

Setting a Device Name for an IO Device is the first action that must be done. If there is no match between the Device Name in the IO Device and what is in the configuration in the IO Controller then the IO Device will never be found by the IO Controller.

## 7-3 Configuring the IO Devices

After adding each of the IO Device DTMs to the network, configurations have to be selected for each of them. Setting up a configuration involves

- Selecting the proper I/O modules, which define the I/O data to be exchanged when operational.
- Setting up the device parameters, which will be send to the device to make or verify its settings.

All these settings will be downloaded to the IO Controller Unit, which will at startup send the data to the individual IO Devices over the PROFINET IO network.

### 7-3-1 Defining the I/O configuration

In order to define the I/O configuration, the DTM Configuration User Interface must be opened. To do this, either

- select the device in the Network view and double-click the left mouse button.
- select the device in the Network view, right click the mouse and select **Configuration** from the context menu.
- select the device in the Network view, select **Configuration** from the **Device** menu.

The DTM will now open a device configuration window. This window can differ per DTM and is targeted at the device to be configured.

In this section the configuration through GSDML files with the PROFINET IO Generic Device DTM is shown. For other DTMs refer to the documentation supplied by the vendor of the DTM and device.

#### Example

The figure below, shows the DTM User Interface for a GSDML file based device with PROFINET IO Generic Device DTM.

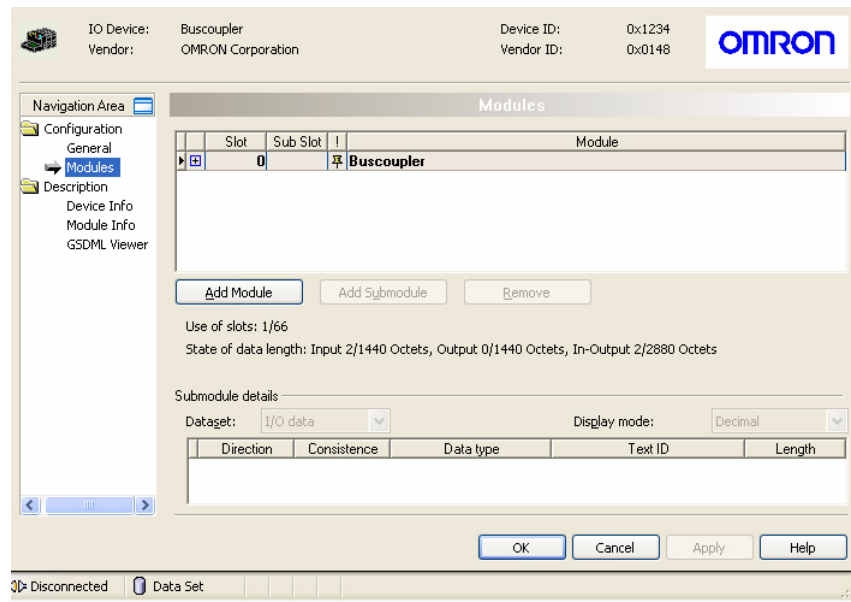


Figure 7.6: PROFINET IO Generic Device DTM

The DTM Configuration User Interface displays the following:



- The selected modules for this device. Modules can be added through the **Add Module** button.
- Details of the selected module. It is separated in I/O data and Parameters. If needed the Parameters are settable. Which ones is defined in the GSDML file.

**Adding/Inserting Modules**

By pressing the **Add Module** button a Module is added to the end of the Module list. The correct Module is select by a dropdownlist.

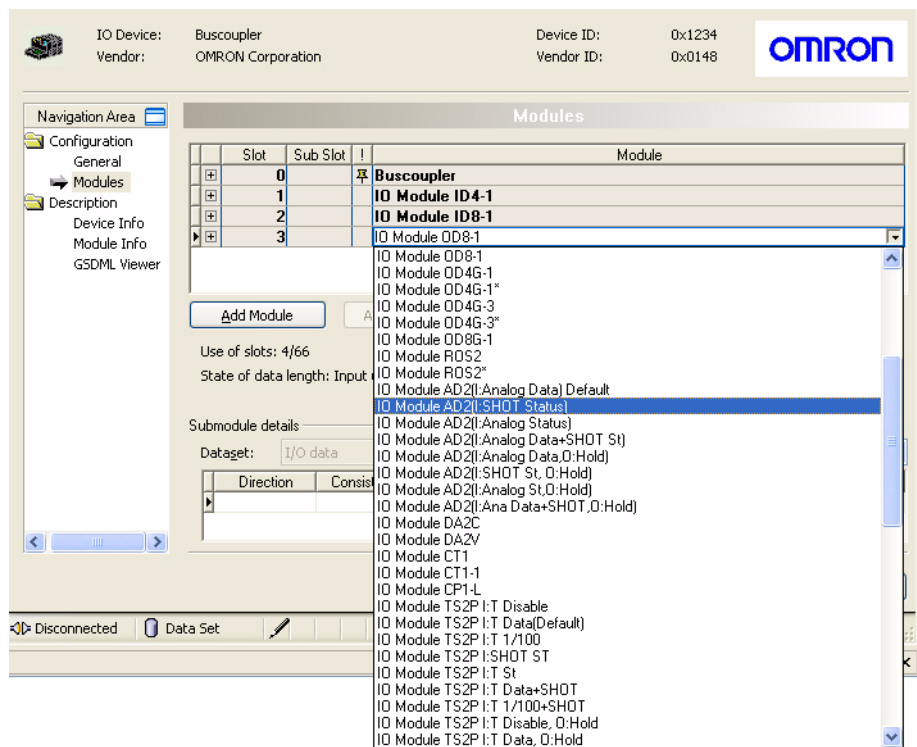


Figure 7.7: Add module

The correct order of the modules is selected by the slot number. A list of available slotnumbers is displayed. Select the correct slotnumber for the module.

**Note**

- 1 The selected I/O modules are sent to the IO Device, in the same sequence as selected in the user interface. Depending on the device, the sequence may be checked by the IO Device. If an incorrect sequence is sent, the I/O configuration is rejected. This is for example the case with the OMRON GRT1-PNT PROFINET IO Device
- 2 A mandatory I/O module sequence is sometimes indicated in the GSDML file, by using non-PROFINET standard GSDML file keywords (i.e. only interpreted by a specific configurator). The Generic IO Device DTM does not check such keywords. In this case, refer to the manual of the specific device for details.
- 3 Also in this window are the maximum values, which can be set, and the totals of I/O data that actually have been set. If - while selecting I/O modules - one of the maximum values is exceeded, a warning message will be displayed.

When done, making the I/O configuration settings, press the Apply button at the bottom of the window. Next, select the Parameters, to make the necessary parameter selections.

## 7-4 Configuring the IO Controller

### Opening the Master DTM Configuration Interface

After configuring all the slave DTMs, the CJ1W-PNT21 IO Controller DTM must be configured. In order to open the IO Controller DTM Configuration Interface do either one of the following.

- Select the CJ1W-PNT21 IO Controller DTM in the Network view and double-click the left mouse button.
- Select the CJ1W-PNT21 IO Controller DTM in the Network view, and right-click the mouse. From the context menu, select **Configuration**.
- Select the CJ1W-PNT21 IO Controller DTM in the Network view, and from the **Device** menu, select **Configuration**.

### 7-4-1 PLC Setup

The DTM Configuration User Interface is shown below.

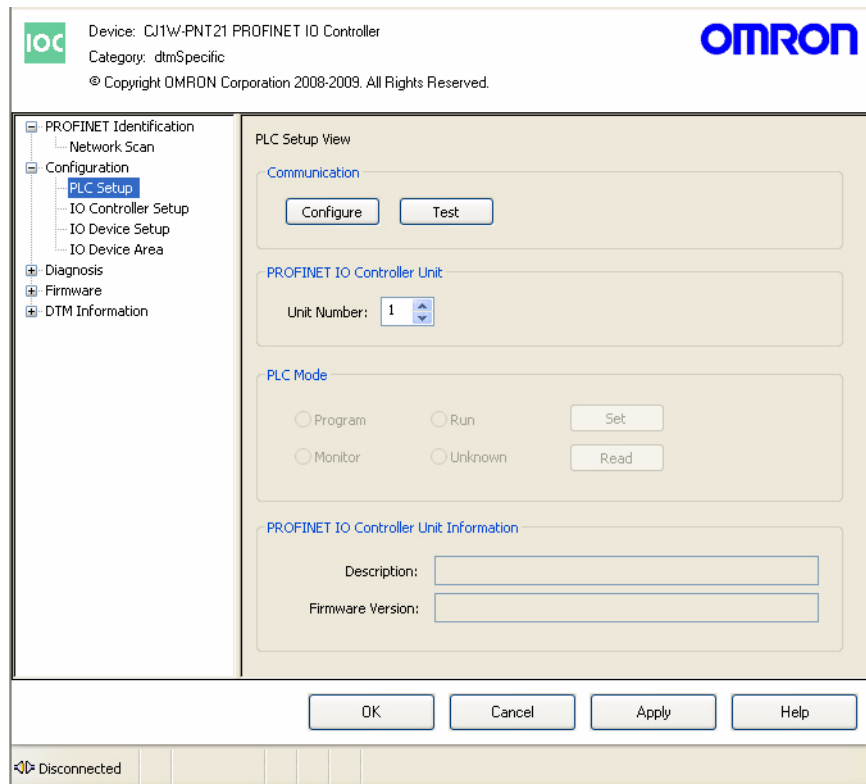


Figure 7.8: PLC Setup

### Communication

The communication path needs to be set to communicate with the IO Controller. By pressing the **Configure** button. The CX-Server configuration screen appears. Set the communication path and press the **Test** button to check if the IO Controller can be reached. The Description and the Firmware Version is displayed in the PROFINET IO Controller Unit Information.

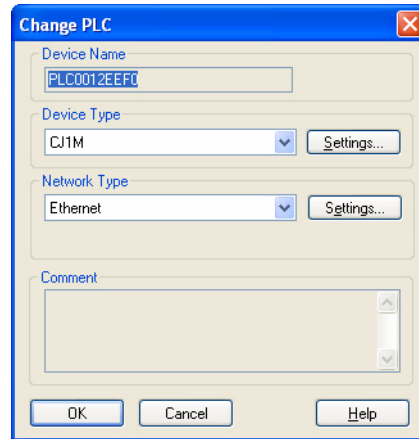


Figure 7.9 Communication setup

**Unit Number**

The setting of the unit number is required to setup communication with the Unit through CX-Server. The setting in the user interface must match the setting made with the rotary switch on the front of the Unit.

After making the changes, select the **Apply** button in the lower right corner of the user interface to accept the changes. Next select the IO Controller Setup item, to display the IO Controller Setup options.

**7-4-2 IO Controller Setup**

In the IO Controller setup the PROFINET Name and IP address are set, how addresses are assigned to added IO Devices and how the Valid/Invalid state of the Output Data is handled.

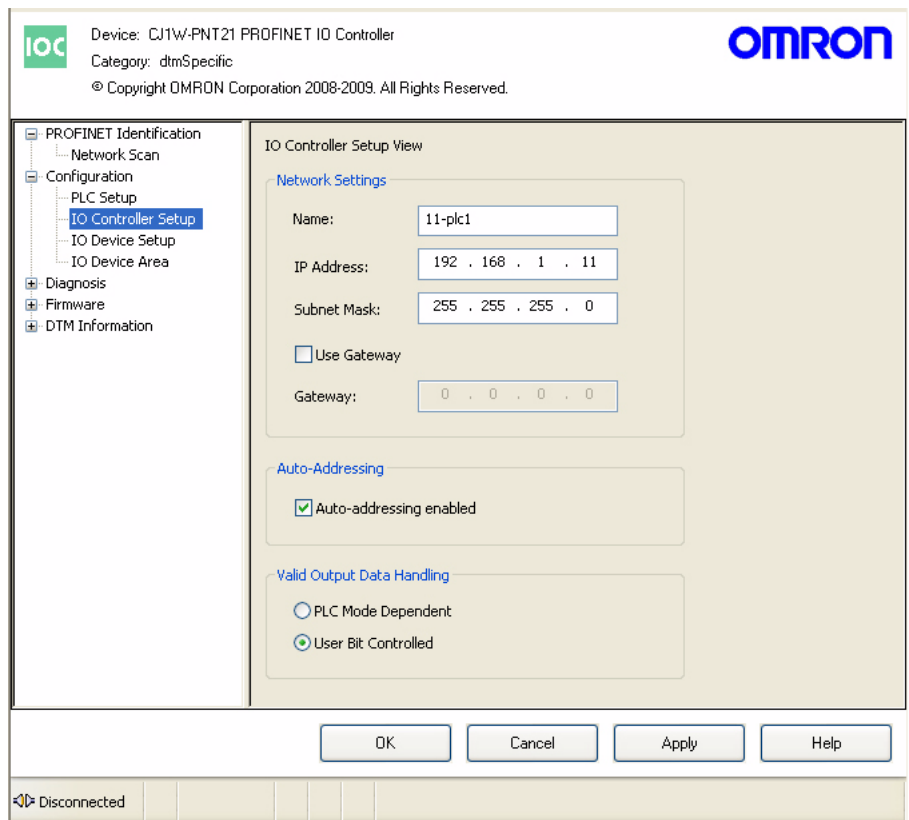


Figure 7.10: IO Controller Setup

**Network settings**

Each PROFINET IO Controller and Device needs to have a PROFINET name and IP-address to communicate on the PROFINET network.

The settings of the name and the IP-Address are done in the Network Settings. The characters in the name must be lower case, numbers and the - sign. This is according to the PROFINET specification. Incorrect characters are not accepted.

The IP-address and the Subnet Mask must be according the IP-network the PROFINET IO-Controller must be working in. Gateways, however are not supported.

**Auto-Addressing**

Auto-Addressing defines whether or not the CJ1W-PNT21 IO Controller DTM will automatically map the I/O data in such a way that no gaps exist in the I/O data. If enabled, the user does not need to handle the exact mapping of I/O data on to the PLC memory areas.

**Valid Output Data Handling**

Depending on the application set the Valid Output Data Handling to PLC Mode Dependent or User Bit Controlled. If set to PLC Mode Dependent then the IO Controller will follow the state of the PLC, Program or Monitor/Run mode. This is convenient in most applications, where only one IO Controller is used.

In case where the application needs to be in control of the state of the output data then set User Bit Controlled.

Example where to use User Bit Controlled is a redundant configuration where two IO Controllers can control IO Devices but only one is Active and the other is the Standby. The Active will set the Output Data to Valid and the Standby has Invalid Output Data. The IO device will only use the Output Data of the IO Controller that has set it to Valid.

After making the changes, select the **Apply** button in the lower right corner of the user interface to accept the changes. Next select the IO Device Setup to set the information for the IO Devices.

**7-4-3 IO Device Setup**

In the IO Device Setup the Names of the IO Devices the IO Controller will search for to connect to are set. Also other settings like IP-address, Update rate and Watchdog- and Datahold-time need to be done here.

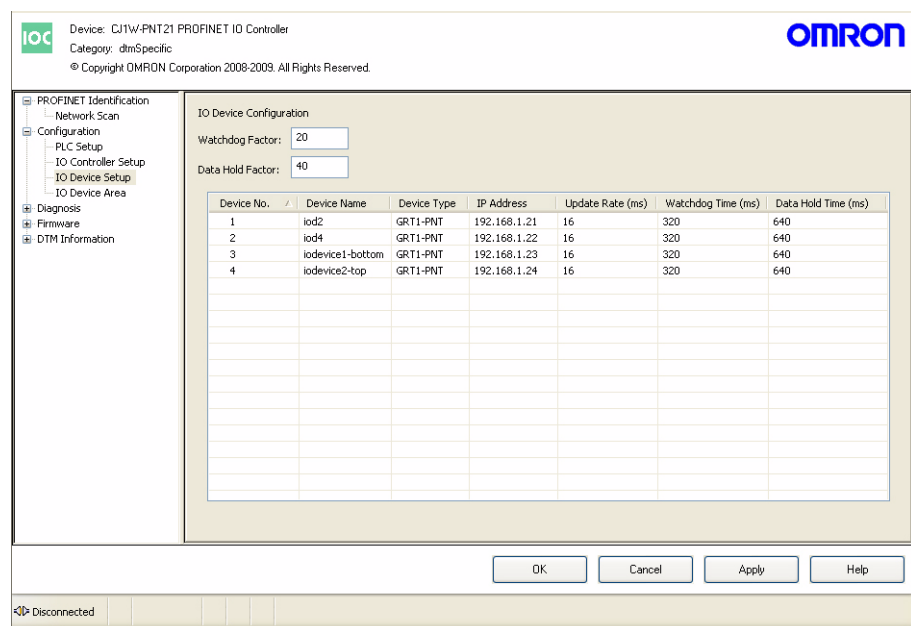


Figure 7.11 IO Device Setup

<b>Device No.</b>	<p>The Device No. is assigned by the IO Controller DTM and is used in several places. As the IO Controller can not easily handle names Device No. are used. The functions where the Device No is used are:</p> <ul style="list-style-type: none"> <li>• In the Connection and Diagnostics information screen of the IO-Controller.</li> <li>• In the IO Device Input Valid (Word n+9 ~ Word n+16) and New Alarm flags areas (Word n+17 ~ Word n+25).</li> <li>• Reading New Alarms from the IO Controller.</li> <li>• FINS routing through the IO Controller to determine FINS address to IP-address.</li> </ul>
<b>Device Name</b>	<p>The Device Name is the name set in the IO Device in the Network Scan sub item in the PROFINET Identification. The Device Name entered here must be an exact match with what is entered in Network Scan sub item. Only lower case characters, numbers and the - sign are allowed.</p> <p>The Device Name is the used to identify the IO Device on the PROFINET network.</p>
<b>Device Type</b>	<p>The Device Type is read by the IO Controller DTM from the IO Device DTM. It can not be changed.</p>
<b>IP Address</b>	<p>The set IP Address is what the IO Controller sets in the IO Device found by its Device Name. This is over writing the IP Address the IO Device maybe already has. Any IP based communication to the IO Device must be done to the IP Address set by the IO Controller if the IO Controller is in data-exchange with the IO Device.</p> <p>The IP Address of the IO Device must be in the same subnet as the IO Controller.</p>
<b>Update Rate</b>	<p>The Update Rate is the time in milliseconds that data is refreshed between the IO Controller and the IO Device. The settings range is from 8 to 512ms. If the Update Rate is set to fast for a bigger configuration then it could be that IO Controller can not service all IO Devices.</p> <p>The Update Rate is the base for the calculation of the Watchdog Time and the Datahold Time</p>
<b>Watchdog Time / Data Hold Time</b>	<p>The Watchdog Time and the Data Hold Time are set in the IO Device by the IO Controller during start of the PROFINET IO communication.</p> <p>The Watchdog Time is used by the IO Device and the IO Controller to determine when to close the PROFINET IO connection. If the time since the last update has exceeded the Watchdog Time then the IO Device and the IO Controller will close the PROFINET IO connection. The IO Controller must set up the PROFINET IO Connection again to communicate with the IO Device.</p> <p>The IO Device will keep its outputs set to till the Data Hold time is reached. Both the Watchdog Time and the Data Hold Time start counting since the last IO Data Exchange.</p> <p>When using network redundancy with for example MRP set the Watchdog Time and the Data Hold Time to a value that the connections will not time out when problems on the network occur. Also check if the Watchdog Time and Data Hold Time set are sufficient when the network is brought to a normal state.</p> <p>After making the changes, select the <b>Apply</b> button in the lower right corner of the user interface to accept the changes. Next select the IO Device Area to set the memory locations where the I/O data for the IO Devices resides in PLC memory.</p>

### 7-4-4 IO Device Area

The I/O data of all IO Devices can be mapped on to the PLC memory areas. through two Output Areas and two Input Areas. The Output data can be distributed over two Output Areas, each of which can be mapped on to PLC memory. Similarly, the Input data can be distributed over two Input Areas, each of which can be mapped on to PLC memory.

**Example**

The figure below shows the CJ1W-PNT1 IO Controller DTM's IO Device Area sub item for an example network with 4 IO Devices.

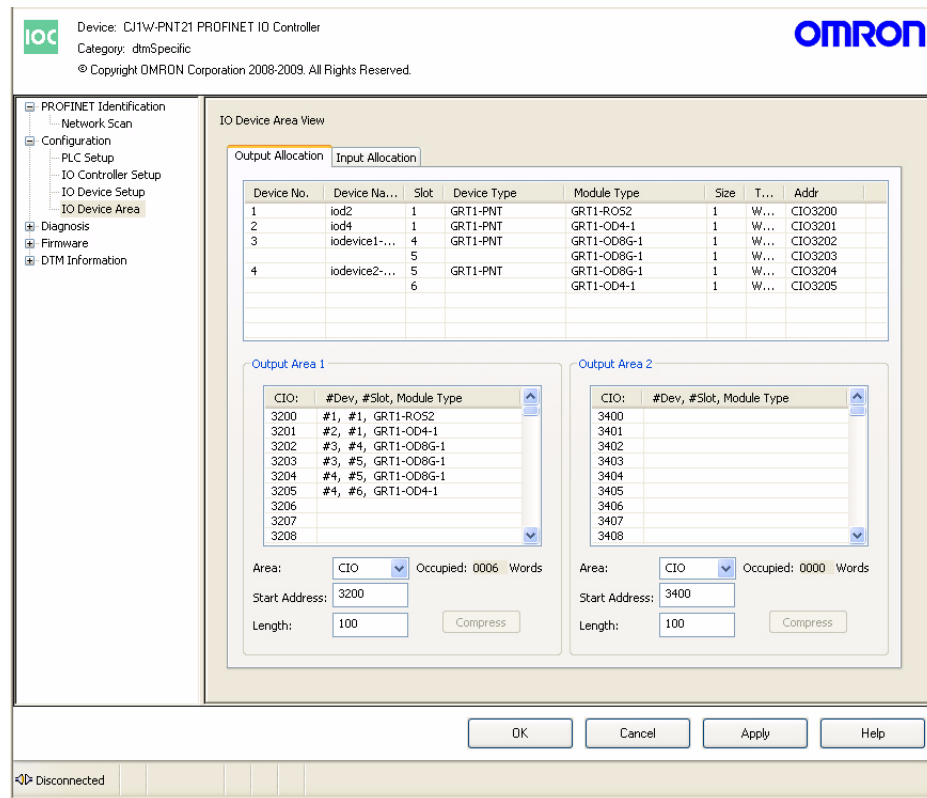


Figure 7.12: IO Device Area

By default all Output data is mapped on to Output Area 1, and all Input data is mapped on to Input Area 1. Each of these Areas can be mapped on to PLC memory independently of each other.

Changing the mapping can be achieved using drag & drop. The module which is mapped to Area 1 and which must be mapped to Area 2, can be copied there by dragging it from the overall module list on top to Area 2.

- Note**
- 1 By default the Auto-Addressing option will be enabled (see the section IO Controller Setup). If any I/O modules are moved from one Area to another, the I/O modules in first Area are re-mapped to close all the gaps between mappings.
  - 2 Prior to download, the CJ1W-PNT21 IO Controller DTM will check the mappings for possible Area overlaps, PLC memory overlaps and non-existing EM banks. If an error is detected, download will be aborted and the necessary correction must be made first.

**Caution** When mapping the I/O Areas, make sure that the I/O data will not overlap the Unit's own CIO Area or one or more of the I/O data areas of any other PLC CPU or I/O Unit. The CJ1W-PNT21 IO Controller DTM does not check this. Failure to avoid this, will lead to unpredictable behaviour of the Unit, other units or the PLC.

### 7-4-5 Mapping I/O Data

#### IO Mapping Concept

The CJ1W-PNT21 IO Controller Unit provides an I/O mapping concept, based on the I/O module selection for each slave device. Each selected I/O module can - depending on whether it defines input and/or output data - be mapped to one of two input and/or output areas. Each of the two input and output areas can be mapped to any PLC memory area location, independent of each other. The I/O mapping must be setup using the CJ1W-PNT21 IO Controller DTM, as provided with CX-ConfiguratorFDT.

Mapping the I/O modules involves two steps:

- 1 Allocate each I/O module to one or more of the Input/Output areas.
- 2 Allocate each Input/Output area to PLC memory.

#### Default I/O Mapping Algorithm

When setting up the network, i.e. selecting the slave devices and I/O modules per slave, all input modules will - by default - be allocated to Input area 1, all output modules will be allocated to Output area 1. The following rules apply when allocating the I/O modules to the areas:

- I/O modules are mapped starting at the lowest address of an Input/Output area.
- I/O modules are mapped in ascending order according to IO Device No.
- I/O modules per slave device, are mapped in the order in which they were selected, when setting up the slave device.

Furthermore, Input area 1 is by default mapped to CIO 3300, whereas Output area 1 is by default mapped to CIO 3200.

#### Example

The default mapping algorithm is illustrated in the figure below, with the following configuration:

- Slave device 1: One input/output module, one output modules.
- Slave device 2: One input module.
- Slave device 3: One output module.
- Slave device 4: Two input modules.

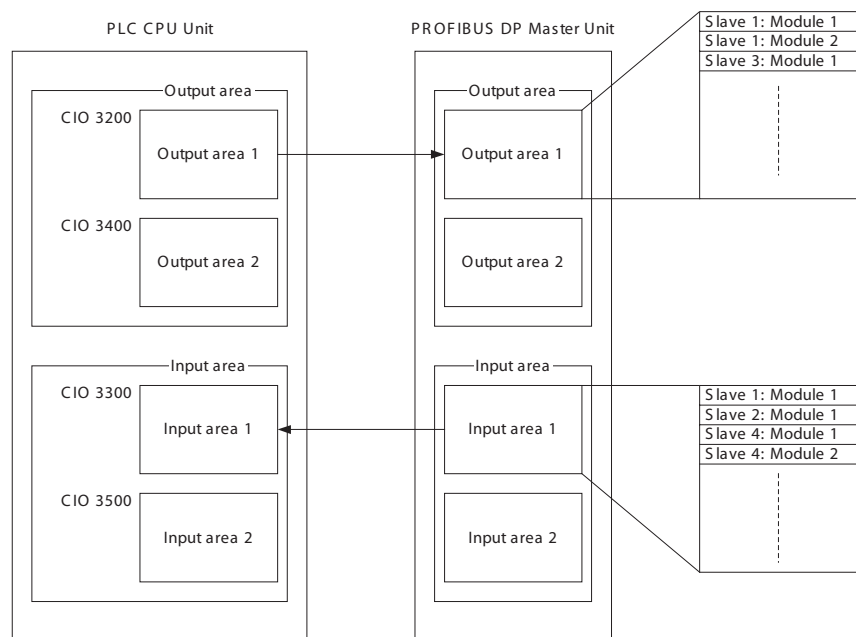


Figure 7.13: I/O Data mapping

- Note**
- 1 The end address of each Input/Output area in the PLC memory, depends on the size of the allocated I/O data.
  - 2 If more than 100 words of input or output have been configured for the slave, overlap of memory areas will occur in the PLC, if default I/O mapping is used as shown above.

**Caution** The default mapping of areas on to the PLC memory is the same default mapping as used in the CJ1W-DRM21 Devicenet Master/Slave Unit and the CJ1W-PRM21 PROFIBUS Master. Care should be taken to avoid data overlap, if such a Unit is part of the same PLC CPU system as the CJ1W-PNT21 PROFINET IO Controller Unit.

The CJ1W-PNT21 PROFINET IO Controller Unit, will assemble the correct PROFINET data messages from the storage order in the Input and Output memory areas.

**Auto Addressing**

The default allocation of I/O modules, i.e. I/O modules are mapped in ascending order of IO Device No. and module selection, uses the concept of Auto Addressing of the CJ1W-PNT21 IO Controller DTM. Auto Addressing will (re)allocate I/O modules according to the algorithm explained above in each area.

If a configuration has been selected, which is changed later - for example - by adding an I/O module to one of the IO Devices, the Auto Addressing feature will add that module to the default area, between the already selected modules of that particular slave device.

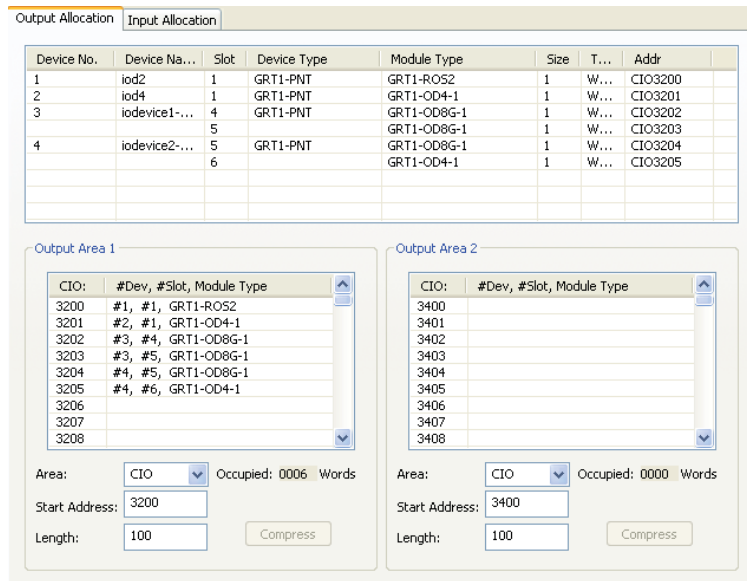
**Caution** When an I/O module is added to or deleted from a configuration at a later point in time, Auto Addressing will cause a change in the addresses of subsequent I/O modules in an Input/Output area. This will cause I/O data of (a part of the) IO Devices to be re-mapped to different locations in the PLC memory. In order to avoid unexpected results, the PLC user program may have to be adapted as well.

- Note**
- 1 Auto Addressing will not change the allocation of I/O modules to a certain area, i.e. a module allocated to Input/Output area 2, will not be re-allocated to area 1, if Auto Addressing is enabled
  - 2 Auto Addressing will not change the start address of the areas.
  - 3 Auto Addressing is by default enabled, when starting a new project. It is however, disabled for existing projects to avoid unwanted re-mapping.

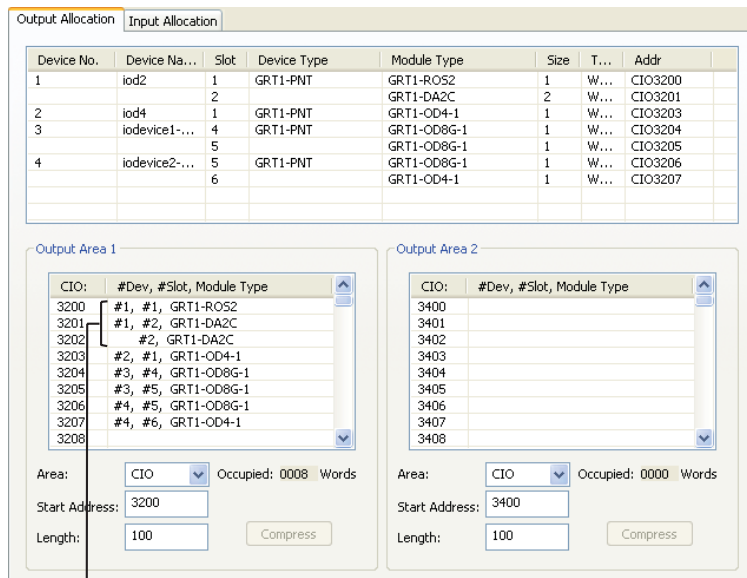
**Example**

The figure below shows an example of the effects of Auto Addressing on (re)allocation of I/O modules. In the original I/O configuration on the left, the first slave - an OMRON GRT1-PNT - consisted of one Output modules. In new configuration one I/O module was inserted, and subsequent modules were re-allocated in the process





Initial I/O Configuration



One I/O module of two output words was inserted, and re-allocated subsequent I/O modules.

Figure 7.14: Auto-addressing

**Note** The start address of Output area 1 in the example remains the same, after adding an I/O module.

**Re-allocating I/O Modules**

After setting up the initial I/O configuration, the I/O modules can be re-mapped to the second Input/Output area. This can be accomplished by using drag & drop to move the I/O modules. To accomplish this, perform the following sequence:

- 1,2,3... 1 Open the CJ1W-PNT21 IO Controller DTM - Configuration User Interface.
- 2 Select the IO Device Area sub item. The window shows two sub tabs: One for Output Allocation and one for Input Allocation. The following points apply to each of these tabs.

- 3 After setting up the initial I/O configuration, all I/O modules will be shown in the overall list in the upper half of the Slave Area tab. This is a pick list from which modules can be selected. The allocated I/O modules are listed in area 1, the column on the left of the lower half of the window.

**Note** The I/O modules in the pick list, all remain there. The allocated I/O modules are copies of the modules selected from the pick list.

- 4 In order to move an I/O module from one area to another, select the module in the pick list.
- 5 Hold the left mouse button and drag the I/O module to the Input/Output area of choice. Release the left mouse button to drop the module in place.

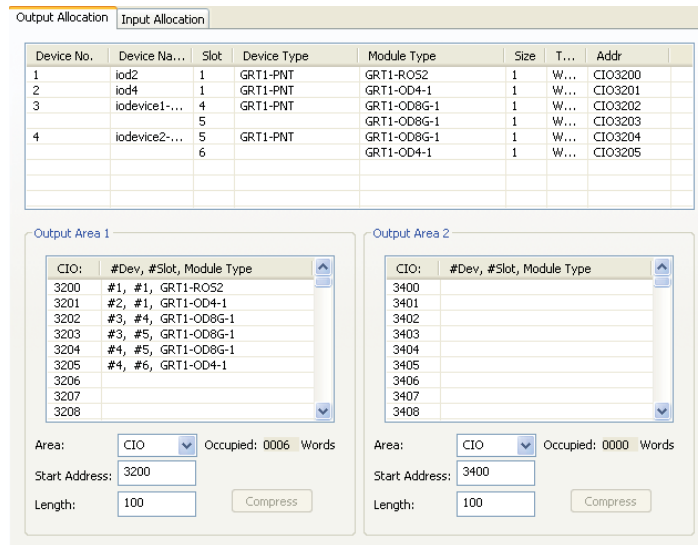
**Note** The area to place the module in must be empty. The area to put the modules in does not need to be selected first.

### **Auto Addressing and Re-allocating I/O Modules**

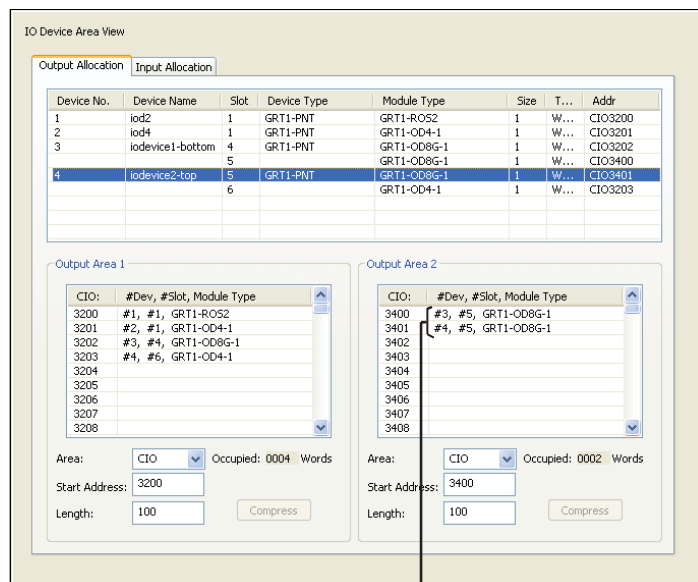
Auto Addressing (re)allocates I/O modules in all Input/Output areas. If - after setting up the initial I/O configuration - two or more I/O modules are moved from one area to another, Auto Addressing maintains the same sequence, i.e. the slave device with the lowest address and its I/O modules in the selected sequence are allocated before a slave device with a higher address.

### **Example**

In the figure below two output modules from the initial I/O configuration (top window) have been re-allocated to Output area 2 (bottom window)



Initial I/O Configuration



The first Output modules of IO Device #3 and #4 were moved to Output area 2.

Figure 7.15: Move IO Device

The example shows that the sequence of IO Device No. is maintained, the sequence of I/O modules selected is maintained and the I/O modules are allocated to the lowest address of the area.

**Enable/Disable Auto Addressing**

The Auto Addressing feature can be disabled in the CJ1W-PNT21 IO Controller DTM. In order to do that, perform the following sequence.

- 1,2,3... 1 Open the CJ1W-PNT21 IO Controller DTM - Configuration User Interface.
- 2 Select the Configuration - IO Controller Setup sub item.
- 3 Enable/Disable Auto Addressing by selecting/de-selecting the Auto Addressing enabled checkbox in the Auto-Addressing box.
- 4 When Auto Addressing is being enabled, a warning message is displayed, informing the user of the effects of enabling Auto Addressing.

**⚠ Caution** Enabling Auto Addressing has the immediate effect of re-allocating I/O modules of an existing configuration, within each Input/Output area. The I/O modules are re-mapped according to the algorithm described above.

**Note** Disabling Auto Addressing has no immediate effect on an existing I/O mapping.

**I/O Mapping Without Auto Addressing**

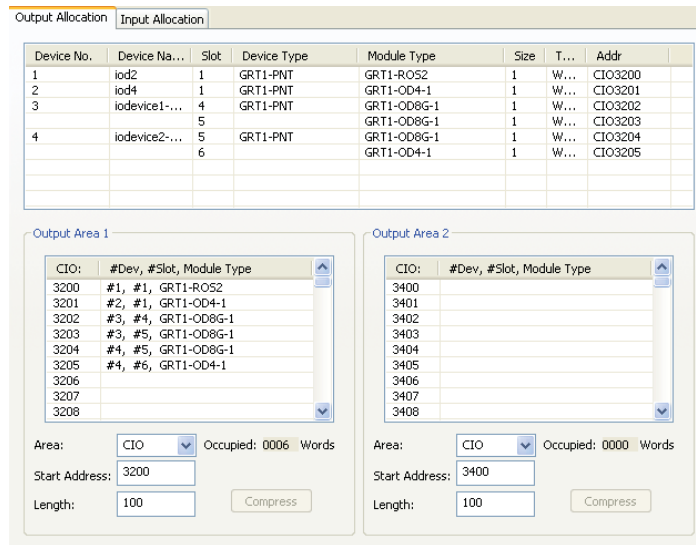
A disabled Auto Addressing feature has the following effects on I/O mapping:

- When adding new IO Devices or new I/O modules to an existing configuration, the I/O modules will be mapped to the first I/O areas, but the modules will be appended to the existing I/O mapping.
- When deleting a IO Device from the network configuration, or deleting I/O modules from a IO Device, the deleted I/O modules will leave gaps behind in the already existing I/O mapping. If after deleting an I/O module a slave device still has more than one module configured, but these modules are not in the same place, the DTM will attempt to re-map them together.
- Changing the address of a IO Device, of which already an I/O mapping exists, has no effect on the existing mapping.
- Selecting an additional I/O module for a IO Device, in the presence of already allocated I/O modules, will cause a complete re-map of all existing modules if the total I/O does not fit within the space it is already occupying. The modules are re-mapped to the next available location in the area, leaving behind a gap in the existing I/O mapping. Subsequent I/O modules of other slave device will remain mapped as before the module addition.
- When moving an I/O module from one area to another, they can be located anywhere with in the target area. They are not re-mapped to the start of that.
- When moving an I/O module from one area to another, the module leaves behind a gap in the I/O mapping of the first area.

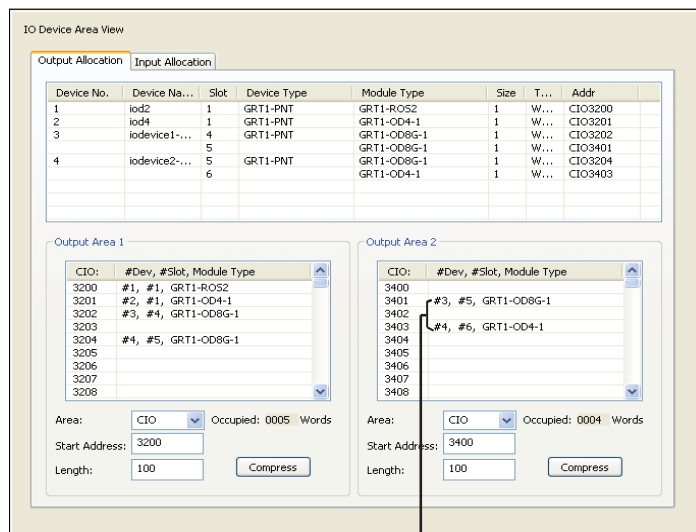
**Note**

- 1 Gaps in the I/O mapping still contribute to the total size of an area, although they do not contain valuable data. They therefore decrease the total I/O capacity of the CS1/CJ1W-PRM21 PROFIBUS Master Unit, and unnecessarily occupy PLC memory.
- 2 In the I/O data exchange with the PLC CPU, these gaps will contain zeros.

**Example** The figure below illustrates the effects of re-allocating I/O modules, when Auto Addressing has been disabled.



Initial I/O Configuration



Note: Auto-Addressing is disabled

The second Output modules of IO Device #3 and #4 were moved to Output area 2, leaving a gap in Output Area 1.

Figure 7.16: Auto-addressing disabled

### Removing Gaps from the I/O Mapping

Since gaps in the I/O mapping are generally undesirable, the CJ1W-PNT21 IO Controller DTM provides a means to remove all gaps, after finalizing the I/O mapping procedure. This removal is accomplished by compressing the I/O modules in a particular area.

### Compressing the I/O Mapping

Compressing re-allocates all I/O modules in an area as close to the start of the area as possible. Compressing an area does not change the sequence of the slave devices and/or the I/O modules. It only removes the unused memory gaps. Compressing can be initiated for each area individually.

1,2,3...

- In order to compress an area, perform the following sequence.
- 1 Open the CJ1W-PNT21 IO Controller DTM - Configuration User Interface.
- 2 Select the IO Device Area sub item. The window shows two sub tabs: One for Output Allocation and one for Input Allocation. The following points apply to each of these tabs.

- 3 To compress the area, press the **Compress** button at the bottom.
- 4 After finalizing the compress action, select the **Apply** button at the lower right corner, to save the changes made.

**Note** Compressing an Input/Output area has no effect on the start address of the area.

**Selecting the I/O Area Start Address**

After finalizing the mapping of the I/O modules on to the various I/O areas, the addresses to which the areas will be mapped in the PLC memory need to be defined. To define the area mapping, perform the following settings.

- 1,2,3...**
- 1 For each area, which contains I/O modules, select the PLC memory area.
  - 2 For that area, set the address to which the first location of the Input/Output area will be mapped. The Input/Output area will occupy the PLC memory area, from this start address to ascending memory locations.
  - 3 The total size per Input/Output area can be found for each area, next to the PLC memory area selection box.

**Note**

- 1 The CJ1W-PNT21 IO Controller DTM will check whether two or more selected mappings on to the PLC memory will be overlapping. In that case, the start address set, will be shown in red.
- 2 Upon downloading the configuration to the CJ1W-PNT21 PROFINET IO Controller Unit, the Master DTM will also check if the PLC memory areas selected do exist in the PLC CPU model, connected to the Master Unit (e.g. are any selected EM-banks present).
- 3 If any mapping error is discovered by the Master DTM, an error message is displayed, and download is terminated.

**7-4-6 Supported Data Types and Conversion**

The CJ1W-PNT21 PROFINET IO Controller Units perform an interface function between a PROFINET IO network and the CJ1 PLC CPU. On both sides of the interface different formats for data and data storage are used. To ensure that I/O data transferred through the interface can be used on both sides of the interface without additional formatting, the CJ1W-PNT21 PROFINET IO Controller Units perform the necessary data formatting. This ensures that I/O data in the PLC CPU memory can be processed by standard PLC Instructions, and that the I/O data transferred to / from the PROFINET IO Devices over the network is compliant with the PROFINET IO definitions.

The table below lists the I/O data formats supported by both the PROFINET IO network and PLC CPU. The I/O Data Conversions defines the conversion of I/O data in detail.

<b>Data Type</b>	<b>Size [bytes]</b>	<b>PROFINET IO</b>	<b>CJ-Series PLC</b>
Boolean	1	Supported Data is transmitted on bit by bit basis	Supported Single 16-bit integers are transferred to memory words in PLC memory.
Single 8-bit Integer signed/unsigned	1	Supported Data is transmitted on byte by byte basis	Supported Minimum is 16-bit words. Two bytes will be formatted in one word. Words containing odd bytes will be padded with zeros
Single 16-bit Integer signed/unsigned	2	Supported Data is transmitted on a Most-Significant-Byte First basis	Supported Single 16-bit integers are transferred to memory words in PLC memory.
Single 32-bit Integer signed/unsigned	4	Supported Data is transmitted on a Most-Significant-Byte First basis	Supported Data is stored with the Least-Significant-Word at the lowest address.
Single 64-bit Integer signed/unsigned	8	Supported Data is transmitted on a Most-Significant-Byte First basis	Supported Single 16-bit integers are transferred to memory words in PLC memory.
32-bit Floating point	4	Supported Data is transmitted on a Most-Significant-Byte First basis	Supported Single 16-bit integers are transferred to memory words in PLC memory.
64-bit Floating point	8	Supported Data is transmitted on a Most-Significant-Byte First basis	Supported Single 16-bit integers are transferred to memory words in PLC memory.
TimeOfDay	2	Supported Data is transmitted on a Most-Significant-Byte First basis	Supported Single 16-bit integers are transferred to memory words in PLC memory.
TimeOfDay with date indication	2	Supported Data is transmitted on a Most-Significant-Byte First basis	Supported Single 16-bit integers are transferred to memory words in PLC memory.
TimeOfDay without date indication	2	Supported Data is transmitted on a Most-Significant-Byte First basis	Supported Single 16-bit integers are transferred to memory words in PLC memory.
TimeDifference	2	Supported Data is transmitted on a Most-Significant-Byte First basis	Supported Single 16-bit integers are transferred to memory words in PLC memory.
TimeDifference with date indication	2	Supported Data is transmitted on a Most-Significant-Byte First basis	Supported Single 16-bit integers are transferred to memory words in PLC memory.
NetworkTime	2	Supported Data is transmitted on a Most-Significant-Byte First basis	Supported Single 16-bit integers are transferred to memory words in PLC memory.
NetworkTimeDifference	2	Supported Data is transmitted on a Most-Significant-Byte First basis	Supported Single 16-bit integers are transferred to memory words in PLC memory.

Data Type	Size [bytes]	PROFINET IO	CJ-Series PLC
OctetString	--	Supported Data is transmitted on byte by byte basis	Supported Minimum is 16-bit words. Two bytes will be formatted in one word. Words containing odd bytes will be padded with zeros
VisibleString	--	Supported Data is transmitted on a Most-Significant-Byte First basis	Supported Single 16-bit integers are transferred to memory words in PLC memory.

**Integer Conversion**

The figure below shows each of the formats both on the PROFINET IO network and in the PLC data area. The data bytes on the PROFINET IO network are transmitted in the sequence shown in the figure, i.e. Byte 0 is transmitted and received first, after that byte 1, etc. The PLC data is stored in word-sized locations, word 0 at the lowest address, word 1 at the next higher address, etc.

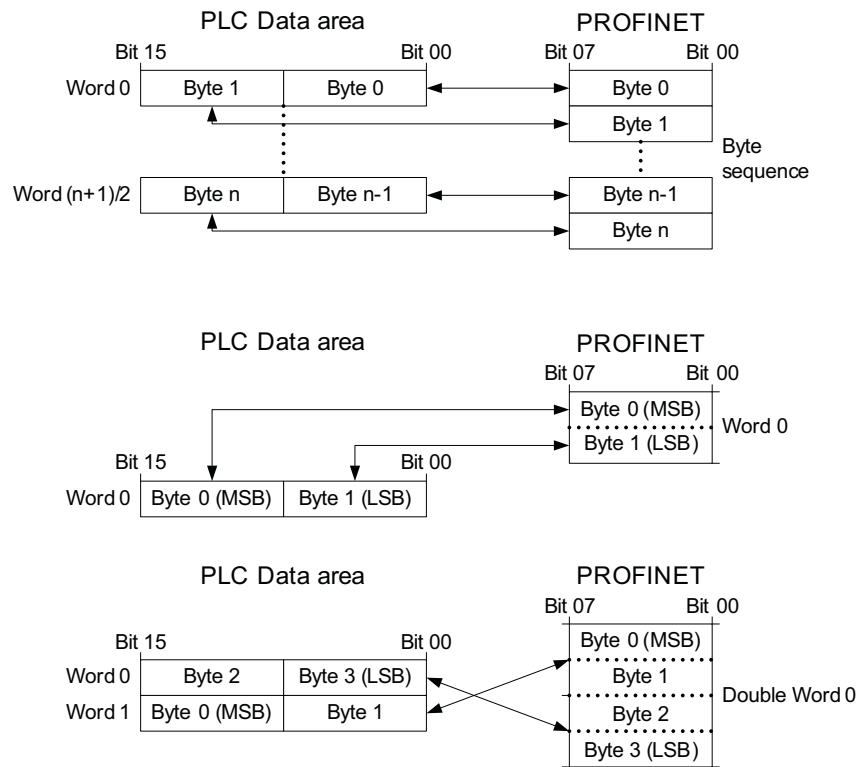


Figure 7.17: Data conversion

The following format conversions are required:

- 1 A sequence of 8-bit bytes, either signed or unsigned must be mapped to the PLC data area words on a low-byte/high-byte sequence. If the number of bytes is even, all bytes will fit in the words. If the number of bytes is odd, the last byte of the sequence will be mapped to the low-byte of the last word. The high-byte of the last word must be padded with a 0.
- 2 A 16-bit word or a sequence thereof, either signed or unsigned must be mapped to the PLC data area words on a high-byte/low-byte sequence.
- 3 A 32-bit double word or a sequence thereof, either signed or unsigned must be mapped to the PLC data area words on a high-byte/low-byte sequence as well as on a high-word/low-word sequence.



All conversions work both ways, i.e. when transferring data from the PLC data area to the PROFINET IO network and when transferring data from the PROFINET IO network to the PLC data area.

The following conversion steps are required here: Every two data bytes are stored in 1 word in the same sequence as in the case of 16-bit integer data, but the two words, required to store the 4 bytes must be swapped, for the PLC data area. The conversion has to be reversed when transferring data from the PLC data area to the PROFINET network.

**Text strings**

Both PROFINET IO and the CJ1 System define the ASCII text strings as data format. The figure below shows the format both on the PROFINET IO network and in the PLC data area. The data bytes on the PROFINET IO network are transmitted in the sequence shown in the figure, i.e. Byte 0 is transmitted and received first, after that byte 1, etc.

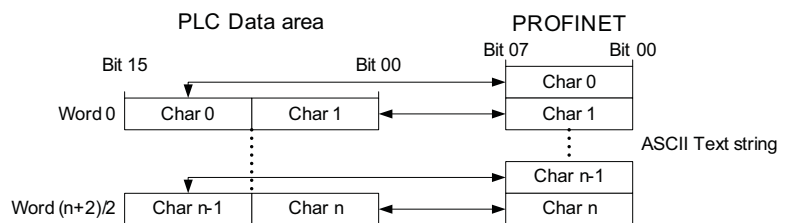


Figure 7.18: String conversion

The following format conversions are required:

- 1 On the PROFINET IO network, the text strings are handled as a sequence of 8-bit bytes, but the storage in the PLC data area is following the (unsigned 16-bit) word storage method, i.e. the bytes are stored in a high-byte/low-byte sequence.
- 2 If the number of text characters is even, all bytes will fit in the words, but one additional word must be set to 0000. If the number of bytes is odd, the last byte of the sequence will be mapped to the high-byte of the last word. The low-byte of the last word must be padded with a 0.

In case of transmissions of text strings, the trailing zero byte or word is not transmitted along with the string.

## 7-5 Performance

### 7-5-1 Number of devices

As specified, the CJ1W-PNT21 IO Controller can cyclically exchange I/O data with up to 126 PROFINET IO Devices. The rate at which it can service IO Devices depends on the number of connected devices and the size and complexity of the data. Especially with modular I/O devices, the IO Controller needs time to pack and unpack the I/O data of each device module and convert them to the correct representation in the PLC.

Measurements with various I/O configurations have been done to determine the boundaries of the IO Controller's performance. At different Update Rates, the greatest number of SmartSlice IO Devices was determined at which the cycle times can be maintained reliably. These measurements were done for SmartSlice stations with a minimum I/O configuration, a typical configuration, and a maximum configuration.

SmartSlice IO Configurations:

- **Minimum:** Each IO Device has 1 x OD4-1, 1 x ID4-1 and an END-M connected. This results in 1 data word output and 2 data words input. The number of modules is 4.
- **Typical:** Each IO Device has 4 x ID8-1, 3 x OD8-1, 1 x AD2, 1 x DA2V and 1 x END-M. This results in 8 data words input and 5 data words output. The number of modules is 13.
- **Maximum:** Each IO Device has the maximum number of units connected (64) and has the maximum amount of I/O data (64 words output and 65 words input). This is reached by connecting 19 x CP1-L, 22 x OD4-1, 22 x ID4-1 and 1 x END-M.

Number of SmartSlice stations that can be serviced at each Update Rate:

Update Rate	Minimum configuration	Typical configuration	Maximum configuration
8ms	10	10	7
16ms	20	17	13
32ms	35	25	20
64ms	65	45	35
128ms	90	65	55
256ms	126	80	55
512ms	126	105	55

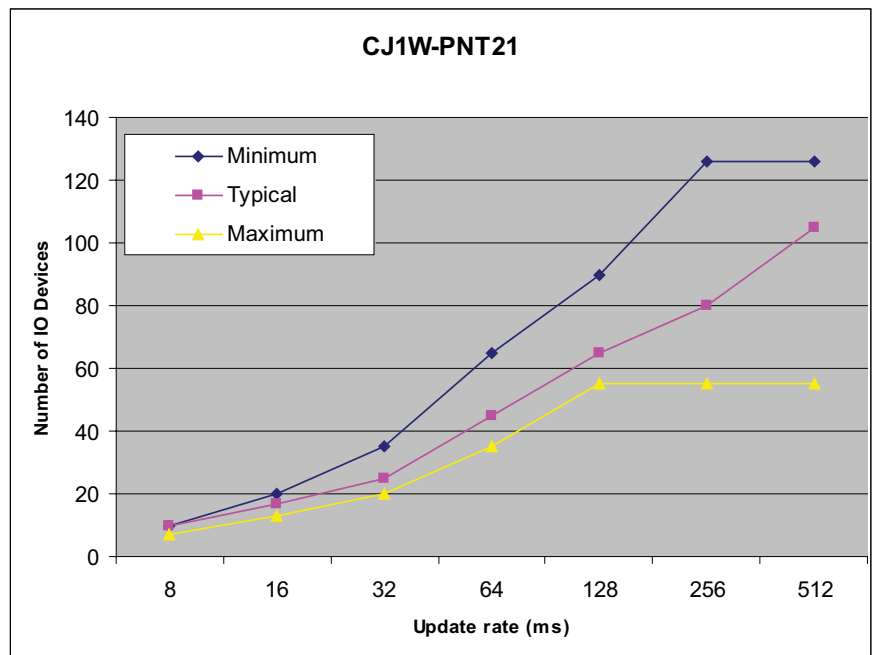


Figure 7.19: Performance

- Note**
- The maximum of 55 devices in maximum configuration is caused by the reaching the limit of 7168 Words that the IO Controller can exchange with the PLC CPU.
  - The maximum number of IO Devices that the IO Controller supports is 126.

### 7-5-2 Input / Output data processing time

The IO Controller is packing and unpacking the I/O data transferred between PLC memory and the network. The time it needs for this is called the data processing time.

There are two directions through the IO Controller, for input data and output data respectively.

- The input data processing time (TCI) is the time between the moment the input data is received by the IO Controller from the PROFINET network and the moment the IO Controller has the input data ready for the PLC.
- The output data processing time (TCO) is the time between the moment the output data is supplied by the PLC and the moment the IO Controller has the output data ready to send onto the PROFINET network.

Measurements were made with minimum, typical and maximum IO Device configurations to determine these times.

Network Configuration	T <sub>ci</sub> (ms)		T <sub>co</sub> (ms)	
	Lower limit	Upper limit	Lower limit	Upper limit
Minimum	3.9	5.2	1.1	2.1
Typical	4.8	6.4	2.0	4.0
Maximum	24.5	45.0	15.0	40.6

**Minimum network configuration:** One SmartSlice IO Device connected, with the minimum configuration (see above)

**Typical network configuration:** 8 SmartSlice IO Devices connected, with the typical configuration (see above).

**Maximum network configuration:** 126 SmartSlice IO Devices with minimum configuration at an update rate of 126 ms, or 55 IO Devices with maximum configuration at an update rate of 126 ms.

## 7-6 Operating the network

### 7-6-1 User Access to the Network

There are several ways through which a user can have access to and control over the PROFINET IO network.

- Through a PLC user program  
A PLC user program can set the operational mode of the Unit, read IO Controller and IO Device status / diagnostics information, and access the Unit's Error Log. Furthermore, the I/O data transferred between the PROFINET IO network and the PLC memory, and can be used by the user program.
- Through CX-ConfiguratorFDT  
The CJ1W-PNT21 IO Controller DTM Diagnosis User Interface provides the user with buttons to set the operational mode of the Unit, read IO Controller and IO Device status information, and access the Unit's Error Log.
- Through any other CX-Server based program, capable of accessing PLC memory areas and communicating through FINS messages, e.g. CX-Programmer, CX-Supervisor, etc.


This section will explore both means to control the CJ1W-PNT21 PROFINET IO Controller Unit.

The CJ1W-PNT21 IO Controller DTM Diagnosis User Interface provides the means to control the Master Unit directly from CX-ConfiguratorFDT, running on a PC.

#### Access to the Unit

For access to the Unit's controls, an online connection with the Unit has to be established first. To achieve this perform the following sequence.

- 1,2,3... 1 To go on line, select the DTM in the Network view, and perform one of the following actions.
  - Select the **Device - Go Online** option from the main menu, or the DTM context menu, or
  - Select the **Online** button from the Tool Bar.
- 2 A communication channel will be opened through CX-Server. The name of the DTM in the Network view, will turn to Italic font, to indicate that the Unit is on-line.
- 3 From the context menu, select the **Diagnosis** option. The DTM's Diagnostics User Interface will be displayed.

 **Caution** Controlling the CJ1W-PNT21 PROFINET IO Controller Unit from the CJ1W-PNT21 IO Controller DTM Diagnosis User Interface, may interfere with a PLC user program running at the same time. This can result in unexpected behaviour. It is recommended to change the PLC CPU mode to PROGRAM mode to avoid this interference, during the use of the CJ1W-PNT21 IO Controller DTM Diagnosis User interface.

### 7-6-2 Changing the Output Data state of the IO Controller.

#### I/O Data state

The PROFINET IO standard defines the Provider State of I/O data, further called the I/O Data state. With this a PROFINET IO Controller or Device can signal if the data it provides is reliable, if it is **Valid** or **Invalid**. I/O Data that is marked as invalid is discarded by the receiving device.

The Output Data state of the IO Controller is controlled in two ways:

- 1 The Output Data state is PLC Mode Dependent.  
 If the PLC is in Program mode then the Output Data is marked as invalid.  
 If the PLC is in Monitor/Run mode then the Output Data is marked as valid.
- 2 The Output Data state is User Bit Controlled.  
 Bit 12 of Software switch 1, the Set output data valid bit, set the state of the output data. If the bit is set to ON the Output Data is set to valid.

When the Output Data state is User Bit Controlled then it can be set or reset from any place. From an HMI or SCADA system or another PLC. But most logical is the PLC program. For instance a Function Block that supports redundant IO Controllers need to use the User Bit Controlled way of operation. For commissioning purposes also the IO Controller DTM can be used. In the Diagnosis item, IO Controller Status sub item has the button **Toggle User Bit** to set/reset the Output Data state.

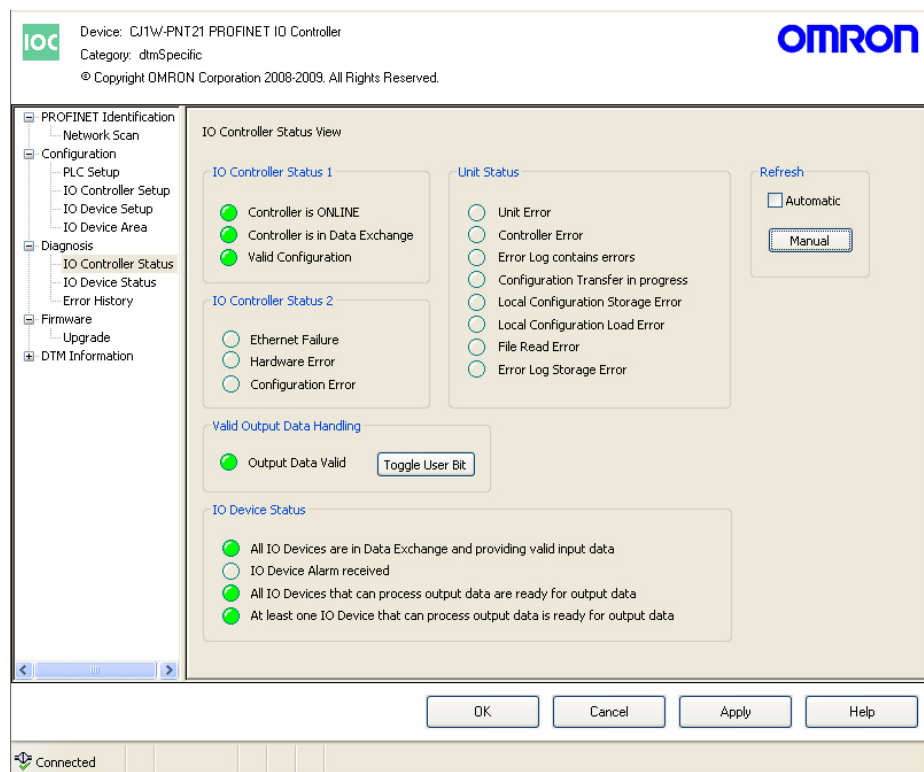


Figure 7.20: User Bit Controlled

**Note** When the Valid Output Data Handling is set to User Bit Controlled then the Outputs of the IO Devices will only be controlled if the Output Data of the IO Controller is valid. Input Data coming from the IO Devices is forwarded to PLC memory if it is set to valid by the IO Device.

## **SECTION 8 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 optimal. We recommend reading through the error processing procedures before operation so that operating errors can be identified and corrected more quickly.

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## 8-1 Overview

The CJ1W-PNT21 PROFINET IO Controller Unit and the Configuration software package provides extensive means for troubleshooting, which can be used to quickly determine errors in the Unit, in the configuration, in the network, and/or in IO Devices, allocated to the Unit.

### Troubleshooting on the IO Controller Unit

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

- LED indicators on the front of the Unit  
Two red/green and two yellow status LED indicators to show the Unit's and PROFINET IO network 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.
- CIO Words  
Unit Status (CIO Word  $n + 4$ ) containing status and error flags of the Unit, and IO Controller Status 1 and 2 (CIO Word  $n+5$  and  $n+6$ ) containing error information about the PROFINET IO network and the PROFINET IO functions of the Unit.
- The Error Log collects error codes for various error events. Serious errors are stored in non-volatile memory and can be retrieved, even after a Unit power down.
- FINS command provide defined response codes, which can indicate specific errors.

**Note**  $n = \text{CIO } 1500 + (25 \times \text{unit number})$

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

### Troubleshooting the Configuration Software

The Configuration software, i.e. CX-ConfiguratorFDT, the PROFINET IO Controller DTM and the Generic IO Device DTM provide several mechanisms for error detection and correction:

- Errors occurring in CX-ConfiguratorFDT are displayed in pop-up message windows and/or the error log window. The contents of the error log window can be copied to the clipboard to allow analysis afterwards.
- CX-ConfiguratorFDT provides a FDT communication log window, which can be copied to the clipboard. Analysis of this communication may provide additional information in case errors occur.

### Troubleshooting the network

The PROFINET IO Controller DTM and the Generic IO Device DTM provide diagnostics information windows, which can display:

- Indications of errors in the PROFINET IO interface of the Unit
- Indications of errors in the communication between the PROFINET IO Controller Unit and IO Devices.
- Indications of errors in the IO Devices, allocated to the PROFINET IO Master Unit.



## 8-2 Troubleshooting using the IO Controller indicators

### 8-2-1 Determining Operating Status from the Indicators

This section presents a number of easy to use procedures to troubleshoot possible errors using the LED indicators on the front of the Unit (see figure below).

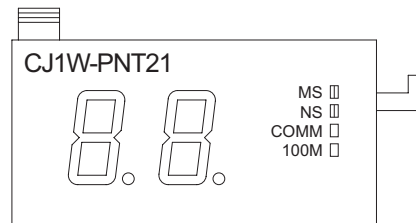


Figure 8.1: Indicators

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

LED	Indicates the
MS	PROFINET IO Controllers Module Status
NS	PROFINET IO Controllers Network Status
COMM	PROFINET IO Controllers Communication Status
100	PROFINET IO Controllers IO Data Exchange Status

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

- Normal operation  
This is the normal startup procedure and operation of the PROFINET IO Controller. Any other indication means the Unit is an abnormal state.
- Start-up errors  
These include errors in the PLC CPU, as well as errors in the Unit, which prevents the combination from starting up correctly.
- Operational errors  
These include PLC errors, PLC Bus errors, and error log problems, all during operations.
- Configuration problems  
These include errors during or after downloading a new configuration as well as errors in the configuration after startup.
- PROFINET IO errors  
These include errors in the PROFINET IO interface or on the network.

### 8-2-2 Normal Operating Status

The following table shows the status of the MS, NS, COMM and 100M indicators and the 7-segment display during normal operation

Indicator status				Network/Unit status	Comments
MS	NS	100M	7-segment		
OFF	OFF	OFF	--	Booting and initializing with the PLC	Bootup and initialization with the PLC in progress. Restart the PROFINET IO Controller unit if this status continues for an extended period of time. Replace the CPU Unit and/or PROFINET IO Controller Unit if the problem is not corrected by restarting.
ON (green)	OFF	OFF	r dot flashing	Valid configuration detected	The PROFINET IO Configuration downloaded from the configuration tool is evaluated during startup of the unit.
ON (green)	Flashing (green)	OFF	r dot flashing	PROFINET IO core software started	The PROFINET IO Controller has started its core communication software and is ready to start communication with PROFINET IO Devices.
ON (green)	Flashing (green)	OFF	r dot ON	Relations to PROFINET IO Devices are set up	Before PROFINET IO Communication is fully running a relation between each IO Device and the IO Controller is established.
ON (green)	Flashing (green)	ON (yellow)	r dot ON	Data Exchange with at least one IO Device	At least one IO Device is exchanging IO Data with the IO Controller
ON (green)	ON (green)	ON (yellow)	r dot ON	Data Exchange with at all configured IO Devices	All configured IO Devices are detected by the IO Controller and to all IO Data Exchange is established.

The COMM indicator turns ON during any communication at the Ethernet port. It functions independently from the operation mode of the Unit.

On smaller PROFINET IO Networks the sequence from starting the PROFINET IO core software to being in full Data Exchange with all the IO Devices can be very fast that the individual steps can not be distinguished.

### 8-2-3 Troubleshooting Errors Occurring in the IO Controller Unit

Unit errors are errors which occur at starting or normal operation of the system and which prevent the Unit from functioning correctly in the PLC system. Usually these errors also cause the CS/CJ PLC CPU ERR/ALM indicator to be lit or flashing. For more information on error indications in the PLC, refer to the CS1 Series CPU Unit Operation Manual (W339) or the CJ Series CPU Unit Operation Manual (W393) for more details.

Unit errors

Error category	Error	Indicators			Error log (Hex)
		7-segment	MS	NS	
Unit errors	Startup errors	1 to 6	ON (red)	OFF	--
IO Controller function	PROFINET configuration set invalid	C7	ON (green)	Flashing (red)	0202
PROFINET Network errors	Ethernet failure	E3	ON (red)	OFF	020C
	Bus hardware error	E5			0219
Memory access errors	Special Unit error	--	Flashing (green)	Flashing (red)	0601
	Memory access error	E9			0602
CPU Unit Exchange	Backplane bus error	H0	Flashing (red)	OFF	000E
	Unit number duplication	H1			--
	CPU Unit faulty	H6			--
	I/O table not registered	H7			--
	CPU Unit service monitoring error	HE			0001
	CPU Unit watchdog timer error	HF			0002

**Note** If Module Status is Red lit or flashing then refer to the displayed error code on the 7-segment display for further information.

8-2-3-1 Unit errors

Startup errors

7-segment	MS indicator	NS indicator	Error log (Hex)
1 to 6	ON (red)	OFF	--

**Likely cause**

During startup of the IO Controller it encountered a problem and can not continue

**IO Controller Unit response**

The Unit will stop processing. There will be no error logged in the error log.

**CIO Area Flags allocated to the IO Controller Unit**

None of the bits is set.

**Correction**

Restart the IO Controller. Replace the IO-Controller if the error recurs.

**8-2-3-2 IO Controller Functions**

PROFINET configuration  
set invalid

7-segment	MS indicator	NS indicator	Error log (Hex)
C7	ON (green)	Flashing (red)	0202

**Likely cause**

During startup of the IO Controller encountered a problem interpreting the PROFINET IO Configuration file. This could be because the Unit started for the first time and does not contain a configuration file yet. Also the Configuration file could be damaged.

**IO Controller Unit response**

The Unit is started and is capable to receive a PROFINET Configuration. It will not initiate PROFINET IO Communication. Records the error in the error log.

**CIO Area Flags allocated to the IO Controller Unit**

IO Controller status 1 (word n+5) bit 07 will be OFF

**Correction**

Use CX-ConfiguratorFDT to download a valid PROFINET IO Configuration in the IO Controller. Or restore the Configuration from a Compact Flash memory card. Replace the IO-Controller if the error recurs.

**8-2-3-3 PROFINET Network errors**

Ethernet failure

7-segment	MS indicator	NS indicator	Error log (Hex)
E3	ON (red)	OFF	020C

**Likely cause**

The PROFINET IO controller could not establish a Ethernet link to the connected switch or IO Device.

**IO Controller Unit response**

The Unit is not capable to communicate on the PROFINET network and therefore control to the IO Devices will be lost. The Unit will stop processing. Records the error in the error log.

**CIO Area Flags allocated to the IO Controller Unit**

IO Controller status 2 (word n+6) bit 03 will be ON

**Correction**

Check the Ethernet cable and switch or IO Device Restart the IO Controller.

**Bus hardware error**

7-segment	MS indicator	NS indicator	Error log (Hex)
E5	ON (red)	OFF	0219

**Likely cause**

Disturbance on the Ethernet network causes the Ethernet interface to fail.

**IO Controller Unit response**

The Unit is not capable to communicate on the PROFINET network and therefore control to the IO Devices will be lost. The Unit will stop processing. Records the error in the error log.

**CIO Area Flags allocated to the IO Controller Unit**

IO Controller status 2 (word n+6) bit 03 will be ON

**Correction**

Check the ethernet network for possible causes of disturbance. This can be EMC influences, broken or shorted Ethernet cable, faulty connectors, defective Ethernet switches or IO Devices and grounding problems to name a few. This will result in interrupted data streams or broken messages.

**8-2-3-4 Memory access errors**

**Special Unit error**

7-segment	MS indicator	NS indicator	Error log (Hex)
--	ON (red)	OFF	0601

**Likely cause**

The PROFINET IO controller encountered an internal error and can not continue.

**IO Controller Unit response**

The Unit will stop processing. Records the error in the error log.

**CIO Area Flags allocated to the IO Controller Unit**

None of the bits is set.

**Correction**

Restart the IO Controller. Replace the IO-Controller if the error recurs.

**Memory access error**

7-segment	MS indicator	NS indicator	Error log (Hex)
E9	Flashing (green)	Flashing (red)	0602

**Likely cause**

During startup the IO Controller encountered a problem reading the PROFINET IO Configuration file. This could be because the Unit started for the first time and does not contain a configuration file yet.

**IO Controller Unit response**

The Unit is started and is capable to receive a PROFINET Configuration. It will not initiate PROFINET IO Communication. Records the error in the error log.

**CIO Area Flags allocated to the IO Controller Unit**

IO Controller status 1 (word n+5) bit 07 will be OFF.

**Correction**

Use CX-ConfiguratorFDT to download a valid PROFINET IO Configuration in the IO Controller. Or restore the Configuration from a Compact Flash memory card. Replace the IO-Controller if the error recurs.

**8-2-3-5 CPU Unit exchange**

**Backplane Bus error**

7-segment	MS indicator	NS indicator	Error log (Hex)
H0	Flashing (red)	OFF	000E

**Likely cause**

The PROFINET IO controller encountered an error while assessing the backplane bus of the PLC.

**IO Controller Unit response**

The Unit will stop processing. Records the error in the error log.

**CIO Area Flags allocated to the IO Controller Unit**

None of the bits is set.

**Correction**

Restart the PLC. Check the PLC for faults in the backplane bus. Replace the IO-Controller or other Units if the error recurs.

**Unit number duplication**

7-segment	MS indicator	NS indicator	Error log (Hex)
H1	Flashing (red)	OFF	--

**Likely cause**

At startup the PROFINET IO Controller detected that there is another Unit having the same Unit number set.

**IO Controller Unit response**

The Unit will stop processing.

**CIO Area Flags allocated to the IO Controller Unit**

None of the bits is set.

**Correction**

Correct the Unit number of the IO Controller or the other Unit. Restart the PLC.

**CPU Unit fault**

7-segment	MS indicator	NS indicator	Error log (Hex)
H6	Flashing (red)	OFF	--

**Likely cause**

The PROFINET IO Controller detected that PLC CPU Unit is faulty.

**IO Controller Unit response**

The Unit will stop processing.

**CIO Area Flags allocated to the IO Controller Unit**

None of the bits is set.

**Correction**

Replace the CPU Unit if the error recurs when the CPU Unit is restarted.

**Backplane bus error**

7-segment	MS indicator	NS indicator	Error log (Hex)
H7	Flashing (red)	OFF	--

**Likely cause**

The PROFINET IO Controller detected that an error on the backplane bus.

**IO Controller Unit response**

The Unit will stop processing. Records the error in the error log. (The time information is set to all zeroes.)

**CIO Area Flags allocated to the IO Controller Unit**

None of the bits is set.

**Correction**

Replace the CPU Unit if the error recurs when the CPU Unit is restarted.

**Cyclic refresh monitor timeout**

7-segment	MS indicator	NS indicator	Error log (Hex)
HE	Flashing (red)	OFF	0001

**Likely cause**

During normal operation the cyclic refresh to the PLC CPU timed out.

**IO Controller Unit response**

The Unit will stop processing. Records the error in the error log.

**CIO Area Flags allocated to the IO Controller Unit**

None of the bits is set.

**Correction**

Replace the CPU Unit if the error recurs when the CPU Unit is restarted.

**Watchdog timer error**

7-segment	MS indicator	NS indicator	Error log (Hex)
H7	Flashing (red)	OFF	0002

**Likely cause**

The PROFINET IO Controller detected a watchdog timer error with the PLC CPU unit.

**IO Controller Unit response**

The Unit will stop processing. Records the error in the error log.

**CIO Area Flags allocated to the IO Controller Unit**

None of the bits is set.

**Correction**

Replace the CPU Unit if the error recurs when the CPU Unit is restarted.

## 8-3 Troubleshooting the Network

### 8-3-1 Troubleshooting Parameter Download

The PROFINET IO Controller DTM provides clear error messages if downloading of the parameters to the PROFINET IO Controller Unit fails. Failure can be due to either

- Errors or inconsistencies in the slave parameter sets, which are checked prior to download.
- The IO Controller DTM being unable to establish communication with the CJ1W-PNT21 PROFINET IO Controller Unit.
- A communication interruption of the process during download.

#### Errors in Slave Parameter Sets

The error messages displayed will provide a clear indication of the problem. A download initiated by the user, starts with a check on the IO Device parameter sets. The IO Controller DTM will check

- The total number of IO Devices assigned, which must be at least one slave device.
- The total number of I/O modules per IO Device, which must be at least one I/O module per IO Device.
- The maximum size of the I/O data size, which must not exceed 7168 words.
- Any existing overlap in the I/O Areas configured.
- Any existing overlap in the allocated PLC memory areas.
- Availability of EM banks should any of the I/O Areas be mapped to one of the EM Banks. Availability of the EM banks depends on the PLC CPU type.

Any of these errors will abort the download process without consequences for the CJ1W-PNT21 PROFINET IO Controller Unit.

#### Errors when Establishing Communication

If no errors occurred during the checking phase, the IO Controller DTM will try to establish communication with the CJ1W-PNT21 PROFINET IO Controller Unit through CX-Server. If this fails, an error message will be displayed, indicating a communication problem. A failure to establish communication prior to download will have no consequences for the CJ1W-PNT21 PROFINET IO Controller Unit.

#### Errors During Download

If none of the first two processes result in a failure, downloading will commence. As soon as downloading has started, the configuration data in the CJ1W-PNT21 PROFINET IO Controller Unit will be over written.

#### Recovery After Failing Download

If a failure occurs during the download process, which prevents the IO Controller DTM from completing the process, the user must restart the Unit manually. Restarting the IO Controller Unit will abort the download process in the Master Unit and recover the previous configuration from its memory.

### 8-3-2 Troubleshooting the Network using CX-ConfiguratorFDT

CX-ConfiguratorFDT provides several means to troubleshoot either the CJ1W-PNT21 PROFINET IO Controller Unit, the IO Devices or the network. The means all rely on features discussed in the previous section.

#### Troubleshooting the IO Controller Unit

To troubleshoot the IO Controller Unit or the network, the IO Controller DTM Diagnosis User Interface provides a help in determining problems. The figure below shows the Diagnosis - IO Controller Status item of the IO Controller DTM Diagnosis User Interface.



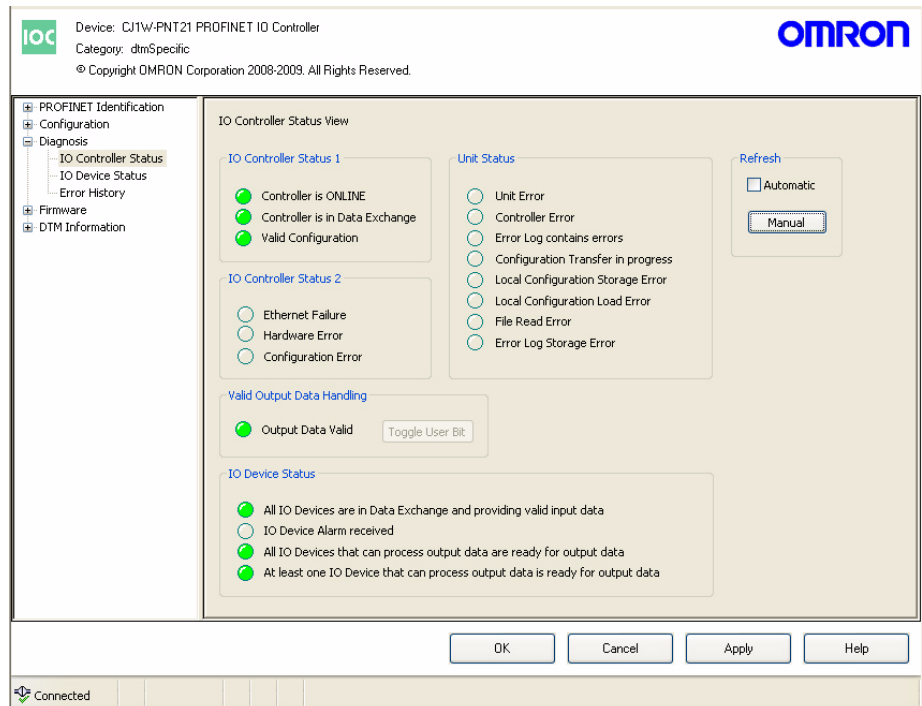


Figure 8.2: IO Controller status view

The LED indicators shown in the (example) figure above are all related to bit flags in the Unit Status Word, the IO Controller Status Word 1 and Word 2, and the IO Device Status Word.

**Unit Status**

The table below lists combinations of LED indicators with information on possible problems. They are derived from the Unit Status word. If one of the errors occur then there is a problem with the IO Controller itself. Probably the Unit needs to be replaced.

LED Indicators	Description/Correction
Unit Error	The Unit Error flag is ON if the unit has an error. That is if one of the other error flags in the Unit Status is ON.
Controller Error	The Controller Error Flag is On if one of the IO Controller Status 2 error flags is ON.
Error Log contains errors	When a new error is logged in the Error Log then this flag is ON. After reading or clearing the Error Log this flag is OFF. Reading or Clearing the Error Log can be done or by the Diagnosis Error History of the IO Controller DTM or by using the appropriate FINS commands.
Configuration Transfer in progress	During download of a new configuration from the IO Controller DTM to the IO controller this flag is ON

LED Indicators	Description/Correction
Local Configuration Storage Error	After the download of a new configuration or a restore from the Compact Flash card in the PLC CPU the IO Controller will store the configuration in its memory. If it does not succeed then this flag is ON. Try to download the configuration again. If the problem persists the replace the IO Controller.
Local Configuration Load Error	During startup of the IO Controller loads the configuration from memory. If it does not succeed then this flag is ON. Try to download the configuration again. If the problem persists the replace the IO Controller.
File Read Error	If the IO Controller restores a configuration from Compact Flash card in the PLC CPU and it can not access the configuration file on the Compact Flash card then this flag is ON.
Error Log Storage Error	If a new error needs to be written to the Error Log and the IO Controller does not succeed in storing this error in the Error Log then this flag is ON.

**IO Controller Status 1**

The IO Controller Status 1 word displays the state of the Unit. It shows if the IO Controller can go on the network and communicate with the current configuration with the IO devices.

LED Indicators	Description/Correction
Controller is ONLINE	Normally the IO Controller is always Online. If the IO Controller has gone Offline then a severe error has occurred. Check the Unit Status and the Error History to see the cause. Eventually replace the Unit.
Controller is in Data Exchange	The IO Controller is in Data Exchange when it can reach at least one of the configured IO devices. This shows that the network connection to the IO Devices works. If some of the IO Devices can not be reached it is a network issue and not an issue of the IO controller. If the IO Controller is out of Data Exchange it means that there is something wrong with the network connection from the IO Controller to the IO Devices.

LED Indicators	Description/Correction
Valid Configuration	At startup the IO Controller checks if the stored configuration is valid. A new IO Controller contains no configuration yet so therefore it will show it has no valid configuration. If a configuration is not valid it means that means the file could be damaged. It is possible to download the configuration again with CX-ConfiguratorFDT. If downloading the configuration to the Unit does not solve the issue then replace the unit.

**IO Controller Status 2**

The IO Controller Status 2 word displays the state of the Unit's network interface. It shows if the Ethernet cable is correctly inserted in the IO Controller and an Ethernet Link could be established to the connected switch or IO Device. Or that the Ethernet interface of the Unit itself encountered a problem.

LED Indicators	Description/Correction
Link Status	The Unit could not establish an ethernet link at 100Mbps, Full Duplex to the connected switch or IO device. It could be that the Ethernet cable is damaged or not correctly inserted. Or that the connected device has a fault.
Hardware Error	The Ethernet controller of the Unit encountered a problem. It could be because of faulty access or there where broken messages or interrupted data streams from the network. This could be caused by external influences on the network.
Configuration Error	At startup the IO Controller checks if the stored configuration is valid. A new IO Controller contains no configuration yet so therefore it will show it has no valid configuration. If a configuration is not valid it could be that the file is damaged. It is possible to download the configuration again with CX-ConfiguratorFDT. If downloading the configuration to the Unit does not solve the issue then replace the unit.

**IO Device Status**

The IO Device Status word displays the state of the Unit's communication to its assigned IO Devices. Whether all or at least one IO Device that can process output data are connected. And if all IO Devices configured are supplying valid input data.

If one or more IO Devices have an Alarm then this will also be signalled.

LED Indicators	Description/Correction
All IO Devices are in Data Exchange and providing valid input data.	The Unit could establish a connection to all configured IO devices. All these IO Devices are now in Data Exchange and are providing valid input data. If one of the IO Devices sets it input data to be invalid then there could be something wrong with that IO Device. For more information refer to the IO Device Status item or to the IO Device DTM itself for further information. Also when an IO Device is simply turned off it is signalled here also.
IO Device Alarm received.	One of the IO Devices signalled it has a alarm available. Refer to the IO Device status item or the IO Device DTM to retrieve further.
All IO Devices that can process output data are ready for output data.	The IO Controller has found all configured IO Devices with output data and successfully created a connection to them. Now the output data must be activated by setting the state of the output data to valid. Output data is set valid by the IO Controller depending on the setting Valid Output Data Handling in the IO Controller Setup item. It could be or PLC Mode Dependent or User Bit Controlled.
At least one IO Device that can process output data is ready for output data.	The IO Controller has found at least one configured IO Devices with output data and successfully created a connection to it. If the IO Controller can reach at least one but not all IO Devices this could mean that something is wrong with the network connection to that part of the network. To see which IO devices can not be reached refer to the IO Device Status item.

**Valid Output Data Handling**

The IO Controller signals to the IO Devices that the output data it is sends is valid or not. The IO Devices use the state of the output data to active their outputs. If the output data is set to invalid it is up to the settings of the IO Device what will happen. Normally the IO Device will go to an fail-safe state. the PROFINET IO connection between the IO Controller and IO Device will stay intact.

The Toggle User Bit button will be accessible if the setting in the IO Controller Setup item for the Valid Output Data Handling is set to User Bit Controlled. Now it is possible to manipulate the Set Output Data Valid in Software Switches 1 (word N bit 12). Normally this bit would be controlled by the PLC program.

LED Indicators	Description/Correction
Output Data Valid.	<p>If set the IO Controller sends valid output data to the IO Devices. The IO Devices should normally operate their outputs. If not set the IO Devices will set their outputs to a safe state. The IO Controller handles the state of the output data depending on the setting if it is:</p> <ul style="list-style-type: none"> <li>• PLC Mode Dependent</li> <li>• User Bit Controlled</li> </ul> <p>If IO Devices do not operate their outputs please check the setting of the Valid Output Data Handling and the according handling in the PLC program.</p>

**Troubleshooting IO Devices**

The IO Device Status item gives an overview which IO Devices are in Data Exchange and which of them have reported new errors. By selecting a IO Device or in the New Alarm & Data Exchange Active Flags Area or by the Selected IO Device menu more information about the alarm is displayed.

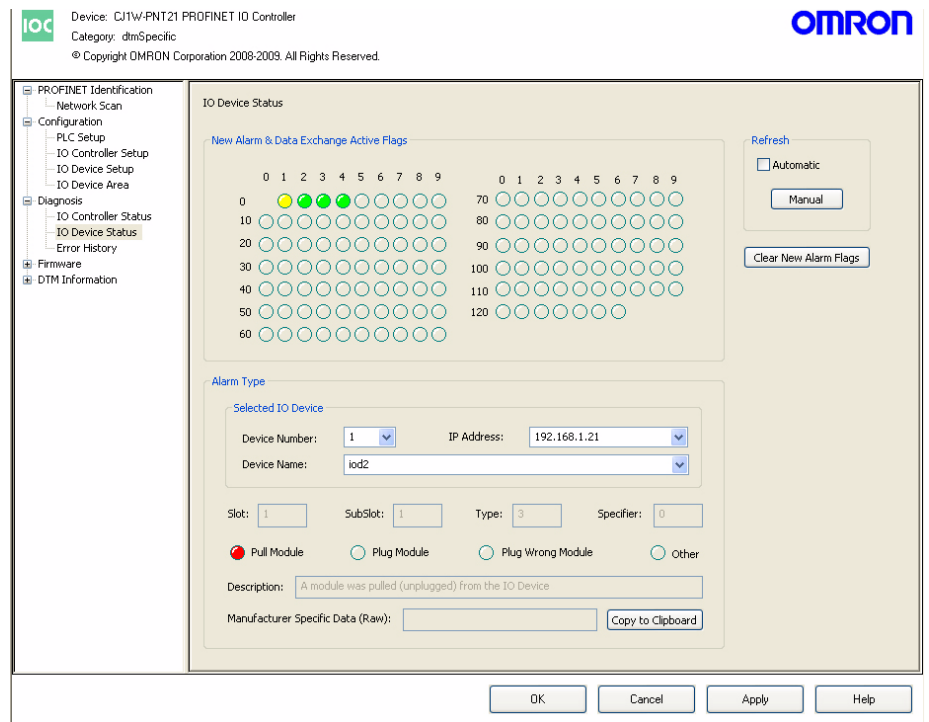


Figure 8.3: IO Device status

Missing IO Devices will be marked will be marked Red.  
 IO Devices that signalled an alarm will be Yellow.  
 The standard PROFINET alarms are implemented:

- Pull Module
- Plug Module
- Plug Wrong Module
- Other

When the type of Alarm is Other then additional information can be found in the Description and the Manufacturer Specific Data (Raw) fields. The additional information can be copied to the Clipboard for further analysis. When selecting an IO Device either in the New Alarms & data Exchange Active Flags or the Selected IO Device area will show the last known alarm of the IO Device. It does not necessarily mean that the alarm is still active. If a IO Device has an active alarm that this will be displayed in the colour of the IO Device (Yellow). Alarms can be acknowledged with the Clear new Alarm Flags button.

**Error History**

The Error History item is reading the Error Log in the IO Controller. The IO Controller stores up to 30 errors in its Error Log. Information on the errors logged can be found in the list of errors. Below the Error Log View is displayed.

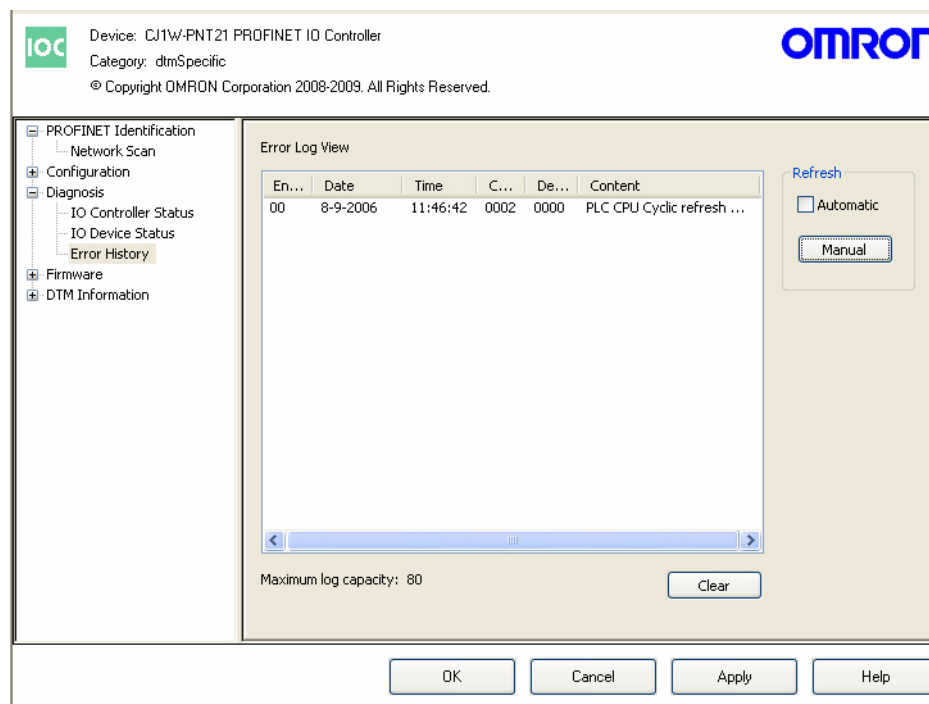


Figure 8.4: Error history


## 8-4 Maintenance

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

### 8-4-1 Cleaning

Clean the PROFINET IO Controller 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, benzene or chemical wipes. These substances could damage the surface of the Unit.

### 8-4-2 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

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	---

## 8-5 Replacing the Unit

### 8-5-1 Replacement Precautions

The PROFINET IO Controller 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 Controller Unit at hand so that repairs may be conducted quickly.

**Replacement Precautions** Observe the following precautions when replacing the Unit.

- 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.

### 8-5-2 Setting up the Unit after Replacement

Setting up the IO Controller Unit again after replacement can be done in two ways. Anyway the IO Controller needs to have a configuration loaded to operate.

The configuration can be stored in the new Unit by:

- Downloading it from CX-ConfiguratorFDT.  
Refer to the section that handles the download of the configurator
- Using the backup functionality of the CJ1 PLC.  
Refer to the CJ1 PLC operation manual.

Re-connect the IO Controller to the network, and restart operation.



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## **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.

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## 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.

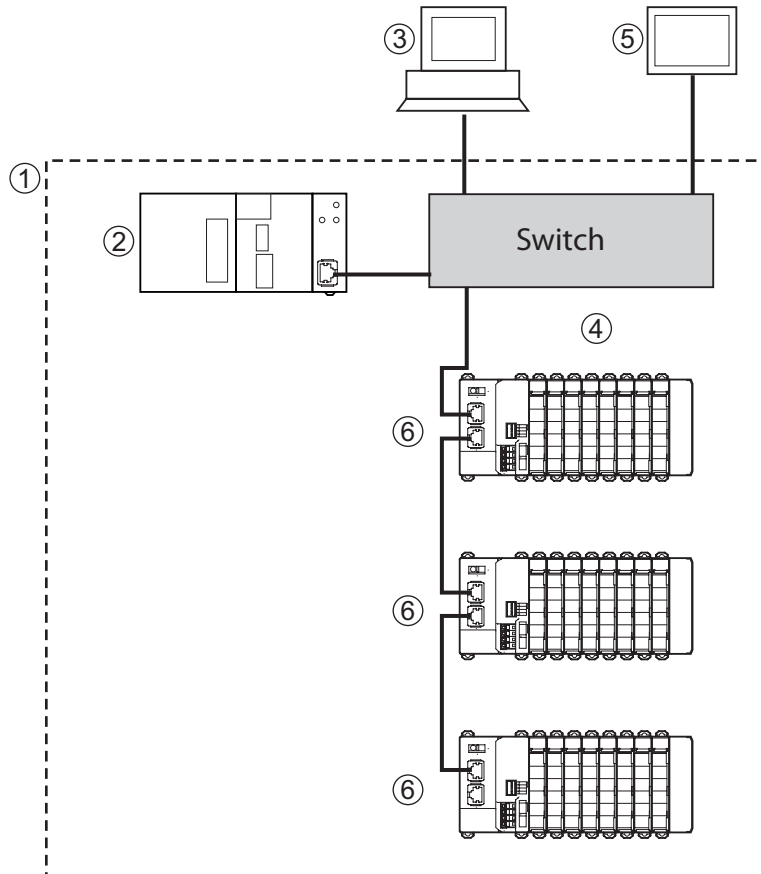
For the prioritized transmission of RT-frames, Real-Time communication uses the VLAN tag as defined in IEEE 802.1Q.

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.

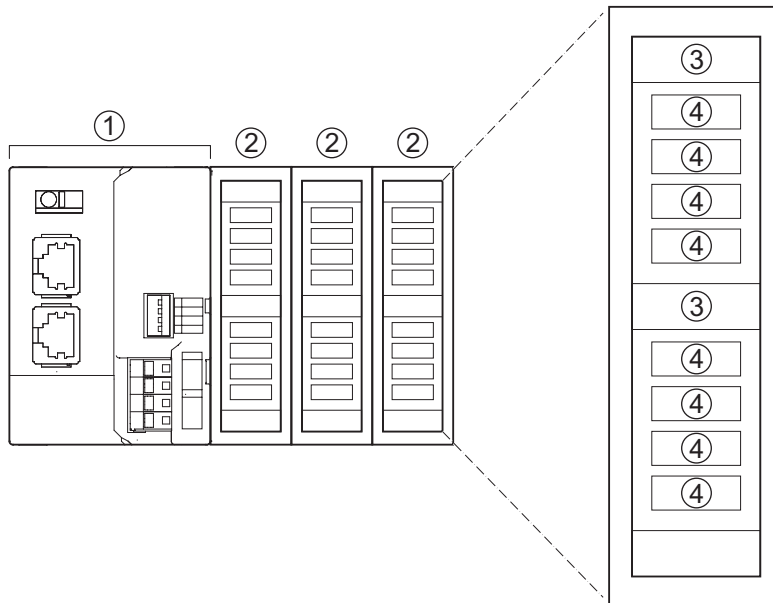
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**Index**

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.

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## 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.

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## 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

Since the IO Device is only capable to hold detailed alarm information for 2 alarms (1 high and 1 low alarm) the alarm must be acknowledged by the IO Controller. When an IO Device generates an alarm this is reported via bit 4, IO Devices Alarm received, in the IO Device status (see section 5-2-5 IO Device status (Word n+7)).

The IO Device New Alarm flags area (see section 5-2-7 IO Device New Alarm flags (Word n+17 ~ Word n+25)) can be used to determine the IO Device(s) reporting the alarm(s). To read the alarm data use the FINS memory area read command (see section 6-2-1 MEMORY AREA READ (0101)). As a result the alarm flag(s) will be cleared and IO Devices can report new alarms.



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## 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.



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## Appendix B PROFINET IO alarm messages

### B-1 Introduction

PROFINET IO Devices 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.

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## 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. <b>Bit:</b> <b>Description:</b> 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.

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## 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.

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### 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.

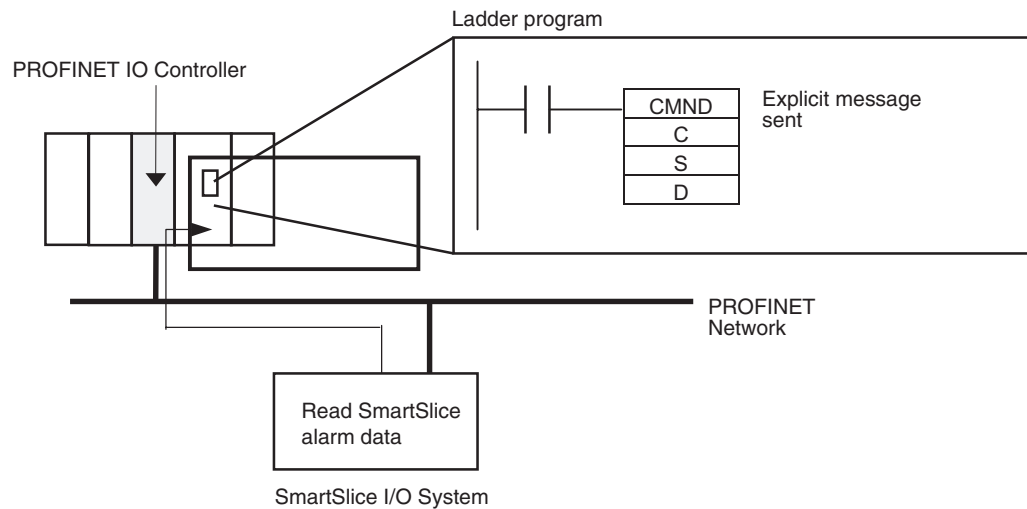
### Configuration

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)



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## Appendix D Memory Card Backup Functions

### D-1 Outline of Function

The PROFINET IO Controller Unit stores the following setup data in the internal non-volatile memory (Flash ROM).

- PROFINETIO Connection Parameters set;
- Allocated IO Device Parameter sets.

All these parameter sets can be backed up to and restored from a Memory Card mounted to the CPU Unit. If the parameter data of a good functioning PROFINET IO Controller Unit has been saved on a Memory Card, this saved data can be used to perform a quick configuration, when replacing the PROFINET IO controller Unit, without the direct use of the Configuration software. The data can be backed up to a Memory Card only. It cannot be backed up to a EM file.

The backup process does not only involve the backup of the PROFINET IO Controller parameter data, but also the parameter data of any other Special CPU Bus Unit on the same PLC, as well as the PLC program, parameter area data, and I/O memory data. This function can be executed in any operating mode.

When performing a backup from the PROFINET IO Controller Unit to the Memory Card, the parameter sets are stored in the file BACKUPnn.PRM, where nn is the Unit number in 2-digit hexadecimal.

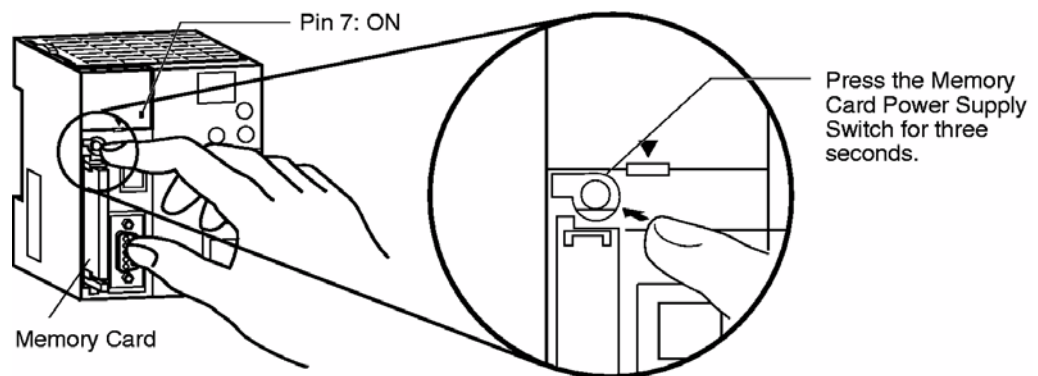
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## D-2 Backing Up Unit Setup Files

In order to save the Unit's parameter sets to the Memory Card mounted to the CPU Unit, perform the following procedure (see figure below).

- 1 Make sure that the parameter sets in the Unit are correct and that the Unit starts up normally, and insert a Memory Card into the Card slot.
- 2 Turn ON pin 7 of the DIP switch on the front of the CPU Unit (behind the cover above the Memory Card slot).
- 3 Press and hold the Memory Card power supply switch for 3 seconds. When the switch is pressed, the MCPWR Indicator on the front of the CPU Unit will flash once and then remain lit while the data is being written. The indicator will go OFF after the data has been written properly. During the transfer to the Memory Card, the Parameter Transfer in Progress bit in Unit Status Word (CIO Word n+4) will turn ON.



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## D-3 Restoring Unit Setup Files

In order to restore the Unit's parameter sets from the Memory Card mounted to the CPU Unit, perform the following procedure.

- 1 Power down the PLC and insert a Memory Card into the Card slot.
- 2 Turn ON pin 7 of the DIP switch on the front of the CPU Unit (behind the cover above the Memory Card slot).
- 3 Turn ON the PLC's power supply.
- 4 When the PLC's power is turned ON, the MCPWR Indicator on the front of the CPU Unit will light and flash once. The MCPWR Indicator will remain lit while the data is being read. The Indicator will go OFF after the data has been read properly. During the Data Transfer the Parameter Transfer in Progress bit in Unit Status Word (CIO Word n+4) will turn ON.
- 5 Restart the PLC.

### Note

- 1 Data will not be read from the Memory Card to the CPU Unit if pin 1 of the DIP switch is ON (write-protecting program memory).
- 2 A CJ1 CPU Unit will remain in PROGRAM mode after the simple backup operation has been performed and cannot be changed to MONITOR or RUN mode until the power supply has been cycled. After completing the backup operation, turn OFF the power supply to the CPU Unit, change the settings of pin 7, and then turn the power supply back ON.
- 3 File backups may take from several seconds to several minutes. Refer to CS/CJ-series Programming Manual (W394) for information on execution times.
- 4 If an error occurred in the transfer from the Memory Card to the Unit, the File Read Error bit in Unit Status Word (CIO Word n + 4, bit 09) will turn ON. To correct this, re-perform the Restore action. If the problem persists, use CX-ConfiguratorFDT to download the original settings from the PC.



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## **Revision History**

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### **Revision history**

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

Cat. No. W12E-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.

<b>Revision code</b>	<b>Date</b>	<b>Revised content</b>
01	20090729	First version
02	20100208	Clarified COMM led, Modified E7 and C9 error code





# OMRON

**Authorized Distributor:**