Cat. No. W18E-EN-02

SmartSlice GRT1-Series
GRT1-ECT

EtherCAT Communication Unit

OPERATION MANUAL

OMRON

GRT1-series
EtherCAT Communication Unit

Operation Manual

Revised March 2012

Introduction

Thank you for purchasing a GRT1-series EtherCAT Communication Unit.
This manual contains information you need to know to use the EtherCAT Communication Unit.
Before use, please make sure that you thoroughly read this manual and have a full understanding of the products functions and performance.
After you finished reading this manual, please keep it in a convenient place.

Intended Readers

This manual is intended for certified electricians (or individuals having equivalent knowledge) who are also qualified for Introducing, Designing or Managing Field Automation systems

Manual Layout, Icons, Typography

Page Structure

This manual's page structure consists of the following.

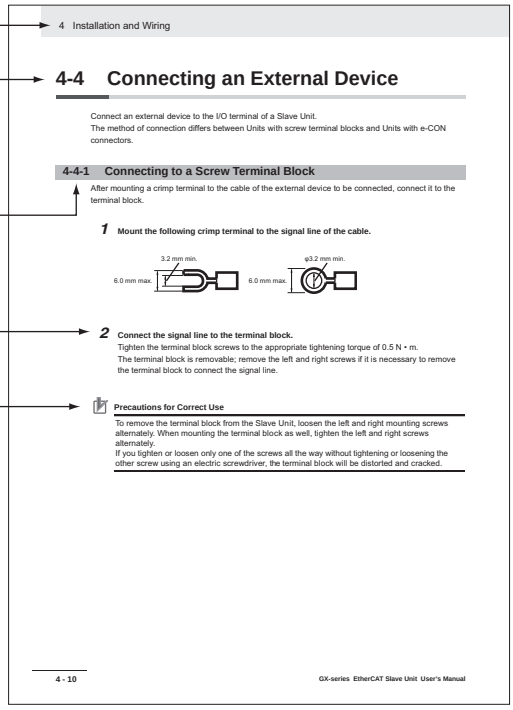
Chapter title

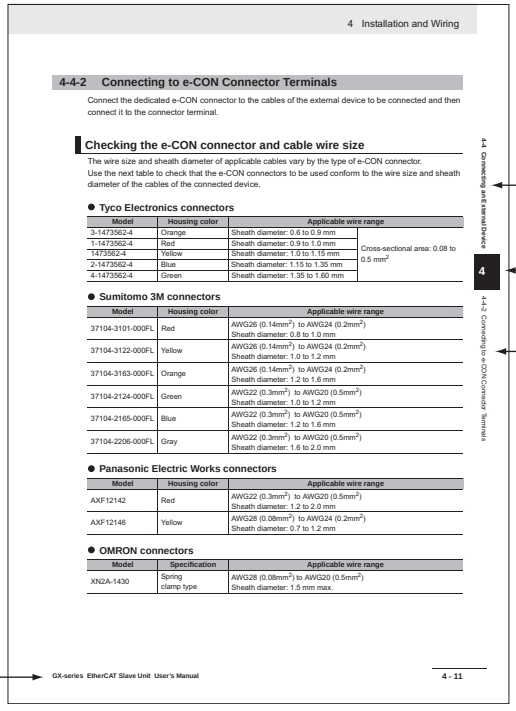
Clause title
Indicates the clause title of the current page.

Section title

Operation procedure number
Indicates operation procedure.

Icon
(Refer to the following section.)





Clause title
Indicates the chapter title of the current page.

Indexes
Indicates the chapter number of the current page.

Section title
Indicates the section title of the current page.

Name of manuals

Icons

The meanings of the icons used in this manual are as follows.

Precautions for Safe Use

Indicates precautions on what to do and what not to do to ensure using the product safely.

Precautions for Correct Use

Indicates precautions on what to do and what not to do to ensure proper operation and performance.

Additional Information

Additional information to read as required.
This information is provided to increase understanding or make operation easier.

Reference

This explains useful tips and reference information when using the product.

Typography

CAPITALS for names displayed on hardware and for abbreviations.
E.g. “The RUN LED will be On”

Bold for names that can be read from the computer monitor.
E.g. “Right-click **EtherCAT** and then select **Edit**.”

<Carets> for keys on the keyboard.
E.g. "Press the <Enter> key."

Manual Structure

This manual consists of the following chapters.

Chapters		Contents
Chapter 1	EtherCAT Network	Explains about the EtherCAT features and the network configuration.
Chapter 2	EtherCAT Communication details	Explains the details of EtherCAT communication.
Chapter 3	GRT1-ECT Network location and Features	This section provides an introductory overview of the GRT1 series SmartSlice I/O Units and the GRT1-ECT EtherCAT Communication Unit and its functions for an EtherCAT network.
Chapter 4	GRT1-ECT Details	This section gives detailed information on the hardware of the GRT1-ECT.
Chapter 5	GRT1-ECT Procedures	This chapter explains basic procedures and settings for the Communication Unit and the EtherCAT Slaves.
Chapter 6	GRT1-ECT Troubleshooting	This contains troubleshooting and inspection methods intended for individuals to handle abnormalities and conduct regular inspections.
Chapter 7	GRT1-ECT Installation	This chapter explains mounting, wiring and replacement of the EtherCAT Slave.
Chapter 8	Sysmac Studio	Explains how to use Sysmac Studio to be able to connect the GRT1-ECT to an NJ-series CPU Unit.
Appendices		
A1	Appendix EtherCAT Terminology	EtherCAT terminology and explanations.
A2	Appendix EtherCAT Specifications	EtherCAT specifications.
A3	Appendix GRT1-ECT Specifications	GRT1-ECT specifications including dimensions.
A4	Appendix Object Dictionary	Object Dictionary of the GRT1-ECT

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

Related Manuals

Refer to following EtherCAT related manuals for more information:

Man No.	Name of manuals	Contents
W455	GRT1-Series SmartSlice I/O Units Operation Manual	Describes the models, specifications, functions, operating procedures, and applications of GRT1-series Slice I/O Units.
W504	Sysmac Studio Manual	An introduction to the Support Software is provided along with information on the installation procedure, basic operations, connection procedures, and procedures for the main features.
W505	NJ-series CPU Unit Built-in EtherCAT Port CPU Unit User's Manual	Information on the built-in EtherCAT port is provided. This manual provides an introduction and provides information on the configuration, features, and setup.

Warranty and Limitations of Liability

WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

LIMITATIONS OF LIABILITY

OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall the responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

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.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

PROGRAMMABLE PRODUCTS

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

Disclaimers

CHANGE IN SPECIFICATIONS

Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the products may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

DIMENSIONS AND WEIGHTS

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

PERFORMANCE DATA

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.

Safety Precautions

This section gives detailed information on Safety Precautions, Precautions for Safe use and Precautions for Correct Use.

Labels and Meanings to Ensure Safe Usage

To ensure safe usage of the EtherCAT Slave, the precautions in this manual are displayed with the following labels and symbols.
The precautions explained in this section describe important information regarding safety. These precautions must be followed without fail.

⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. Additionally, there may be severe property damage.
⚠ Caution	Indicates a potentially hazardous situation which, if not avoided,may result in minor or moderate injury, or property damage.

Symbols

⃠ This symbol indicates a prohibited item (an item you must not do).

The specific instruction is indicated using text inside the ⃠.
The symbol shown to the left indicates "disassembly prohibited".

△ This symbol indicates caution (warnings included).

The specific instruction is indicated using text inside the △.
The symbol shown to the left indicates "typical cautions".

● This symbol means it is a compulsory item (an item that must be done).

The specific instruction is indicated using text inside the ●.
The symbol shown to the left indicates "typical compulsory items".

⚠ WARNING

Do not attempt to take any Unit apart and do not touch the interior of any Unit while the power is being supplied. Also, do not turn ON the power supply while the cover is open.
Doing any of these may result in electric shock.

Do not attempt to disassemble, repair, or modify any Units.
Doing any of these may result in electric shock.

Do not input voltages or currents exceeding the rated range to the Unit.
Using voltages or currents exceeding the rated range may cause Unit failure or fire.

Provide safety measures in external circuits (i.e., not in the Units), 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 PLC operation. ("PLC" includes CPU Units, other Units mounted in the PLC, and Remote I/O Terminals.)
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, not in the Units.
The PLC will turn OFF all outputs when its self-diagnosis function detects any error or when a severe failure alarm (FALS) instruction is executed. As a countermeasure for such problems, external safety measures must be provided to ensure safety in the system.
The Slave 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) 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.
Implement proper measures as part of your communication system or in your program to ensure safety in the system even when a communication error or malfunction occurs during remote I/O communication.

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 I/O Units, Special I/O Units, or CPU Bus Units. Any changes to the data allocated to any Unit specifically the Special I/O Units/CPU Bus Units may result in unexpected operation of the loads connected to the Unit.

- Transferring I/O memory data to the CPU Unit with a Programming Device (PC tool).
- Changing present values in memory with a Programming Device.
- Force-setting/-resetting bits with 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.

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.

Precautions for Safe Use

Observe the following precautions when using the Unit.

Power Supply

- Always use the power supply voltage specified in this manual. An incorrect voltage may result in malfunction or burning.
- Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied. Be particularly careful in places where the power supply is unstable. An incorrect power supply may result in malfunction.
- Always turn OFF the power supply to the PLC, Slaves and other Units before attempting any of the following. Not turning OFF the power supply may result in malfunction or electric shock.
  - Assembling any Units (Expansion Units).
  - Removing or attaching the terminal blocks or connectors to Slave.
  - Replacing parts (e.g., relays).
  - Setting the DIP switches and rotary switches.
  - Connecting cables or wiring the system.

Installation

- Before touching a Unit, be sure to first touch a grounded metallic object in order to discharge any static build-up. Not doing so may result in malfunction or damage.
- Make sure that the terminal blocks, communication cables, and other items with locking devices are properly locked into place. Improver locking may result in malfunction.
- Mount the Units securely using DIN rail.
- Make sure that all Slave mounting screws and cable connector screws are tightened to the torque specified in this manual. Incorrect tightening torque may result in malfunction.
- Make sure that all terminal block screws are tightened to the torque specified in this manuals. Incorrect tightening torque may result in fire, malfunction, or failure.
- Always use the specified communication cables and connectors.
- Do not extend connection distances or the number of connected nodes beyond the ranges given in the specifications.
- When there are multiple systems, keep the cables unbundled and separated by at least 5 mm to prevent unstable operation due to interference.

Wiring

- Turn the power on after checking that the wiring and switch settings are correct.
- Use the correct wire tools to wire the Unit.
- Confirm the polarity of all terminals before wiring them.
- Do not allow foreign matter to enter the Units when wiring and installing the Units.
- 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 past their natural bending radius.
  - Do not pull on the communication cables.
  - Do not place heavy objects on top of the communication cables.
  - Always lay communication cable inside ducts.
- Turn OFF the power of PLC and all the Slaves berofe wiring the communication cables.
- Do not apply voltages to the Input Slaves in excess of the rated input voltage. Excess voltage or loads may result in burning.
- Do not apply voltages or connect loads to the Outputs Slaves in excess of the maximum switching capacity. Excess voltage or loads may result in burning.

● Handling

- When transporting the product, use special packing boxes, and protect it from being exposed to excessive vibration or impact during transportation.
- Do not bend cables past their natural bending radius or pull on cables.
- After replacing Units, resume operation only after transferring to the new CPU Unit and/or Special I/O Units the contents of the DM Area, HR Area, and other data required for resuming operation. Not doing so may result in unexpected operation.
- Check the user program for proper execution before actually running it on the Unit. Not checking the program may result in unexpected operation.
- When replacing relays or other parts, be sure to confirm that the ratings of the new part are correct. Not doing so may result in malfunction or burning.
- Confirm that no adverse effect will occur in the system before attempting any of the following.
  - Changing the operating mode of the PLC.
  - Setting/resetting any bit in memory.
  - Changing the present value of any word or any set value in memory.
- Do not use thinner when cleaning. Use commercially available alcohol.

● External Circuits

- Install external breakers and take other safety measures against short-circuiting in external wiring.

Precautions for Correct Use

- Wire all connections correctly according to instructions in this manual.
  Failure to install them may result in serious accidents.
- Do not operate the control system in the following locations:
  - Location subject to direct sunlight.
  - Locations subject to temperatures or humidity outside the range specified in the specifications.
  - Locations subject to condensation as the result of severe changes in temperature.
  - Location subject to corrosive or flammable gases.
  - Location subject to dust (especially iron dust) or salts.
  - Location subject to exposure to water, acid, oil, chemicals, etc.
  - Locations subject to shock or vibration.
- Confirm voltage specifications when wiring communication, the power supply, and I/O crossovers.
  Incorrect wire may result in malfunction.
- Wire all connections correctly according to instructions in this manual.
- Use the correct wiring materials to wire the Unit.
- Take appropriate and sufficient countermeasures when installing systems in the following locations:
  - Locations subject to static electricity or other forms of noise.
  - Locations subject to strong electromagnetic fields.
  - Locations subject to possible exposure to radioactivity.
  - Locations close to power supplies.
- Do not drop any Unit or subject any Unit to excessive shock or vibration. Otherwise, Unit failure or malfunction may occur.

Conformance to EC Directives

Applicable Directives

- EMC Directives
- Low Voltage Directive

Concepts

EMC Directives

The OMRON products described in this manual are designed so that they individually comply with the related EMC Directives so that they can be more easily built into other devices or the overall machine. The actual products have been checked for conformity to EMC Directives (See note)*. Whether the products conform to the standards in the system used by the customer, however, cannot be checked by OMRON and must be checked by the customer. EMC-related performance of the OMRON devices that comply with EC Directives will vary depending on the configuration, wiring, and other conditions of the equipment or control panel on which the OMRON devices are installed. The customer must, therefore, perform the final check to confirm that devices and the overall machine conform to EMC standards.

* Note: Applicable EMC (Electromagnetic Compatibility) standards are as follows:
EMS (Electromagnetic Susceptibility): EN 61131-2 and EN 61000-6-2
EMI (Electromagnetic Interference): EN 61131-2 and EN61000-6-4
(Radiated emission: 10-m regulations)

Low Voltage Directive

Always ensure that devices operating at voltages of 50 to 1,000 VAC and 75 to 1,500 VDC meet the required safety standards.
Applicable standard: EN 61131-2

Conformance to EC Directives

The OMRON products described in this manual comply with the related EMC Directives. To ensure that the machine or device in which the products are used complies with EC Directives, the products must be installed as follows:

- The products must be installed within a control panel.
- A DC power supply with reinforced insulation or double insulation that can maintain a stable output even if the input is interrupted for 10 ms must be used for communication power, internal power, and I/O power. The OMRON S8JX-series Power Supply is recommended. (See note.)*
- Products complying with EC Directives also conform to the Emission Standards (EN 61131-2 and EN 61000-6-4). Radiated emission characteristics (10-m regulations) may vary depending on the configuration of the control panel used, other devices connected to the control panel, wiring, and other conditions. You must therefore confirm that the overall machine or equipment complies with EC Directives.
- Conformance with the EC Directives was confirmed with a system configuration using I/O wiring lengths of less than 30 m.

* Note: Conformance with the EMC Directive was confirmed when using the recommended power supply.

Trademarks

- EtherCAT(R) is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.
- Windows is a registered trademark of Microsoft Corporation in the USA.
- SYSMAC is a registered trademark for Programmable Controllers made by OMRON Corporation.
- CX-One is a registered trademark for Programming Software made by OMRON Corporation.

Other system names and product names that appear in this manual are the trademarks or registered trademarks of the relevant companies.

Contents

Chapter A4 Appendix Object Dictionary A4-1

1

EtherCAT Network

This chapter explains the overview of EtherCAT network.

1-1 Overview of EtherCAT Networks

EtherCAT (Ethernet Control Automation Technology) is a high-performance industrial network system based on the Ethernet system that can realize fast and efficient communication.
Additionally, although EtherCAT is a unique communication protocol, it employs standard Ethernet technology in the physical layer. Using standard Ethernet technology has advantages like decreasing training needs and the use of commercially available Ethernet tools like cables.
EtherCAT can be used for large-scale control systems but also for small- and medium-scale applications.

1-1-1 Features of EtherCAT

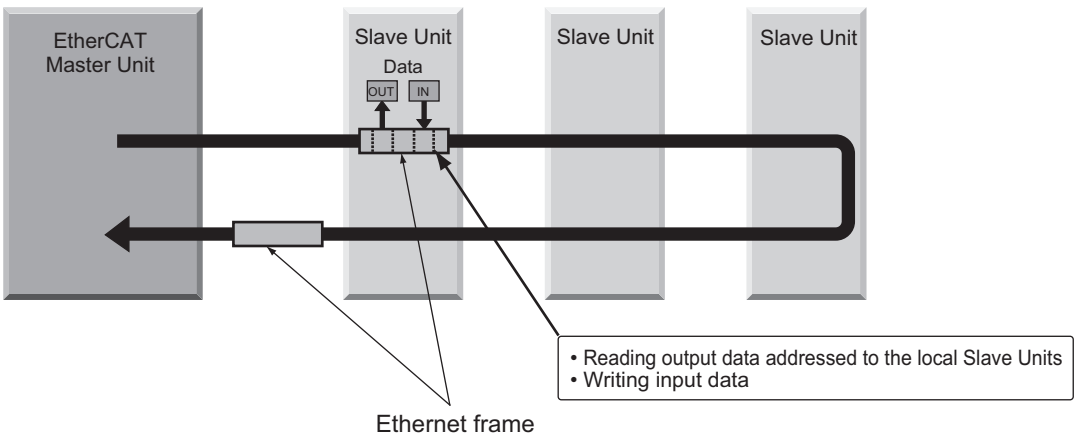
EtherCAT has the following features.

- **Extremely high-speed communications with speed of 100 Mbps**
  It dramatically shortens the I/O response time from the generation of input signals to the transmission of output signals. It makes the best use of the optimized Ethernet frame band, and transmits with the high-speed repeat method, thereby allowing transmitting various types of data at high efficiency.

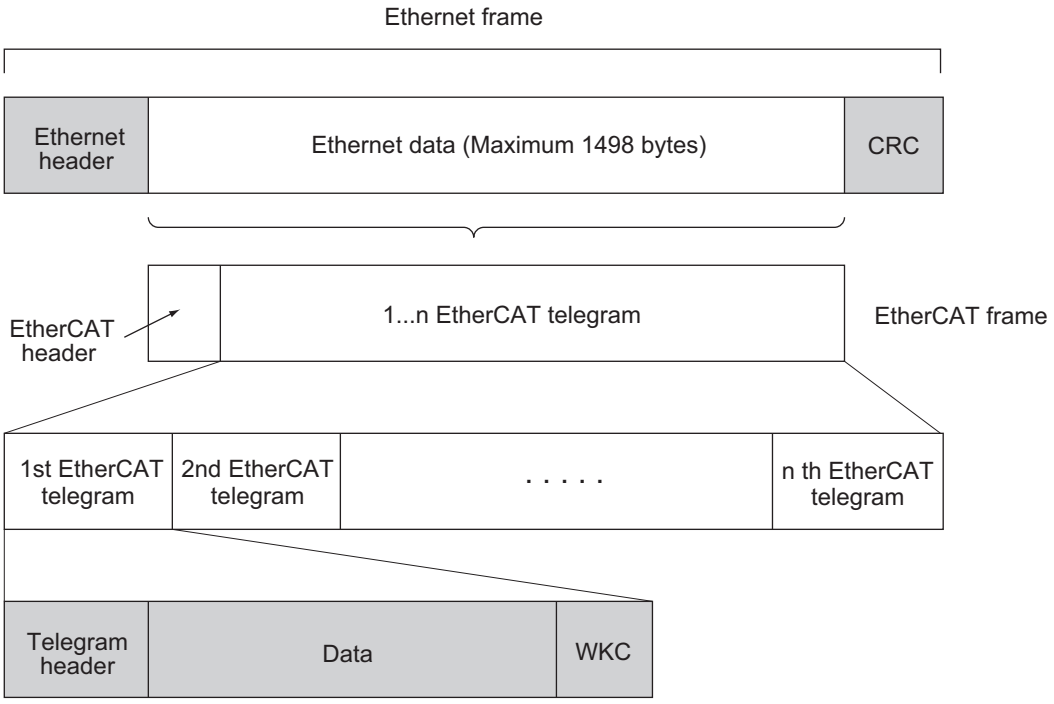
- **Employment of standard Ethernet technology**
  EtherCAT is a global open network that employs standard Ethernet technology in the physical layer. For this reason, commercially available Ethernet cables, connectors, tools, and other general-purpose products can be used.

1-1-2 Structure of EtherCAT

EtherCAT does not transmit data to each node on a network, but gets Ethernet frames through each node. At passing, each node reads and writes data in Units of several nanoseconds in its own area within a frame.
Ethernet frames sent from the EtherCAT Master Unit go through all the EtherCAT Slaves without stopping on the way. Once they reach the final Slave, they are sent back from the final Slave, pass through all Slaves again, and return to the EtherCAT Master Unit.
With this structure, EtherCAT secures high-speed and real-time data transmission.



It is the "EtherCAT telegram" stored directly in an Ethernet frame that exchanges data regularly between the EtherCAT Master Unit and Slaves.
Each "EtherCAT telegram" is configured with telegram header (data length, including address of one or more Slaves, etc.), data, working counter (check bit).
When an Ethernet frame is compared to a "train", an EtherCAT telegram can be considered as "railway car."



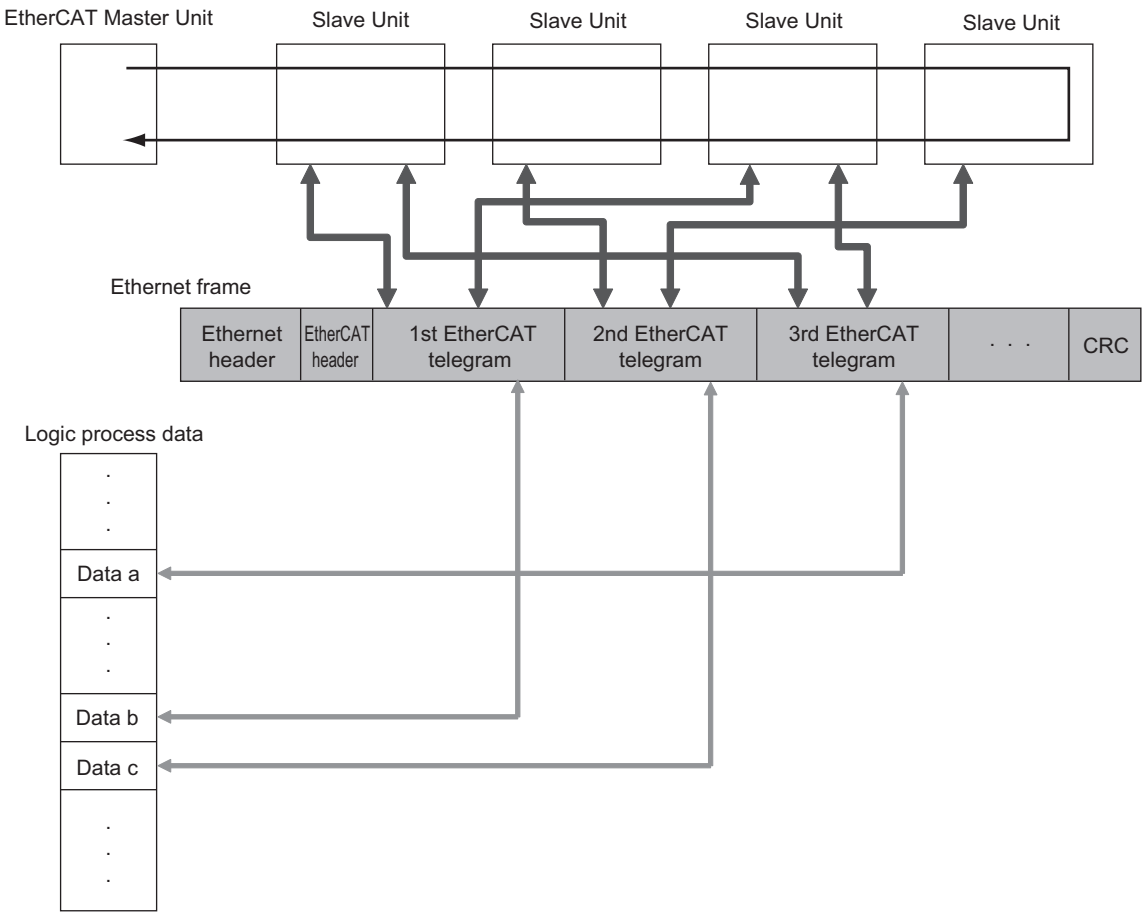
WKC : Working counter

1-1-3 Communication types of EtherCAT

EtherCAT provides the following two types of communication types.
PDO communications are always updating data per communication cycle on EtherCAT, while SDO communications are processed in between those updates.

Process Data Communication functions (PDO communication)

The PDO communication function is used to transfer process data in real time in a fixed-cycle.
By mapping logical process data space to each node by the EtherCAT Master Unit, it achieves fixed-cycle communication among the EtherCAT Master Unit and Slaves.



Mailbox communication functions (SDO communication)

Communication with Service Data Objects (SDO) refers to message communication.
At any timing, the EtherCAT Master Unit transmits commands to Slaves and the Slaves return responses to the EtherCAT Master Unit.
It performs the following data communication:

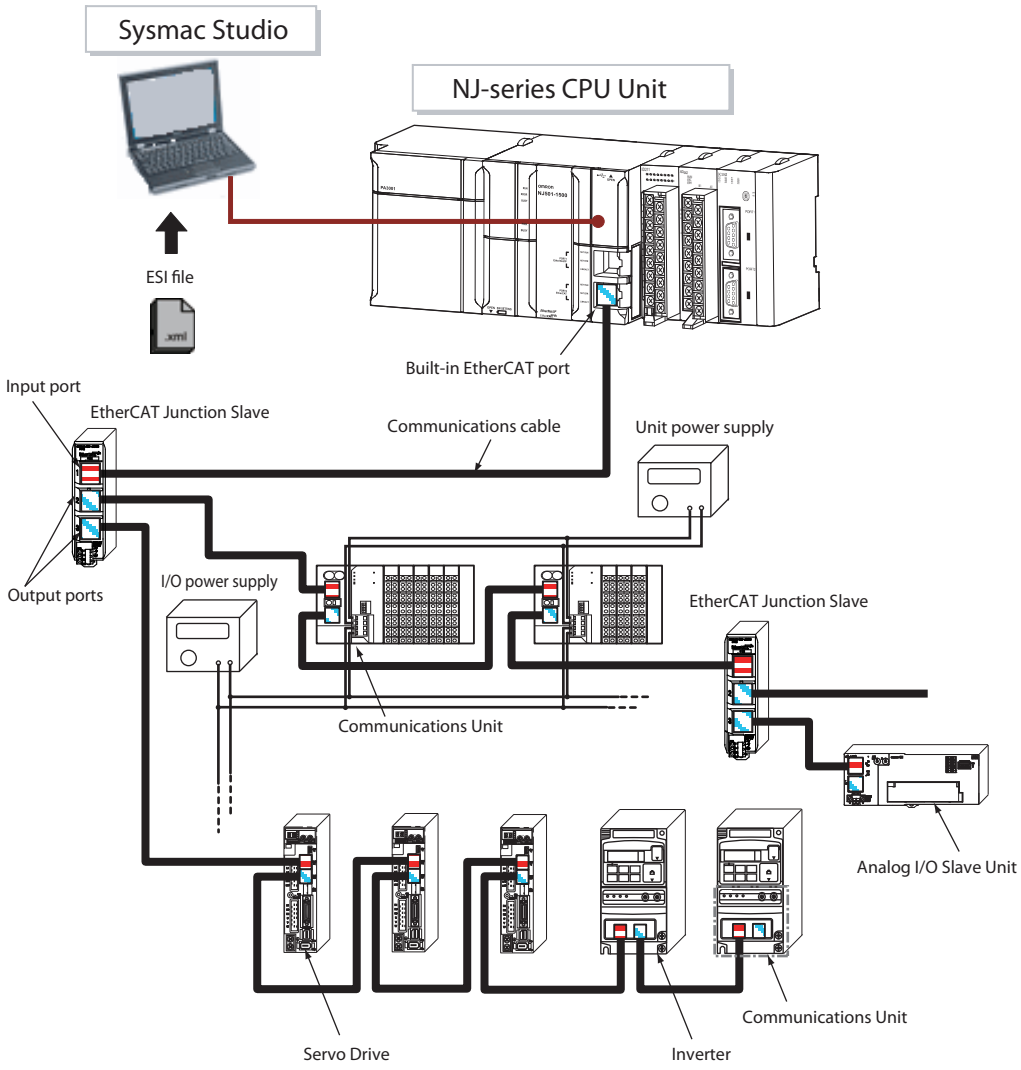
- Read and write process data
- Make Slave setting
- Monitor Slave state

1-2 Parts of an EtherCAT Network

This section gives information on parts using in an EtherCAT network.

1-2-1 Configuration Devices of EtherCAT Network

An example of parts of an EtherCAT network are shown in the figure below.



1-2-2 Overview of EtherCAT network parts

An EtherCAT network contains following parts:

EtherCAT Master Unit

Administers the EtherCAT network, monitors the state of Slaves, exchanges I/O data with Slaves.

Slave / EtherCAT Slave

One unit or a combination of units that can receive signals from the EtherCAT Master Unit and that can perform a task.

Example for one unit as an EtherCAT Slave
- A Servo Drive with an EtherCAT connector.

Example for a combination of units as an EtherCAT Slave:
- A Communication Unit with a set of I/O Units.

Communication Unit

A Communication Unit gives other units the possibility to function as a Slave in an EtherCAT network.
The hardware has:
- EtherCAT IN connection = To receive signals from an EtherCAT Master Unit.
- EtherCAT OUT connection(s) = To relay signals to other EtherCAT units.
- Possibility to connect to other units like I/O units.

The GRT1-ECT is a Communication Unit.

Configuration Tool

The configuration tool is PC software for configuration of settings of the EtherCAT network and each Slave. Connect the configuration tool to the EtherCAT Master Unit.

Communication cable

Use 100BASE-TX shielded twisted pair cables, category 5 or higher.
The cables should be double-shielded (aluminum tape and braided shielding).

ESI (EtherCAT Slave Information) file

Describes information specific to EtherCAT Slaves in XML format.
By reading this file into the Configuration Tool, it is possible to perform various settings such as mapping of Slaves to I/O memory easily.

Unit power supply

Provides for communication of each Slave and internal operations.
Separate them from the I/O power supply when wiring.

I/O power supply

Provides power for Input/Output operations of external devices connected to Slaves.
Separate from Unit power supply when wiring.

2

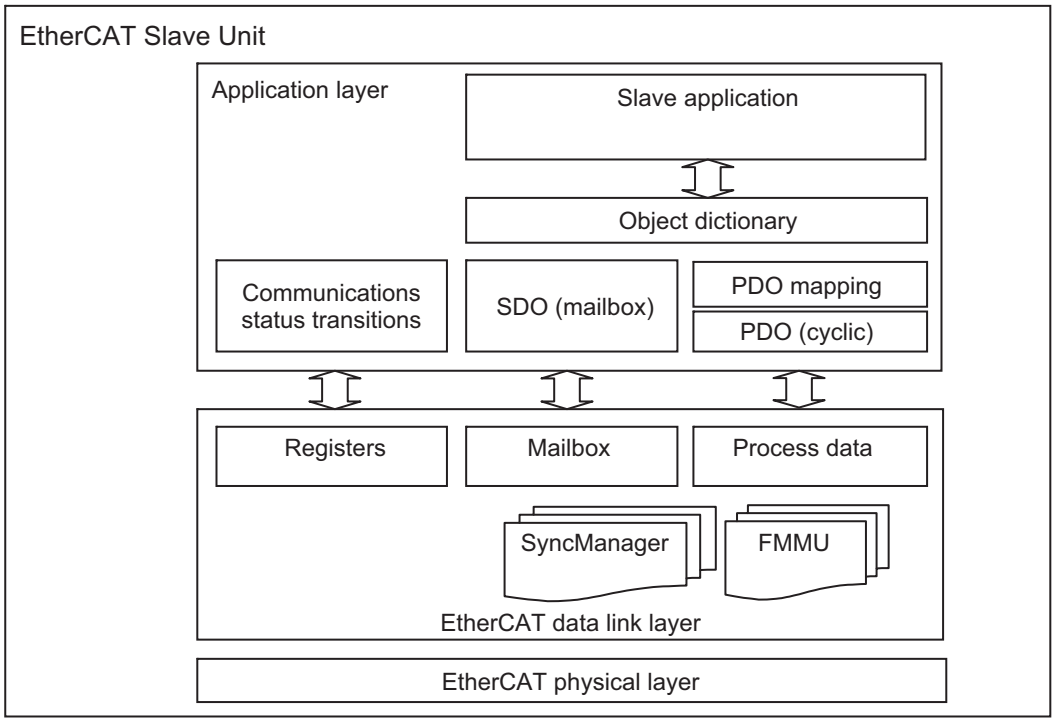
EtherCAT Communication details

This chapter provides details on EtherCAT communication.

2-1 Structure of CAN application protocol over EtherCAT (CoE)

Multiple protocols can be transferred by EtherCAT. The GRT1-series EtherCAT Communication Unit uses "CAN application protocol over EtherCAT (CoE)". CoE is a communication interface for EtherCAT devices, as the device profile of the open network standard "CAN application protocol".

The figure below shows the structure of CoE in the GRT1-series EtherCAT Communication Unit.



The CAN application protocol has a data object dictionary.
There are two types of data objects in this dictionary:

● Process Data Objects (PDO)

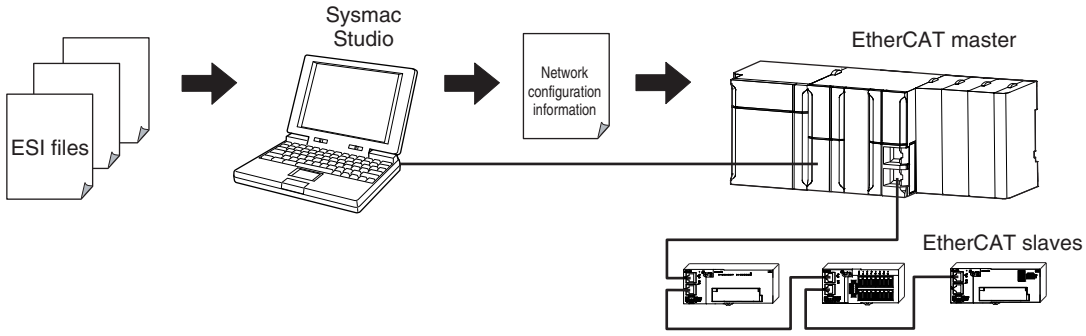
- Contains Process data
- Composed of objects that can be mapped.
- The process data is defined by PDO mapping.
- PDO is primarily used in PDO communication for cyclic exchange of process data.

● Service Data Objects (SDO).

- SDO are used in non-cyclic type SDO (event type messages) communication.

2-2 EtherCAT Slave Information File (ESI File)

An EtherCAT Slave Information (ESI) file contains the setting information of an EtherCAT Slave Unit. The network setting software (Configuration Tool) uses the ESI files to create the network connection information. This information is transferred to the EtherCAT Master Unit to establish a communication network.



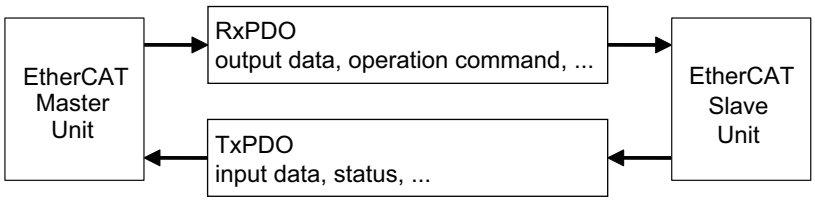
Communications are started according to the communications settings and the network configuration in the ESI files that are installed.

2-3 Process Data Objects (PDO)

This section contains information on Process Data Objects (PDOs) and their mapping.

2-3-1 Overview

The Process Data Objects (PDO) are used for real-time data transfer via cyclic communication.
There are two types in PDO: RxPDO that transfers data from the EtherCAT Master to the EtherCAT Slave and TxPDO that transfers the present value from an EtherCAT Slave to the EtherCAT Master.

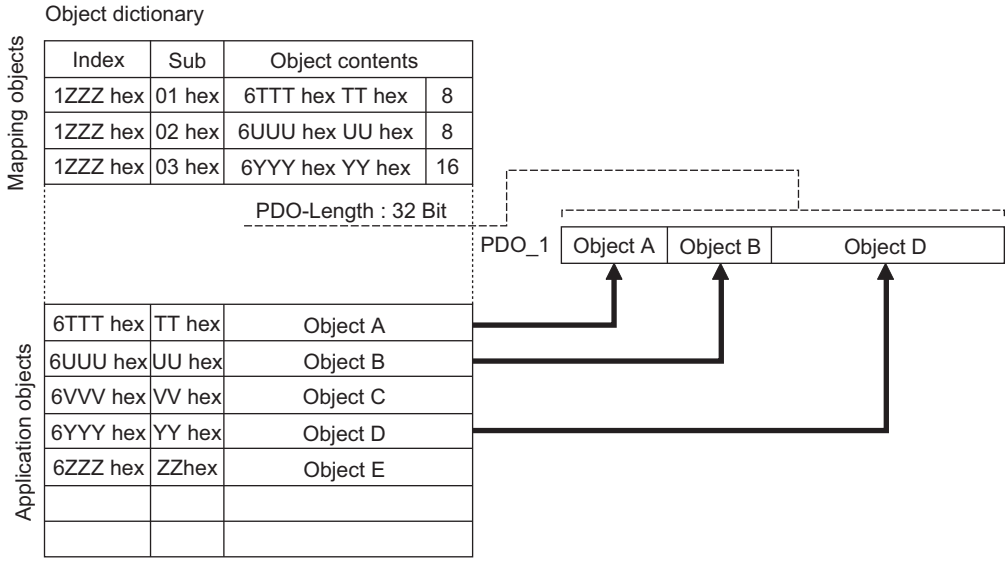


The EtherCAT application layer can contain multiple objects to configure the process data being exchanged. The details of process data are described in PDO Mapping Objects and Sync Manager PDO Assignment Objects.
GRT1-series EtherCAT Communication Unit supports PDO mapping for I/O control.

2-3-2 PDO Mapping Settings

The PDO mapping indicates the mapping for application objects (real-time process data) between the object dictionary and PDO.
The number of mapped objects is described in sub-index 0 of the mapping table. In this mapping table, indexes 1600 hex to 17FF hex are used for RxPDO and 1A00 hex to 1BFF hex are used for TxPDO.

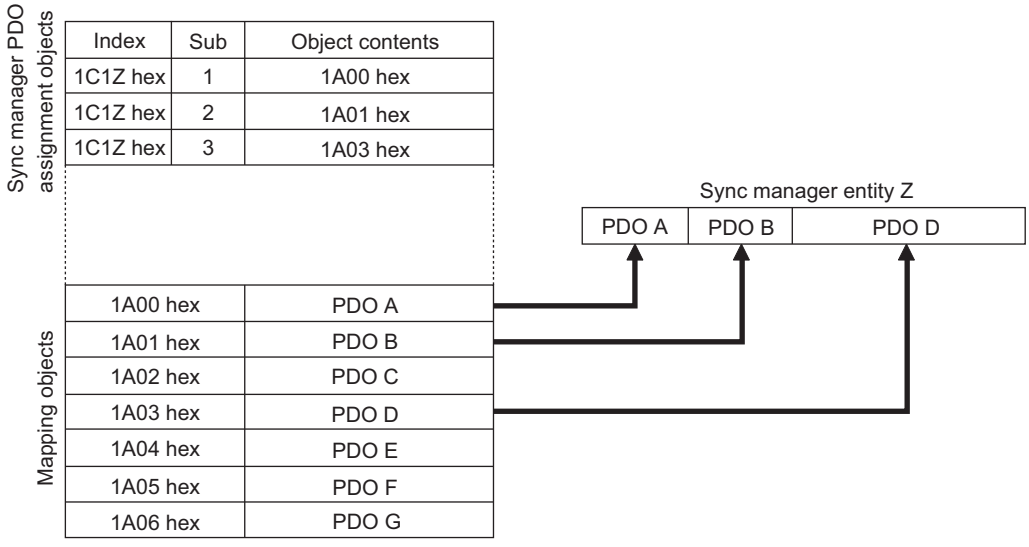
The figure below shows an example of PDO mapping.



2-3-3 Sync Manager PDO Assignment Settings

A sync manager channel consists of several PDOs. The sync manager PDO assignment objects describe how these PDOs are related to the Sync Manager.
The number of PDOs is given in sub-index 0 of the sync manager PDO assignment table.
In this table, index 1C12 hex is for RxPDOs and 1C13 hex is for TxPDOs.

The figure below shows an example of sync manager PDO mapping.



2-3-4 PDO Mapping for GRT1-ECT

The PDO mapping of the GRT1-ECT depends on the connected SmartSlice I/O units and is detected and configured automatically by the GRT1-ECT. The PDO mapping can also be configured by the connected EtherCAT master. However the written configuration must be equal to the actual configuration of the GRT1-ECT to start the communication between the EtherCAT master and the GRT1-ECT.

2-4 Service Data Object (SDO)

2-4-1 Overview

GRT1-series EtherCAT Communication Unit supports the SDO communication.
The EtherCAT Master Unit is able to make parameter settings and monitor status by reading and writing data from and to entries in object dictionaries via the SDO communication.

2-4-2 Abort Codes

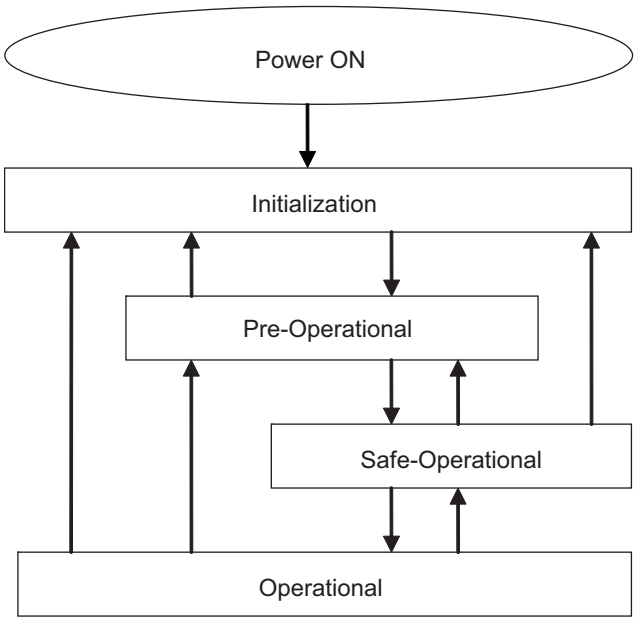
The table below shows abort codes of SDO communication errors.

Code	Meaning
05030000 hex	Toggle bit not changed
05040000 hex	SDO protocol time out
05040001 hex	Client/Server command specifier not valid or unknown
05040005 hex	Out of memory
06010000 hex	Unsupported access to an object
06010001 hex	Attempt to read a write only object
06010002 hex	Attempt to write to a read only object
06020000 hex	The object does not exist in the object directory.
06040041 hex	The object cannot be mapped into the PDO.
06040042 hex	The number and length of the objects to be mapped would exceed the PDO length.
06040043 hex	General parameter incompatibility reason
06040047 hex	General internal incompatibility in the device.
06060000 hex	Access failed due to a hardware error.
06070010 hex	Data type does not match, length of service parameter does not match.
06070012 hex	Data type does not match, length of service parameter too high.
06070013 hex	Data type does not match, length of service parameter too low.
06090011 hex	Sub-index does not exist.
06090030 hex	Value range of parameter exceeded (only for write access)
06090031 hex	Value of parameter written too high
06090032 hex	Value of parameter written too low
06090036 hex	Maximum value is less than minimum value.
08000000 hex	General error
08000020 hex	Data cannot be transferred or stored to the application.
08000021 hex	Data cannot be transferred or stored to the application because of local control.
08000022 hex	Data cannot be transferred or stored to the application because of the present device state.
08000023 hex	Object dictionary dynamic generation fails or no object dictionary is present.

2-5 Communication State Transitions

The EtherCAT State Machine (ESM) indicates the state transition model of EtherCAT Slave Unit communication control. It is controlled by the EtherCAT Master Unit.

The following figure shows the communication state transitions from power ON.



State	SDO communication	PDO transmission	PDO reception	Contents
Initialization (Init)	Not possible	Not possible	Not possible	Communication is being initialized. Communication is not possible.
Pre-Operational (Pre-Op)	Possible	Not possible	Not possible	Initialization of network settings. SDO communication is possible.
Safe-Operational (Safe-Op)	Possible	Possible	Not possible	PDO communication is possible. e.g. status from a Slave Unit. SDO communication is possible.
Operational (Op)	Possible	Possible	Possible	Normal communication state PDO communication to control I/O data.

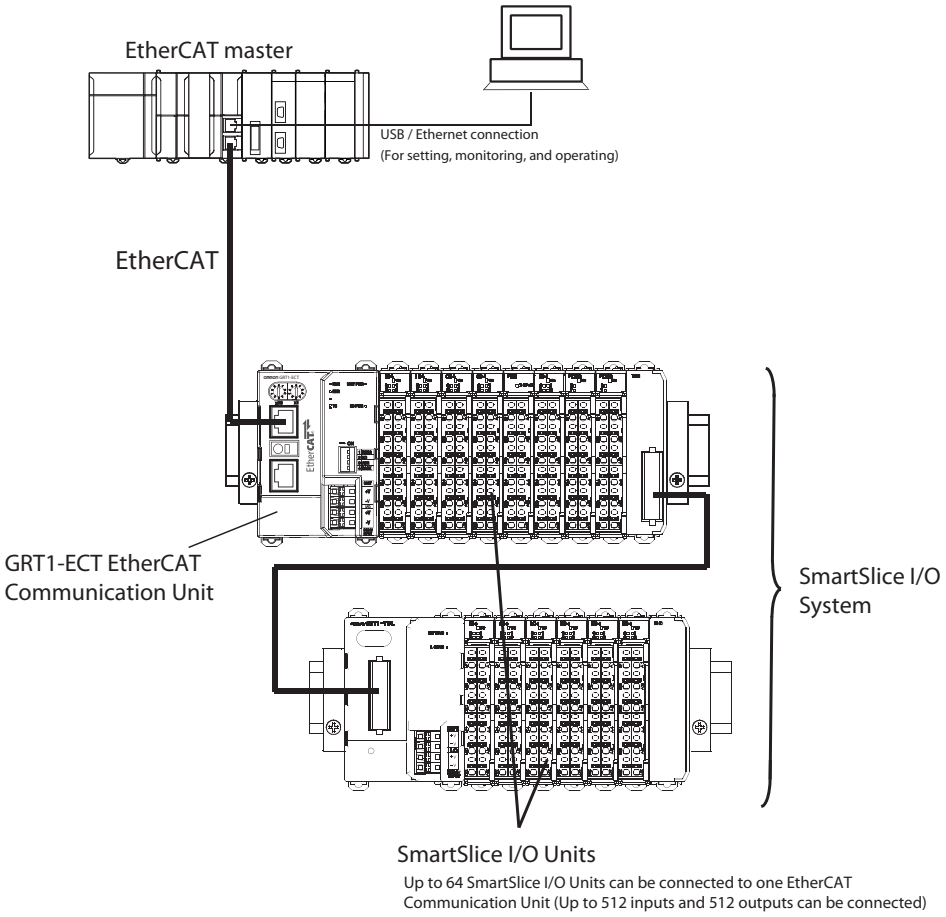
3

GRT1-ECT Network location and Features

This section provides an introductory overview of the GRT1 series SmartSlice I/O Units and the GRT1-ECT EtherCAT Communication Unit and its functions for an EtherCAT network.

3-1 GRT1-ECT In network with SmartSlices

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



SmartSlice I/O configurations can be very compact, consisting of only a few I/O points, but they can also be extended, to up to 64 I/O slices. The slice configuration can also be subdivided over two or more blocks using local extension units and extension cables, as shown in the figure above.

Reference

The GRT1-Series of SmartSlice I/O Units and Communication Units is constantly being expanded with new Units. Refer to the latest revisions of the GRT1 Series SmartSlice I/O Units Operation Manual (W455).

3-2 GRT1-ECT Features

3-2-1 Features

The GRT1-ECT EtherCAT Communication Unit controls data exchange over the EtherCAT network between the EtherCAT Master and SmartSlice I/O Units.

● Manage Multiple SmartSlice I/O Units as One Slave

A single EtherCAT Communication Unit with up to 64 connected SmartSlice I/O Units can be managed as a single slave device from the EtherCAT Master.

● I/O Data Exchange

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

● Simplified Startup

The EtherCAT Communication Unit can be set up easily, just by wiring the Unit, setting the EtherCAT node address on the Unit's rotary switches, and making simple DIP switch settings.
The Unit's configuration is read automatically when the power is turned ON and I/O is also automatically allocated in the SmartSlice I/O Units. It is not necessary to make any settings with a special Programming Device.

● Simplified I/O Wiring

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

● Table Registration

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

● Hot-swap Replacement of I/O Units

The SmartSlice I/O Unit's consist of three parts that can be separated from each other: Base block, Main block and Terminal block. You can leave the Base block connected to the Slice I/O Terminal with power supplied to the Slice I/O Terminal and then replace the Main block or Terminal block.

● Automatic Device Replacement

The Automatic Device Replacement (ADR function) is the mechanism to backup and restore parameters with only a DIP switch setting on the Communication Unit.
Setting a DIP switch will back up parameters in the I/O Unit to the EtherCAT Communication Unit. Another DIP switch will write the backed-up parameters from the EtherCAT Communication Unit to the new I/O Unit.

● Limitations

SmartSlice I/O Units cannot be configured nor accessed through the EtherCAT Communication Unit SmartSlice I/O Units are only supported with their default I/O data configuration.

- E.g. adding status flag information with GRT1-AD2 is not supported and will cause an error during startup

3-2-2 GRT1-ECT and SmartSlices data exchange

The EtherCAT Communication Unit connects to the Master with an Ethernet network cable and it is directly connected to one or more SmartSlice I/O Units.

Precautions for Correct Use

The refresh cycles of the EtherCAT network and the SmartSlice units are independent and not synchronised. Therefore a small "quasi-random" delay exists in the communication between the EtherCAT network and the SmartSlice I/O Units

NJ-serie

To use units of the NJ-serie a GRT1-ECT Version 2.0 (Ver.2.0) or higher is required.

The Version number of the GRT1-ECT is printed on the side of the GRT1-ECT.
Refer to "4-1-1 Frontview and Sideview" on page 4 - 2 for the location of the Version number.

Trajexia TJ2-MC64

The GRT1-ECT Ver.1.0 is supported by Trajexia firmware version 2.0132 or higher.
The GRT1-ECT Ver.2.0 or higher is supported by Trajexia firmware version 2.0152 or higher.

The Version number of the GRT1-ECT is printed on the side of the GRT1-ECT.

To find the firmware version of Trajexia connect the TJ2-MC64 to Trajexia Studio software.
Open the terminal window and type PRINT VERSION in the terminal window.
Refer to the Trajexia Programming manual (I58E-EN) for more information.

4

GRT1-ECT Details

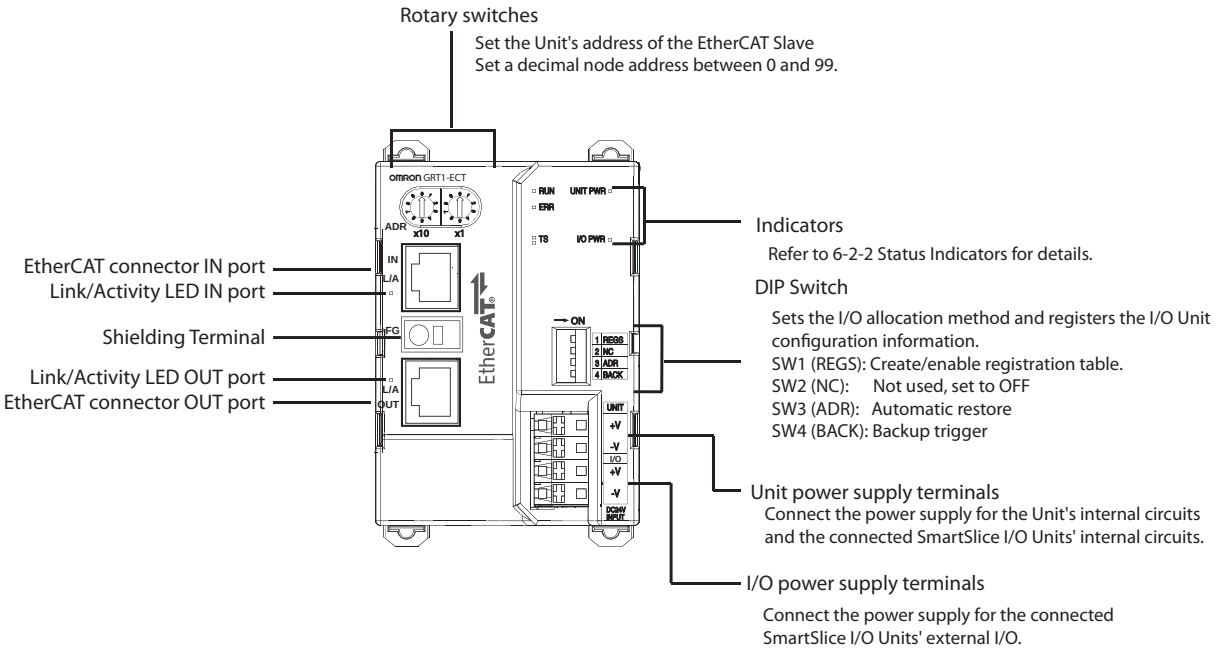
This section gives detailed information on the hardware of the GRT1-ECT.

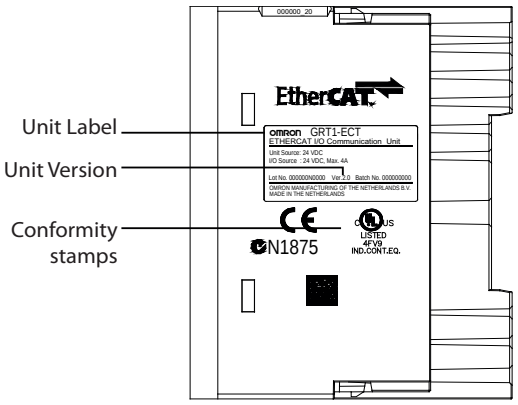
4-1 The GRT1-ECT in detail

This section explains the specifications of indicator, switches, and connectors of the GRT1-ECT.

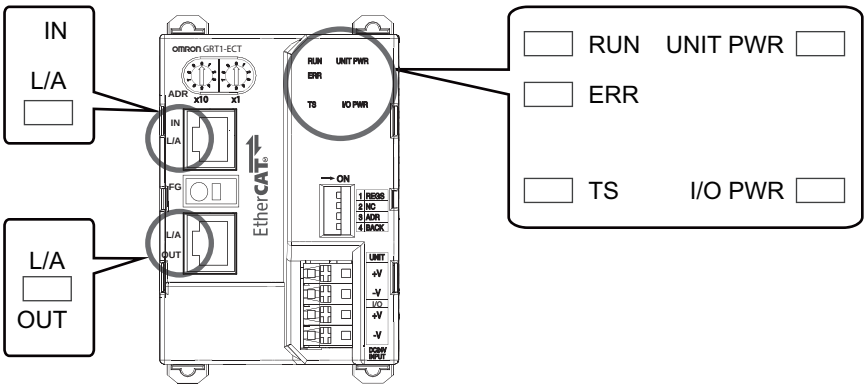
4-1-1 Frontview and Sideview

The GRT1-ECT SmartSlice Communication Unit controls data exchange between an EtherCAT Master Unit and SmartSlice I/O Units over an EtherCAT network. For more information on SmartSlice I/O Units, refer to the GRT1 Series SmartSlice I/O Units Operation Manual (W455).





4-1-2 Status Indicators



[RUN] indicator

Indicates the operation state.

Color	State	Contents
Green	OFF	Init state
	Blinking	Pre-Operational state
	Single flash	Safe-Operational state
	ON	Operational state

For details on each state, refer to "2-5 Communication State Transitions" in Page 2 - 7

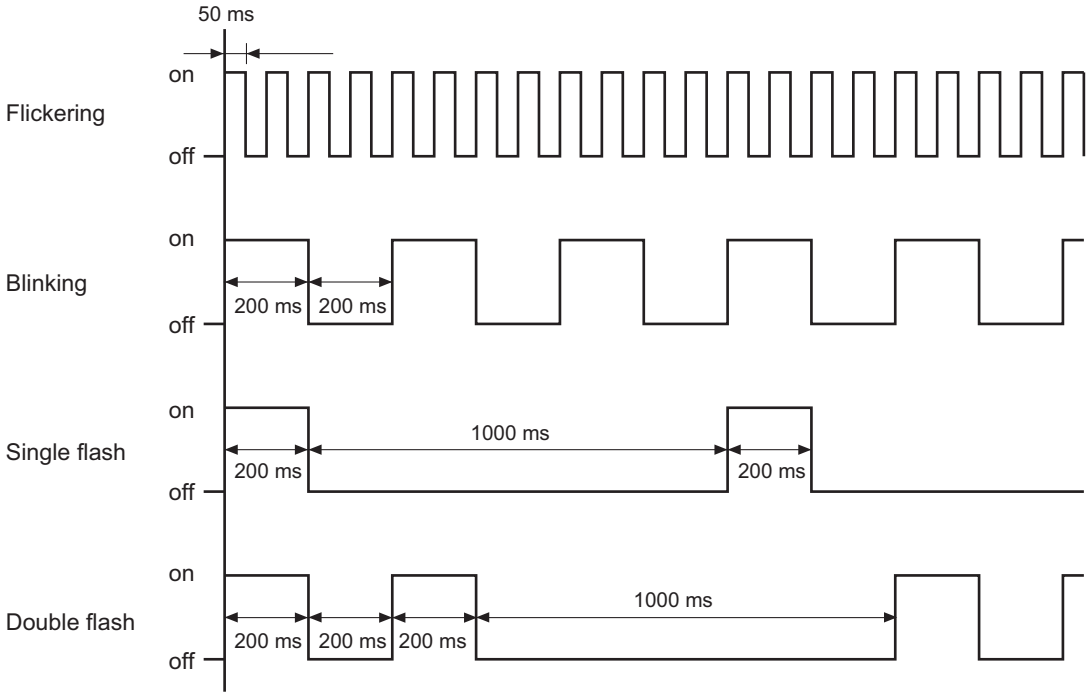
[ERR] indicator

It indicates the information of an error.

Color	State	Contents
Red	OFF	No error
	Blinking	Communication setting error
	Single flash	Synchronization error or communication data error
	Double flash	Application WDT timeout
	Flickering	Boot error
	ON	PDI WDT timeout

Reference

The timing of each flashing state of indicator is as follows.



[TS] indicator

Indicates the status of the SmartSlice I/O system.

Color	State	Contents
N/A	OFF	No power supply Communication with SmartSlice I/O Unit has not started Overcurrent detected
Green	Flashing (every second)	SmartSlice I/O Unit added to the system
	Flashing (every 0.5 second)	Backup/Restore function operating: Restoring settings to SmartSlice I/O Unit, backup function operating Downloading SmartSlice I/O Unit settings
	ON	Communication with SmartSlice I/O Unit established
Red	Flashing	Non-fatal communication error occurred. Communication timeout Verification error occurred with registered table Different model unit detected after SmartSlice I/O Unit replacement
	ON	Fatal communication error occurred.
	Lit for 2 s	Failure occurred while restoring settings to I/O unit or downloading I/O unit settings

[UNIT PWR] indicator

Indicates the unit power supply state.

Color	State	Contents
Green	OFF	Unit power OFF state
	ON	The unit power (24 VDC) is supplied to the Slave.

[I/O PWR] indicator

Indicates the I/O power supply state.

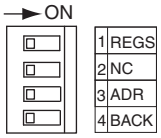
Color	State	Contents
Green	OFF	Unit power OFF state
	ON	The unit power (24 VDC) is supplied to the Slave.

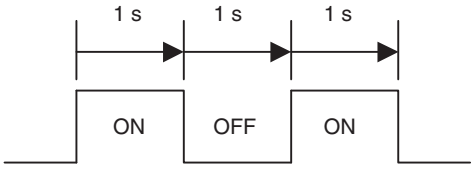
[L/A] indicators

Indicates the communication state of the input side (IN) and output side (OUT)

Color	State	Contents
Green	OFF	Link not established in physical layer
	Flickering	In operation after establishing link
	ON	Link established in physical layer

4-1-3 DIP switches





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

DIP switch	Function	Setting	Description
REGS	Create/enable registration table	ON	Registered table is enabled
		OFF	Registered table is disabled
		OFF to ON[a]	Register I/O unit table
		ON to OFF	Clear registered I/O unit table
NC	N/A	OFF	Not used, always set to OFF
ADR	Automatic restore	OFF to ON	When the SmartSlice I/O Units are replaced, the parameter data that was backed up with the BACK dipswitch is automatically restored[b]
		OFF	Automatic restore disabled
BACK	Backup trigger	ON to OFF to ON in 3 s	Parameter data of all connected SmartSlice I/O Units is backed up

a. When the unit power is on.
b. When DIP switch 1 | REGS is set to ON.

Precautions for Correct Use

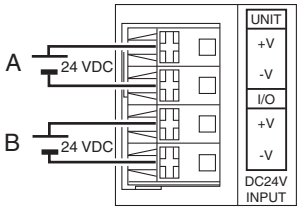
The Backup and Restore functionality is available in the GRT1-ECT. However, the backed up and restored parameters cannot be accessed via EtherCAT communication.

Reference

- It is recommended to do a registration of the SmartSlice I/O Units.
- It is recommended to set dipswitches 1 and 3 to ON and dipswitch 4 to OFF after this registration.
- The factory setting of all dipswitches is OFF.

4-1-4 Unit and I/O Power supply connector

The GRT1-ECT has 2 24 VDC power supply terminals:

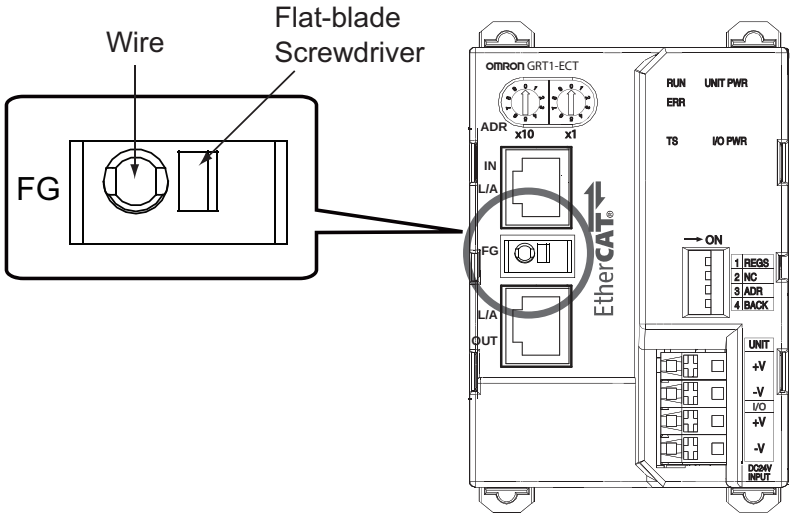


Label	Power supply terminal	Description
A	Unit power supply terminal	Power supply to the internal circuits of the GRT1-ECT and to the internal circuits of the connected SmartSlice I/O Units (through the SmartSlice bus)
B	External I/O power supply terminal	Power supply to the external I/Os connected to the SmartSlice I/O Units

Precautions for Correct Use

- The unit power supply is isolated from the external I/O power supply. Please use 2 separate power-supplies to keep this isolation.
- The unit power supply and the external I/O power supply are not transferred through the GCN2-100 Turnback cable. The GRT1-TBR units have the same power supply terminals as the GRT1-ECT.

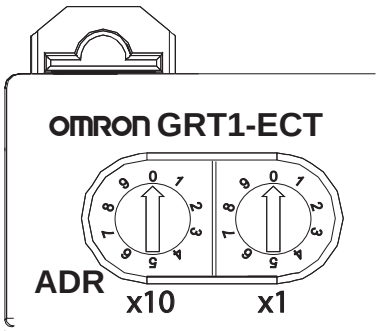
4-1-5 Field Ground Terminal



The GRT1-ECT provides a Field Ground Terminal (FG) between the EtherCAT connectors. If noise is a significant source of errors, ground the Field Ground Terminal (recommended wire 20 AWG to 14 AWG or 0.5 to 2.0 mm^2). Strip the wire between 8 mm and 10 mm of insulation at the ends of the wires (stranded or solid wire) or use pin terminals with a pin (conductor) length of 8 mm to 10 mm.

4-1-6 Node Address Setting Switches

These switches are used to set node addresses of Slaves in the EtherCAT network (decimal).
The 10x digit is set on the left rotary switch and the 1x digit is set on the right rotary switch.
Setting range is 00 to 99. (Default setting: 00)



Note that the node address set values vary as shown below when the EtherCAT Master Unit is made by OMRON or by other manufacturers.

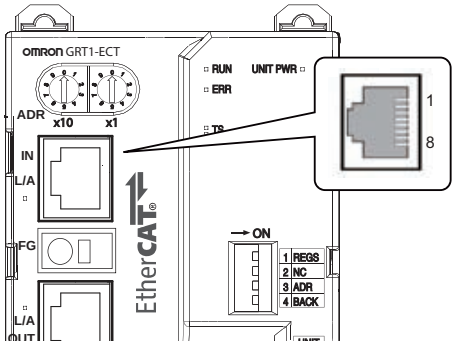
Set value for switch	Set value for node address	
	OMRON EtherCAT Master Unit	EtherCAT Master Unit from another manufacturer
00	Set value according to Configuration Tool (1 to 65535)	Set value according to Configuration Tool (settings by these switches are irrelevant)
01 to 99	Set value by these switches	

Precautions for Correct Use

- The switch settings are read only once when the power supply is turned ON. Even if the settings are changed after turning the power supply ON, they are not reflected in the control. They become effective when the power supply is turned ON the next time.
- If node addresses overlap, an error occurs and the operation stops.

4-1-7 Communication Connectors

The Connectors are used to connect the communication cables.



The specifications are shown below.

- Electrical characteristics: Conforms to the IEEE 802.3 standard.
- Connector structure: RJ45 8-pin modular connector (conforms to ISO 8877)

Terminal arrangement:

Pin No.	Signal name	Abbreviation
1	Send data +	TD +
2	Send data –	TD –
3	Receive data +	RD +
4	Not used	–
5	Not used	–
6	Receive data –	RD –
7	Not used	–
8	Not used	–
Hood	Frame ground	FG

5

GRT1-ECT Procedures

This chapter explains basic procedures and settings for the Communication Unit and the EtherCAT Slaves.

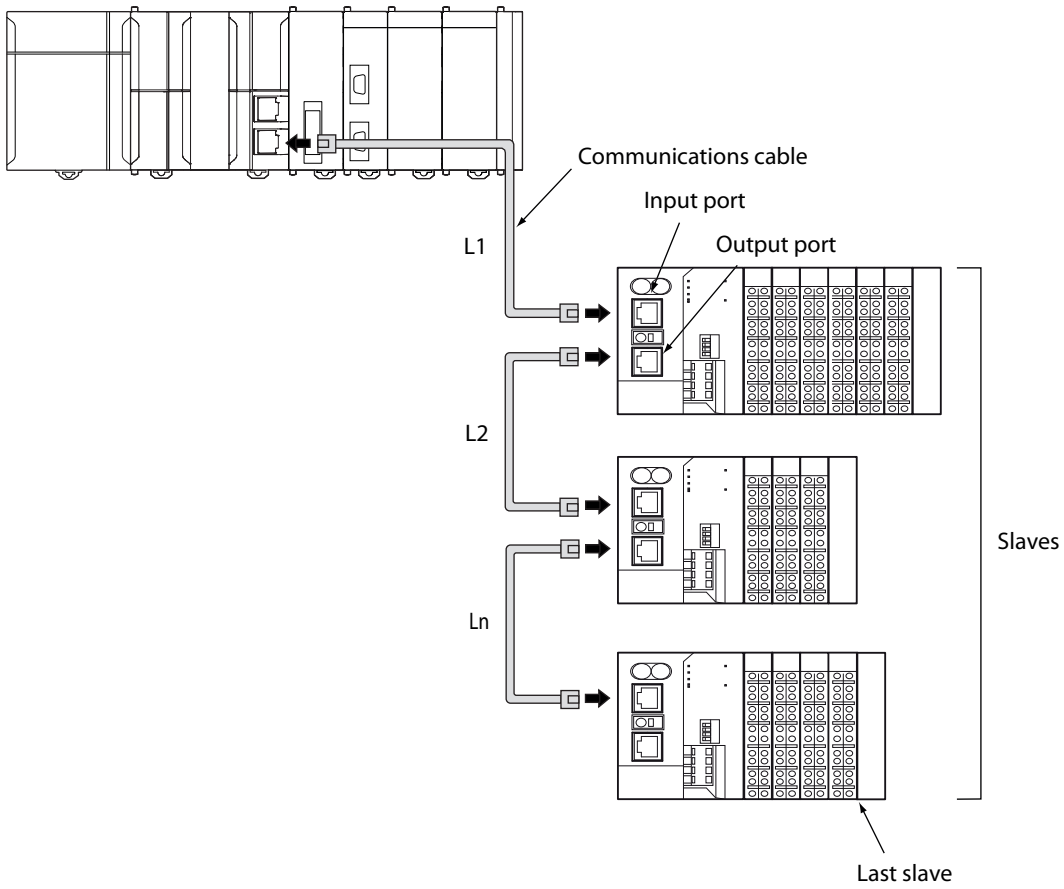
5-1 System Setup Example

This section shows an example with three EtherCAT Slaves and one Master Unit.

5-1-1 Example with three Slaves.

Three Slaves and one Master Unit are connected.
L1 = Connection between Master Unit and first Slave.
L2 = Connection between first Slave and second Slave.
L3 = Connection between second Slave and third Slave.

Not shown are the power supply lines to the three Slaves and to the Master Unit.
Note that the Unit power and the I/O power are separate connections for the Communication Unit.



Reference

The setting example explained here is the basic setting of GRT1-series EtherCAT Communication Unit. For more information about the SmartSlice I/O Units please refer to W455 GRT1-Series SmartSlice I/O Units Operation Manual.
If your system configuration includes Slaves from other suppliers then refer to the manuals of their Slaves for the correct settings.

5-2 Settings Communication Unit

Start the system, allocate I/O data of Slaves, and then start the EtherCAT communication.
For communication state details refer to "2-5 Communication State Transitions" in page 2 - 7.

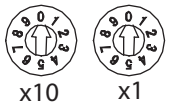
5-2-1 Address Settings

In order to identify the EtherCAT Communication Unit on the EtherCAT network, it needs to have a unique node address. Using this unique address the EtherCAT Master Unit can transfer parameter settings and exchange I/O data.
The EtherCAT node address is assigned using the rotary switches at the front of the Unit.

All individual SmartSlice I/O Units need a unique address to identify each of them to the GRT1-ECT Unit. The GRT1-ECT Unit assigns this unique address automatically to each SmartSlice I/O Unit at startup.

5-2-2 Setting the EtherCAT Node Address

The node address of the GRT1-ECT is set with the rotary switches at the front of the Unit.
The left rotary switch sets the ten's digit, and the right rotary switch sets the one's digit.



EtherCAT node address setting

The valid address range is 00 to 99.

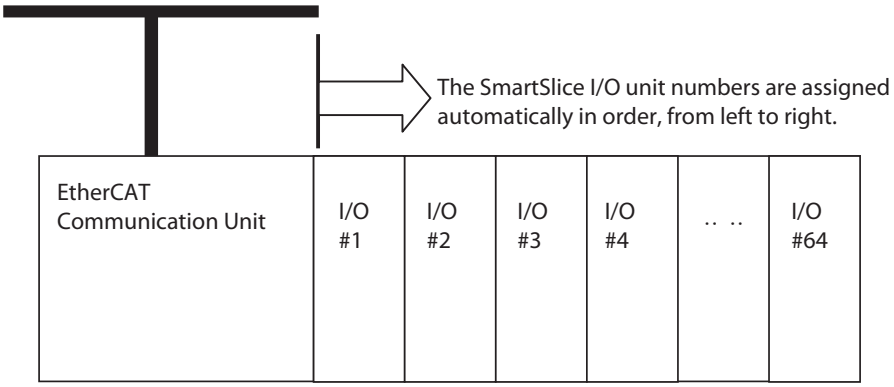
- Address 01 to 99 can be set as long as this number is unique in the network.
- With Address 00 the Communication Unit retrieves its node address from settings stored in its memory. With configuration software (e.g. Sysmac Studio) this node address setting can changed.

Precautions for Correct Use

- Turn OFF the power supply of the GRT1-ECT before setting the node address.
- The factory default setting for the node address is 00, both in hardware and in memory.
- If the node address is duplicated on any other Unit then communication will not be achieved.

5-2-3 SmartSlice I/O Unit Number Allocation

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



Reference

- The presence of Turnback units and cables does not influence the automatic allocation of Unit numbers.
- The unit numbers allocated automatically to the SmartSlice I/O Units are unrelated to the EtherCAT station address set with the rotary switches.

5-2-4 Communication Unit's Status Flags

These flags can be used to monitor the status of the connections between the GRT1-ECT and the SmartSlice I/O Units as well as the status of the SmartSlice I/O Units themselves. The status flags take up 1 word and the information is transferred to the Master as part of the Input data. The table below defines the individual bits in the Status word.

Bit	Name	Contents
0	SmartSlice I/O Bus Communication Error	Monitors the status of SmartSlice I/O communication
1	-	Reserved
2	SmartSlice I/O Unit Warning 0: Normal 1: Error detected	Indicates a minor SmartSlice I/O Unit error. This flag goes ON when there is an error in any one of the connected SmartSlice I/OUnits
3	-	Reserved
4	SmartSlice I/O Unit Alarm 0: Normal 1: Error detected	Indicates a major SmartSlice I/O Unit error. This flag goes ON when there is an error in one of the connected SmartSlice I/O Units
5-11	-	Reserved
12	Unit Maintenance 0: Normal 1: Error (monitor value reached)	Monitors the operating time threshold that is set with the Unit power ON time monitor function
13	Automatic Restore Monitor 0: Restore successful 1: Restore failed	Indicates whether or not the automatic parameter restore to the SmartSlice I/O Units was completed successfully
14	Communication Unit Error 0: Normal 1: Error occurred	This flag is ON if one of the other flags (bits 0 to 13) is ON
15	I/O Refreshing 0: I/O communication stopped 1: I/O communication normal	Indicates whether I/O data is exchanged normally

5-2-5 Unit Functions

The following table lists the EtherCAT Communication Unit's functions.

Function name	Summary	Setting method
Table **regis**tration	Reads the configuration of the SmartSlice I/O Units connected to the Communication Unit and registers that information in a table More info: 5-2-6 Table Registration Function (1 | REGS)	DIP switch '1 REGS'
Backup	Records the parameter data of all connected I/O Units in the Communication Unit More info: 5-2-7 Backup Function (4 | BACK)	DIP switch '4 BACK'
Automatic **D**ownload and **R**estore	Automatically downloads the backed-up parameter data to the appropriate Unit More info: 5-2-8 Automatic Device Restore Function (3 | ADR)	DIP switch '3 ADR'

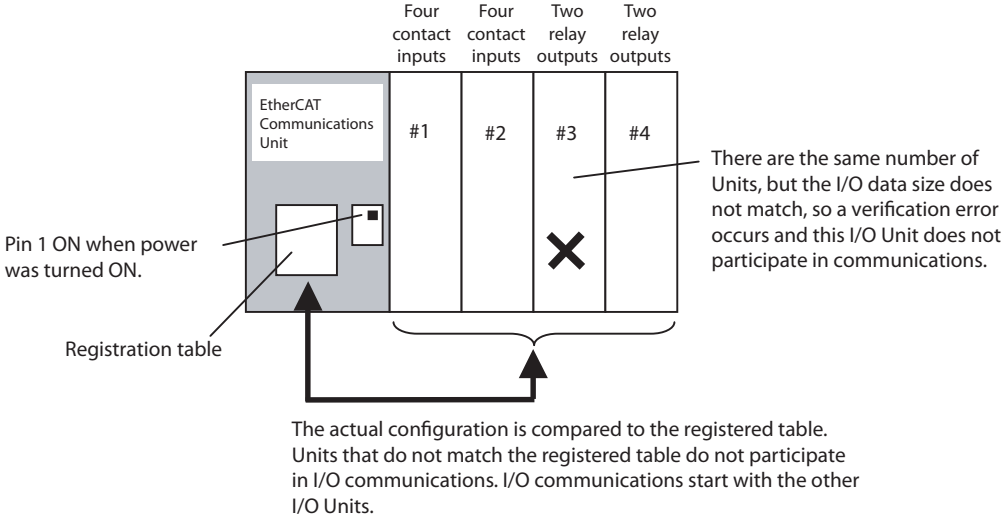
5-2-6 Table Registration Function (1 | REGS)

Functionality to registers the configuration of the connected SmartSlice I/O Units in a table within the Communication Unit. This table can then be used to compare the registered table with the information of the Master.

● ON (during power up) = Compare

The registered I/O table will be compared automatically with the actual configuration each time the power of the EtherCAT Communication Unit is turned ON.

The red blinking TS LED indicates a verification error. A verification error will occur if a registered I/O Unit is not available or an unregistered I/O Unit is detected.
The verification error will prevent the Communication Unit to change from init to pre-operational.
For communication state details refer to "2-5 Communication State Transitions" in page 2 - 7.

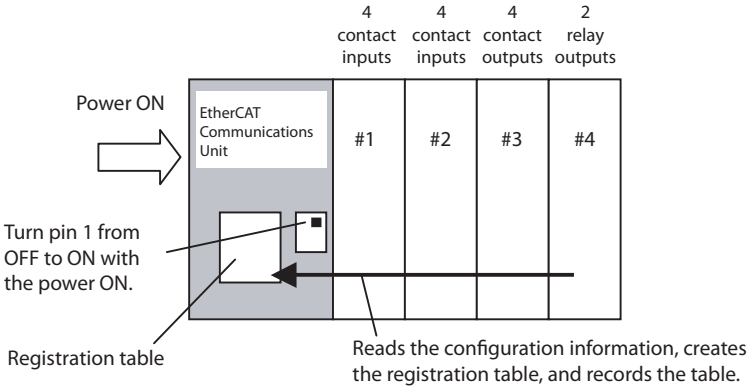


Reference

A mismatch (verification error) with the registered table is indicated at the EtherCAT Communication Unit's TS indicator (flashing red).

- **OFF (during power up) = Automatic detection**
  The registered table is disabled and the Communication Unit will automatically detect the actual I/O configuration and start communication.

- **OFF to ON = Creating a New Registration Table**
  The SmartSlice I/O System's actual I/O configuration can be read and registered in the table just by turning DIP switch 1 (REGS) from OFF to ON while the EtherCAT Communication Unit's power supply is ON. If the registration table is being refreshed, the old registration table will be erased.

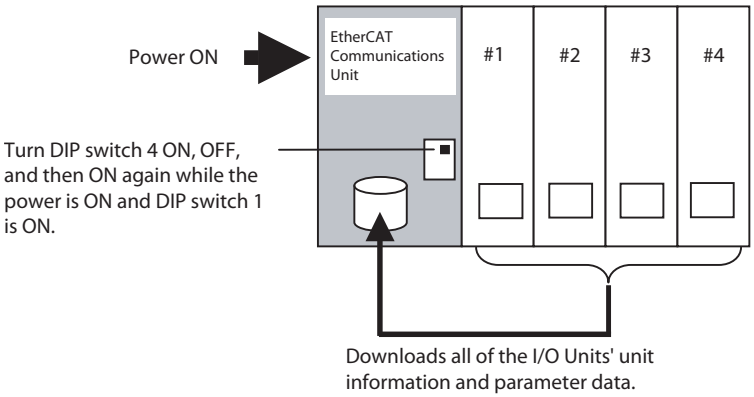


Reference

- Register the I/O configuration table when all of the SmartSlice I/O Units are communicating, i.e., when the EtherCAT Communication Unit's TS indicator is lit green.
- The configuration information records the order that the SmartSlice I/O Units are connected and the I/O size (input or output, number of bits) of each SmartSlice I/O Unit. The I/O Unit model numbers are not recorded.

5-2-7 Backup Function (4 | BACK)

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



● Backup Procedure

1 **Verify that the power is ON, DIP switch 1 (REGS) is ON, and all of the SmartSlice I/O Units are participating in I/O communication.**

2 **Turn DIP switch 4 (BACK) ON, then OFF, and then ON again within 3 s to start the back up.**

3 **While the data is being backed up, the EtherCAT Communication Unit's TS indicator will flash green every 0.5 s. The TS indicator will stop flashing and stay green lit when the backup is completed. If the restore operation fails, the TS indicator will be lit red for 2 s.**

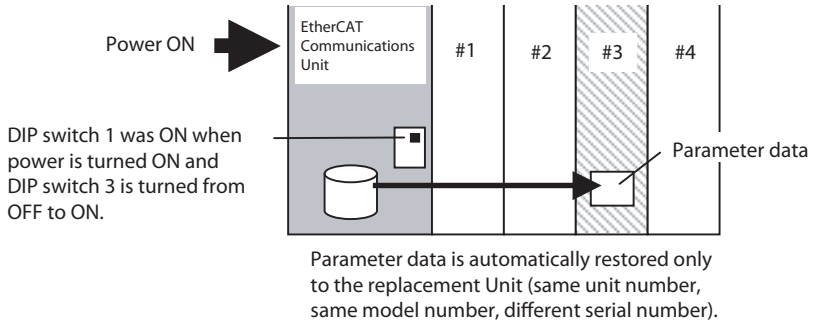
Precautions for Correct Use

- Do not turn OFF the Unit power supply while data is being backed up. The data will not be backed up properly if the power is turned OFF.
- The backup data will be erased along with the registered I/O configuration table if DIP switch pin 1 (REGS) is turned OFF.
- Backing up the parameter data is required for easy replacement of faulty Units.

5-2-8 Automatic Device Restore Function (3 | ADR)

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

- DIP switch 1 (REGS) is ON when the power turns ON, the registered table is enabled.
- DIP switch 3 (ADR) is ON when the power turns ON, the automatic restore function is enabled.
- Before replacement the parameter data has been backed up in the EtherCAT Communication Unit using the Backup procedure.



● Preparing Data Restore

1 **Create backup data in the Communication Unit with the backup function. For details, see 5-2-7 Backup Function (4 | BACK).**

2 **Turn ON DIP switch 3 (ADR).**

● Replacing a Unit

1 **Turn OFF the I/O power supply if required for your application.**

2 **Release the locks on the front of the SmartSlice I/O Unit that must be replaced and remove the terminal block. The wiring can remain connected.**

3 **Remove the main block of the SmartSlice I/O Unit and replace it with a new SmartSlice I/O Unit of the same type.**

4 **Mount the terminal block that was removed in step 2 and latch the lock that was released.**

5 **When the power is turned ON again, the Communication Unit will automatically detect the Unit that was replaced and download the backup data. The SmartSlice I/O Unit's TS indicator will indicate the results of the restore operation.**

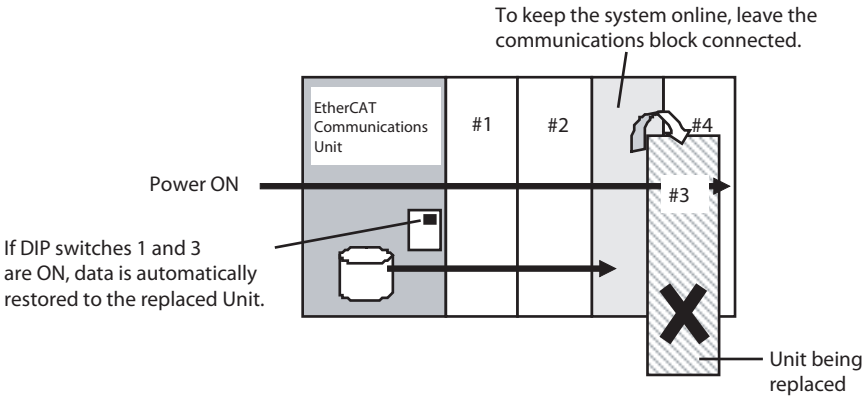
- If the download was successful, the Unit will be reset automatically and join I/O communication normally. The I/O Unit's TS indicator will be lit green.
- If the download failed, the I/O Unit's TS indicator will flash red.
- If the connected Unit is the wrong model, the I/O Unit's TS indicator will be lit red.

Precautions for Correct Use

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

5-2-9 Online Replacement Function

When one of the SmartSlice I/O Units connected to the EtherCAT Communication Unit must be replaced, the Unit can be replaced without turning OFF the power. The Units can be replaced online because the SmartSlice I/O Units are made up of 3 blocks: the base block, main block, and terminal block. When replacing a SmartSlice I/O Unit, leave just the base block connected and replace the main block. I/O communication will continue with the other I/O Units even while the problem Unit is being removed and replaced.



Replacing a Unit

1 **Turn OFF the I/O power supply of the I/O Unit being replaced.**

2 **Release the locks on the front of the I/O Unit that must be replaced and remove the terminal block. The wiring can remain connected.**

3 **Remove the main block of the SmartSlice I/O Unit and replace it with a new I/O Unit of the same type.**

4 **Mount the terminal block that was removed in step 2 and latch the hook that was released.**

5 **Turn ON the I/O power supply.**

Precautions for Correct Use

- When a Unit withdraws from I/O communication during replacement, the corresponding SmartSlice I/O Unit Communication Withdrawn Flag will go ON and the EtherCAT Communication Unit's TS indicator will flash red.
- Before using the automatic restore function, the preparation for automatic restoration (creating backup data and turning ON DIP switch 3) must be completed. See 5-2-8 Automatic Device Restore Function (3 | ADR) for details.
- Always turn OFF the I/O Unit's I/O power supply before replacement in order to prevent false output signals, false input signals, and electrical shocks. In addition, if external power is supplied to the terminal block for a Unit such as a Relay Output Unit, turn OFF that power supply before replacing the Unit.
- Only replace one I/O Unit at a time.
- Always replace the I/O Unit with the same model of I/O Unit. If a Unit is replaced with a different model, there may be unexpected outputs and the restore operation may not be completed properly.
- If the base block is faulty or damaged, turn OFF the power supply and replace the entire Unit. Even in this case, the I/O Unit's parameter data will be restored automatically if the automatic restore function is enabled when the power is turned ON.

5-3 Starting Communication

Start the system, allocate I/O data of Slaves, and then start the EtherCAT communication.
For communication state details refer to "2-5 Communication State Transitions" in page 2 - 7.

5-3-1 Starting a System

Turn ON the power supply to each Unit.

(1) Unit power supply of EtherCAT Master Units
(2) Unit power supply of Slaves (When the power is supplied, Slave's [PWR] indicator is lit.)
(3) I/O power supply of Slaves

Note that there are no restrictions on the order of turning ON the power supplies.

5-3-2 Setting EtherCAT Communication

The following communications are performed in EtherCAT.

- **PDO communication (remote I/O communication)**
  Allocate I/O data of Slaves to the EtherCAT Master Unit (PDO mapping) and perform PDO communication (remote I/O communication).

Reference

- For a detailed explanation of I/O data of the GRT1-ECT refer to "8-2-1 General information PDO mapping" in page 8 - 7.
- ESI file are used to allocate I/O data.For a detailed explanation of the procedure, refer to "8-1-2 ESI files library in Sysmac Studio" in page 8 - 3.

- **SDO communication (message communication)**
  For the method of using, refer to the manual of the EtherCAT Master Unit to be used.
  Refer to "Appendix A4 to 1 Appendix Object Dictionary" for the detailed explanation of objects implemented on GRT1-series EtherCAT Slaves.

Reference

SDO communication is available in the pre-operational state.
For communication state details refer to "2-5 Communication State Transitions" in page 2 - 7.

5-3-3 Starting EtherCAT Communication

Shift to the operational state (EtherCAT communication possible) to start the EtherCAT communication.
For how to shift to the operational state, refer to the manual of the EtherCAT Master Unit to be used.

Reference

For communication state details refer to "2-5 Communication State Transitions" in page 2 - 7.

5-4 Maintenance

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

5-4-1 Cleaning

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

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

Precautions for Correct Use

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

5-4-2 Inspection

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

● Inspection Equipment

Prepare the following equipment before inspecting the system.

● Required Equipment

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

● Optional Test Equipment

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

● Inspection Procedure

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

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

5-4-3 Checks

Confirm that the LED indicators of the EtherCAT Master Unit and Slaves are normal status and that I/O data is correctly read and written.
Moreover, make parameter settings for Slaves as required.

Check Unit Displays

- **EtherCAT Master Unit**
  Refer to the manual of the EtherCAT Master Unit to be used.

- **EtherCAT Slaves**
  The correct status of the status indicators of each Slave is as follows:

LED	State
PWR	ON
L/A IN	Flickering
L/A OUT	Flickering (turned OFF for the terminal Slave only)
RUN	ON
ERR	OFF

Confirming Data Read and Write

Use the Configuration Tool to read IN data and OUT data of the EtherCAT Master Unit in order to check that the I/O data is correctly read and written.

Setting Slave Parameters

Make parameter settings for each Slave as required via the SDO communication.
For the details of parameters that can be set, refer to "Appendix A4 to 1 Appendix Object Dictionary".

6

GRT1-ECT Troubleshooting

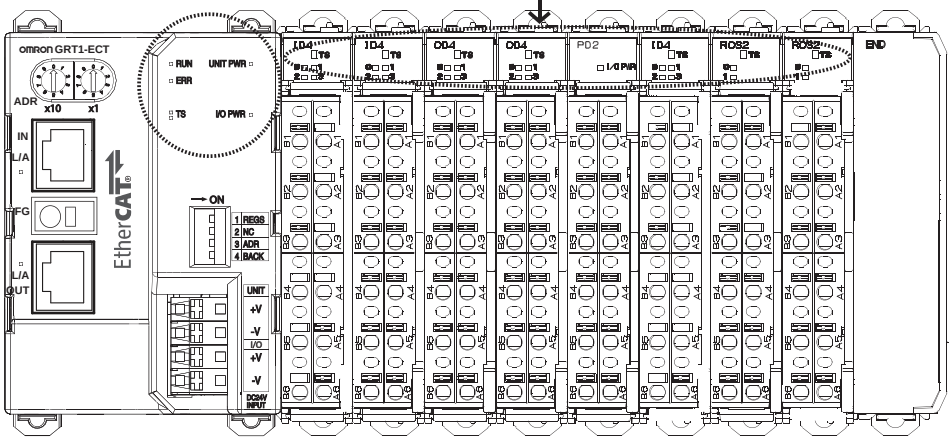
This section provides troubleshooting information using LED indicators and Sysmac Studio.

6-1 Troubleshooting with LED indicators

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

RUN LED: Indicates the status of the EtherCAT Communication Unit.
ERR LED: Indicates the status of EtherCAT Communication Unit.
TS LED: Indicates the status of the SmartSlice I/O System.
UNIT PWR: Indicates the status of the Unit power supply.
I/O PWR: Indicates the status of the I/O power supply.

TS LEDs: Indicate the status of each SmartSlice I/O Unit.



Reference

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

The LED indicators can be used to determine the following categories of errors
- Power errors
- Startup errors
- SmartSlice I/O Unit errors
- EtherCAT errors

6-1-1 Power Supply Errors

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

● Troubleshooting UNIT Power

The UNIT PWR LED Indicator shows whether or not sufficient power is supplied to the EtherCAT Communication Unit and the SmartSlice I/O Units in order for them to startup and operate properly. A UNIT PWR LED Indicator is provided on the following Units:
- GRT1-ECT EtherCAT Communication Unit
- GRT1-TBL Left Turnback Unit

The table below shows the LED Indicator options.

Unit Power Error		
[UNIT PWR] indicator	**Cause**	**Actions**
Off	No Power or not enough power is being supplied to the Units (See note)	Check whether power is supplied to the Unit Power Connector. Check that the supplied power is with in the required range, i.e. 24 Vdc +10% -15% (20.4 to 26.4 Vdc).
Flashing	The Unit power supply capacity is insufficient.	Check the entire SmartSlice I/O System's power supply requirement and replace the power supply with one that has sufficient capacity.
On	No Unit power error. The correct power is supplied to the System.	

Precautions for Correct Use

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

● Troubleshooting I/O Power

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

- GRT1-ECT EtherCAT Communication Unit
- GRT1-TBL Left Turnback Unit
- GRT1-PD2 I/O Power Supply Unit

The table below shows the LED Indicator options.

I/O Power Error		
[I/O PWR] indicator	**Cause**	**Actions**
Off	No Power or not enough power is being supplied to the External I/O of the SmartSlice I/O Units	Check whether power is supplied to the I/O Power Connector on the GRT1-ECT, the GRT1-TBL or the GRT1-PD2 Unit. Check that the supplied power is with in the required range, i.e. 24 Vdc +10% -15% (20.4 to 26.4 Vdc).
On	No I/O power error. The correct power is supplied to the External I/O System.	

6-1-2 SmartSlice I/O System Errors

● TS indicator on GRT1-ECT

[TS] indicator	Color	Cause	Actions
Off	---	Power is not being supplied to the Unit.	Refer to section *6-1-1 Power Supply Errors*.
Flashing (1 Hz)	Green	Joining SmartSlice I/O Units to network.	Wait until the SmartSlice I/O Units have been added to the network.
		There is a possible break in the connection between individual slices, or one of the SmartSlice sockets has not been connected properly to its left neighboring connector. The TS LED Indicator on all correctly connected slices are flashing, whereas the TS LED Indicators on the non-correct Units are Not Lit (OFF).	• Check the connection between slices at the point where the first Unit is located with its TS LED Indicator OFF. • Ensure that all slices are connected correctly to each other.
		The End Unit is not (properly) attached. SmartSlice Communication does not start up. The TS LED Indicator on all SmartSlice I/O Units slices are flashing.	Check the End Unit connection and ensure that it is correctly connected to the SmartSlice system.
	Red	SmartSlice bus communication error occurred.	Check whether the SmartSlice I/O System's base block is connected properly.
		When the registration table function is enabled, the actual configuration does not match the registered configuration.	Correct the configuration and turn the power ON again.
		The total number of I/O points in the SmartSlice I/O Systems exceeds the maximum.	Correct the Unit configuration and number of I/O points and turn the power ON again.
Flashing (2 Hz)	Green	Restore operation in progress	Wait until the restore operation is completed.
		Backup operation in progress	Wait until the backup operation is completed.
On	Red	Backup operation failed (See Note).	Backup the data again.
		Restore operation failed (See Note).	Reinstall the Unit in which the data was being restored and turn the power ON again.
		SmartSlice I/O Unit configuration error occurred.	• Are more than 64 I/O Units connected? • Are more than 128 bytes of I/O data being used? • Has the I/O configuration changed since the I/O configuration table was registered?
	Green	The Slice bus is operating normally.	---

Reference

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

● TS indicator on SmartSlice I/O units

[TS] indicator	Color	Cause	Actions
Off	--	Power is not being supplied to the Unit.	Refer to section *6-1-1 Power Supply Errors*.
		Power is not being supplied to each GRT1-TBL Unit.	Ensure the Unit power supply of each GRT1-TBL is the same Unit power supply used for the GRT1-ECT.
Flashing (1 Hz)	Red	Communication error occurred.	Check whether the connector is inserted properly.
Flashing (2 Hz)	Green	Restore operation in progress	Wait until the restore operation is completed.
		Backup operation in progress	Wait until the backup operation is completed.
On	Red	Unit hardware failure	Turn the power OFF and then ON again. Replace the Unit if the error recurs.
	Green	SmartSlice I/O Unit operating normally.	---

6-1-3 EtherCAT Errors

If power supply to the Unit is correct and the Communication Unit and the SmartSlice I/O Units are operating correctly, problems in the EtherCAT Connection can be determined using the RUN, ERR and L/A LED indicators on the EtherCAT Communication Unit.
In this section, the states of status indicator are indicated using the following abbreviations.

Abbreviation	Definition
On	ON
Off	OFF
F	Flickering (ON (50 ms) - OFF (50 ms) flashing)
B	Blinking (ON (200 ms) - OFF (200 ms) flashing)
SF	Single flash (ON (200 ms) - OFF (1000 ms) flashing)
DF	Double flash (ON (200 ms) - OFF (200 ms) - ON (200 ms) - OFF (1000 ms) flashing)
–	Undefined

For details on definition of each state, refer to "2-5 Communication State Transitions" in page 2 - 7.

● Errors of Slave

[L/A IN] [L/A OUT] indicator	[RUN] indicator	[ERR] indicator	Description	Cause	Actions
F	On	Off	EtherCAT communication is in progress.	EtherCAT communication is being executed.	PDO communication or both PDO and SDO communication are being executed. State is normal.
–	Off	On	Hardware error	A hardware failure occurred.	If the error does not clear even after the power is turned ON again, the Slave hardware is damaged. Replace the Slave.
		F			
		B		The Expansion Unit is disconnected.	Check the Expansion Unit connection.

[L/A IN] [L/A OUT] indicator	[RUN] indicator	[ERR] indicator	Description	Cause	Actions
–	–	B	Illegal switch setting	A range setting switch or other switch setting is illegal.	Check the switch settings then restart the Slave according to the specification of connected EtherCAT Master Unit.
			EEPROM data error	EEPROM data error	Use the Configuration Tool or SDO communication to restore the default data and restart the Slave according to the specification of connected EtherCAT Master Unit.
			Sync manager setting error	The sync manager setting is illegal.	Change to the correct settings.
			Hardware error	A hardware failure occurred.	If the problem is not resolved even after the measures described above are taken, the Slave hardware may be damaged. Replace the applicable Slave.
-	Off	Off	Init state	The EtherCAT Master Unit commands to go to Init state.	■ **If [TS]=Green** **Check the state of the master** ■ **if [TS]=Red** **SmartSlice I/O Unit configuration error:** • Are more than 64 I/O Units connected? • Are more than 128 bytes of I/O data being used? • Has the I/O configuration changed since the I/O configuration table was registered?

● Errors of EtherCAT Network

[L/A IN] [L/A OUT] indicator	[RUN] indicator	[ERR] indicator	Description	Cause	Actions
On	–	–	Link established in physical layer	Operation standby status after establishing link in physical layer.	–

[L/A IN] [L/A OUT] indicator	[RUN] indicator	[ERR] indicator	Description	Cause	Actions
Off	–	–	Link not established in physical layer	A link in physical layer has not been established.	After checking the following items, restart the Slave according to the specification of connected EtherCAT Master Unit. • Is the communication cable wired correctly? • Are any cables disconnected or loose in the part that connects to the connector? • Is the cable length appropriate? • Is the communication cable of the recommended specification?
				The host master has not been started.	Check that EtherCAT Master Unit is operating correctly. If using an OMRON EtherCAT Master Unit, check the EtherCAT Master Unit mode and Slave node addresses. If using EtherCAT Master Unit from another manufacturer, refer to the user's manual for that Master Unit.
				A hardware failure occurred.	If the problem is not resolved even after the measures described above are taken, the Slave hardware may be damaged. Replace the applicable Slave.
–	–	DF	Process data communications timeout *	A communication error occurred.	After checking the following items, restart the Slave according to the specification of connected EtherCAT Master Unit. [Item about communication cable] • Is the communication cable wired correctly? • Are any cables disconnected or loose in the part that connects to the connector? • Is the cable length appropriate? • Is the communication cable of the recommended specification? [Item about power supply] • Is the power supply voltage within the specification range? • Is the power supply capacity sufficient?
				Malfunction due to noise	• If there are devices in the vicinity that generate noise, take necessary measures against the noise to protect the EtherCAT Master Unit and Slaves and the communication cable. • The noise resistance deteriorates if a cable other than those of the recommended specification is used. Use the communication cable of the recommended specification.
			Link in physical later OFF	Communication cable disconnection occurred.	Check to see if the cable is disconnected or loose in the part that connects to the connector.

[L/A IN] [L/A OUT] indicator	[RUN] indicator	[ERR] indicator	Description	Cause	Actions
–	SF	–	Safe-Operational state	It is commanded from the EtherCAT Master Unit to shift to the Safe-Operational state.	If the undesired state occured during operation of the system, check the state of the connected EtherCAT Master Unit.
–	B	–	Pre-Operational state	It is commanded from the EtherCAT Master Unit to shift to the Pre-Operational state.	
–	Off	–	Init state	It is commanded from the EtherCAT Master Unit to shift to the Init state.	

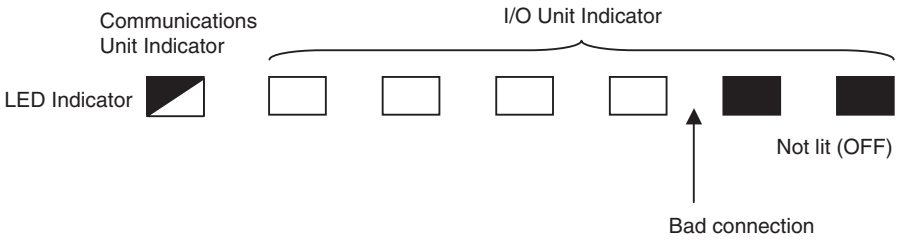
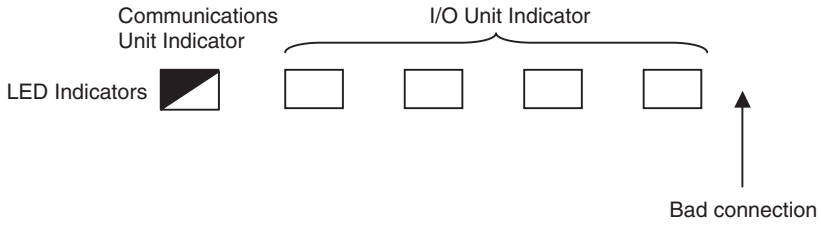
Due to the EtherCAT specification, a communication timeout does not occur with those Slaves that only handle input data.

● Errors returning AL status code

[L/A IN] [L/A OUT] indicator	[RUN] indicator	[ERR] indicator	Description	Cause	Actions
–	Off	B	AL status code 0x0061	ID-selector <> 0 and written Slave Node Address <> 0	• Slave Node Address is automatically updated to 0 • Cycle the power to the GRT1-ECT
			AL status code 0x8001	Unsupported SmartSlice I/O Unit detected	Remove the unsupported SmartSlice I/O Unit. The following Units are not supported: • GRT1-END-M: use GRT1-END • GRT1-CT1(-1) and -CP1-L are supported from Ver.2.1
			AL status code 0x8002	One or more SmartSlice I/O Units are not set to their default configuration	Replace the SmartSlice I/O Unit(s) or set to their default configuration.
			AL status code 0x8003	Slice bus initialization failure	• Slice registration wrong • Only an end-slice present
	B		AL status code 0x0024	Input PDO mapping incorrect	Correct SmartSlice configuration (Number or type of Digital or Analog Input Units)
			AL status code 0x0025	Output PDO mapping incorrect	• Correct the output PDO mapping according SmartSlice configuration. • Correct SmartSlice configuration (Number or type of Digital or Analog Output Units)

6-1-4 Other Errors - SmartSlice I/O Communication

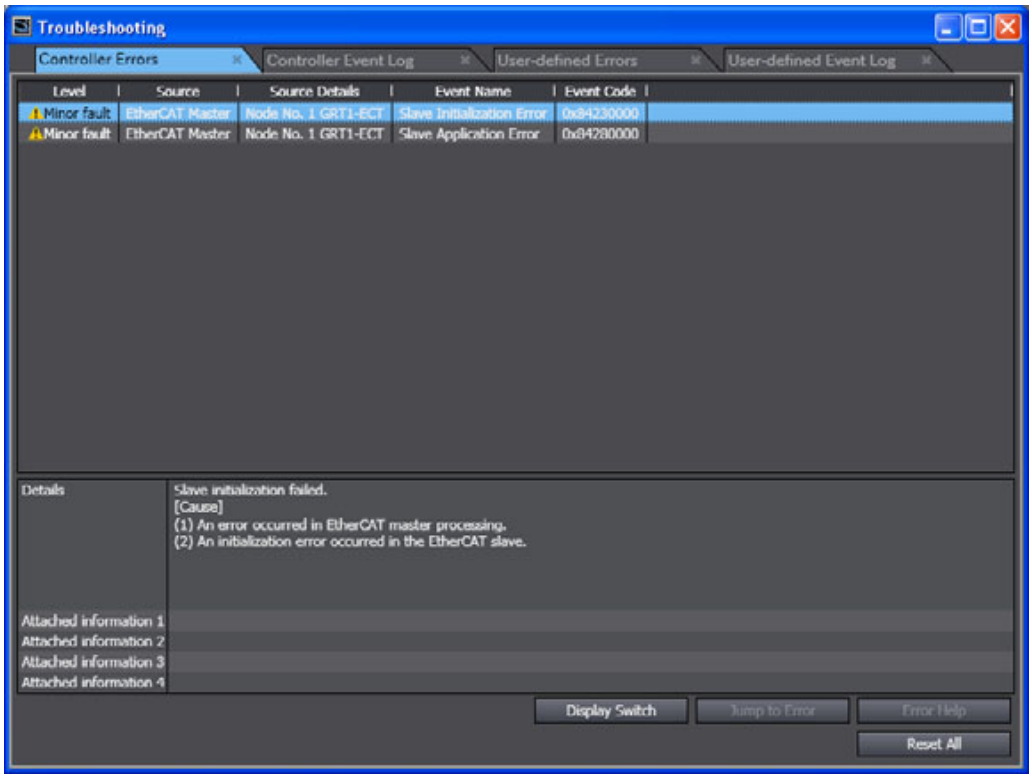
This section deals with troubleshooting the SmartSlice I/O communication on the network from a behavior point of view. The column on the left describes the general perceived problem to the user. The columns on the right list the possible causes and their remedies.

<table>
<tr><th>Problem</th><th>Cause</th><th>Actions</th></tr>
<tr><td>The Communication Unit's Unit Power LED is flashing.</td><td rowspan="2">The Unit power supply capacity is insufficient.</td><td rowspan="2">Check the entire SmartSlice I/O System's power supply requirement and replace the power supply with one that has sufficient capacity.</td></tr>
<tr><td>The I/O Unit repeatedly checks LEDs (TS LED flashing green and red).</td></tr>
<tr><td rowspan="2">The Communication Unit's TS LED intermittently flashes green. The TS LED of the I/O Units in front of the bad connection light green, while the TS LED of the I/O Units behind the bad connection are OFF.</td><td>The slide connector on the left side of the affected Unit is not connected properly.</td><td>Connect this slide connector properly and turn the power ON again.</td></tr>
<tr><td colspan="2"> 
</td></tr>
<tr><td rowspan="2">The Communication Unit's TS LED flashes green and the I/O Unit's TS LED is ON.</td><td>The End Unit is not connected properly.</td><td>Connect the End Unit properly and turn the power ON again.</td></tr>
<tr><td colspan="2"> 
</td></tr>
</table>

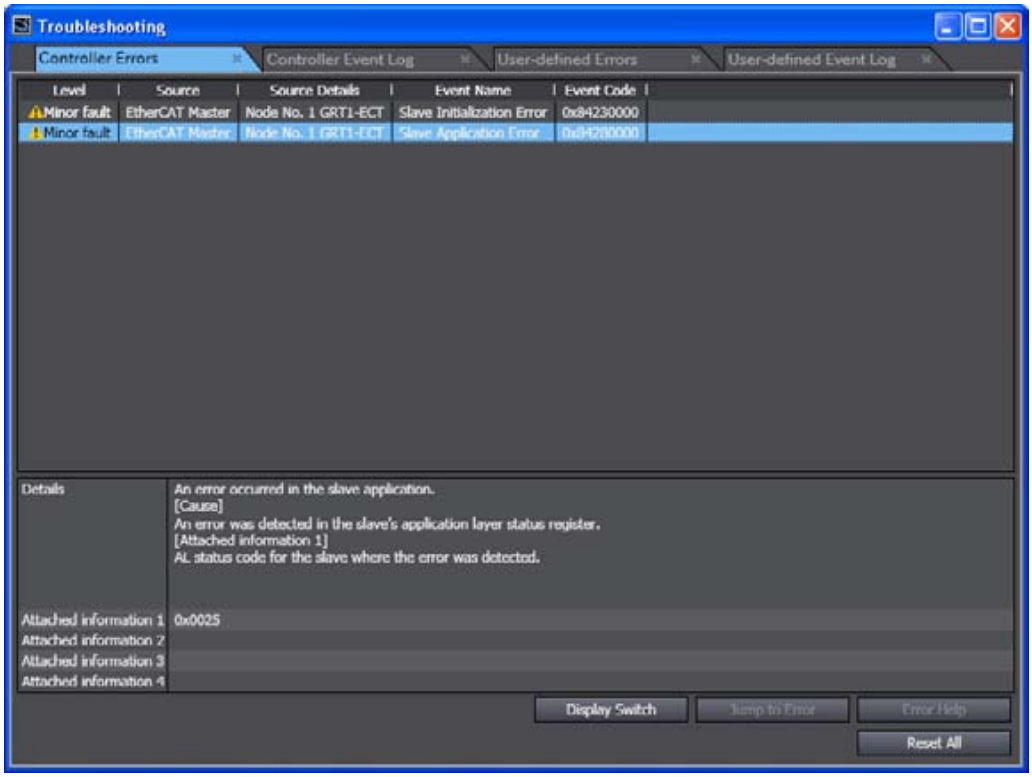
6-2 Troubleshooting with Sysmac Studio

Sysmac Studio also has information available to help troubleshooting.

1. Select the Troubleshooting item from the Tools menu.



2. Select the line with event code 0x84280000:



The line ***Attached Information 1*** lists the AL status code (in the example above 0x0025) which is the cause of the failure for that slave.
The tabel below lists applicable AL status codes for the GRT1-ECT.

AL status code	Cause	Actions
0x0061	ID-selector <> 0 and written Slave Node Address <> 0	• Slave Node Address is automatically updated to 0 • Cycle the power to the GRT1-ECT
0x8001	Unsupported SmartSlice I/O Unit detected	Remove the unsupported SmartSlice I/O Unit. The following Units are not supported: • GRT1-END-M: use GRT1-END • GRT1-CT1(-1) and -CP1-L are supported from Ver.2.1
0x8002	One or more SmartSlice I/O Units are not set to their default configuration	Replace the SmartSlice I/O Unit(s) or set to their default configuration.
0x8003	Slice bus initialization failure	• Slice registration wrong • Only an end-slice present
0x0024	Input PDO mapping incorrect	Correct the input PDO mapping according SmartSlice configuration
0x0025	Output PDO mapping incorrect	Correct the output PDO mapping according SmartSlice configuration

7

GRT1-ECT Installation

This chapter explains mounting, wiring and replacement of the EtherCAT Slave.

7-1 Installing an EtherCAT Network

This section explains how to install an EtherCAT network.

7-1-1 Precautions for Network Connection

Observe following precautions when installing an EtherCAT network:

General Precautions

- Take sufficient safety measures.
- OMRON recommends qualified engineers for all network related actions.
- Install the network according to the network standards and the local standards.

Precautions for devices and cables

- Do not install EtherCAT network devices near any devices generating noise.
  If noise can not be prevented then make sure to take noise measures such as housing each device in metal cases.

- Check all communication cables on cable breakage, short-circuits and a good connector.
- Check for all connectors if the communication cable is locked to the device.
- Install communication cables separate from high-voltage electrical power lines and from devices generating noise.
- Prevent using cables in high-temperature, high-humidity environment, powder dust and oil mist.
- Do not use communication cables with a length of more then 100 meters.
- Ensure the bending radius of communication cables is within the specifications of the supplier.

7-1-2 Communication Cables and Connectors - Preparation

Prepare the required cables.

Use 100BASE-TX shielded twisted pair cables, category 5 or higher.

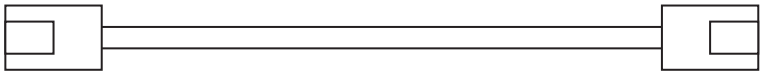
The cables should be double-shielded (aluminum tape and braided shielding).

Precautions for Correct Use

- The maximum cable length between connected nodes is 100 m. Note that some cables do not guarantee 100 m. In general, if the conductors are strand wire, the transmission performance will be lower than solid wire and the operation at 100-m distance cannot be guaranteed. Confirm details with the cable manufacturer.
- When selecting connectors, check that the cables to be used conform to connectors. Items to be checked include conductor size, conductor wire type (solid wire/twisted wire, 2/4 pairs), and outer diameter.

7-1-3 Communication Cables and Connectors - Wiring

Connect a communication cable and a connector by wiring them straight as shown below.



Pin No.	Wire color
1	White-Green
2	Green
3	White-Orange
4	Blue
5	White-Blue
6	Orange
7	White-Brown
8	Brown
Connector hood	Shielded cable *

Wire color	Pin No.
White-Green	1
Green	2
White-Orange	3
Blue	4
White-Blue	5
Orange	6
White-Brown	7
Brown	8
Shielded cable*	Connector hood

Reference

- There are 2 types of wiring standards for Ethernet cables : "T568A" and "T568B."
  The figure above shows a wiring method conforming to the standard "T568A". The wiring method conforming to the standard "T568B" can also be used.
- Connect both ends of cable shielded wires to the connector hoods.
- The twisted pairs are 1 & 2, 3 & 6, 4 & 5 and 7 & 8.

7-1-4 Connecting the Communication Cables

Arrange following connections:

● Connect the EtherCAT Master Unit

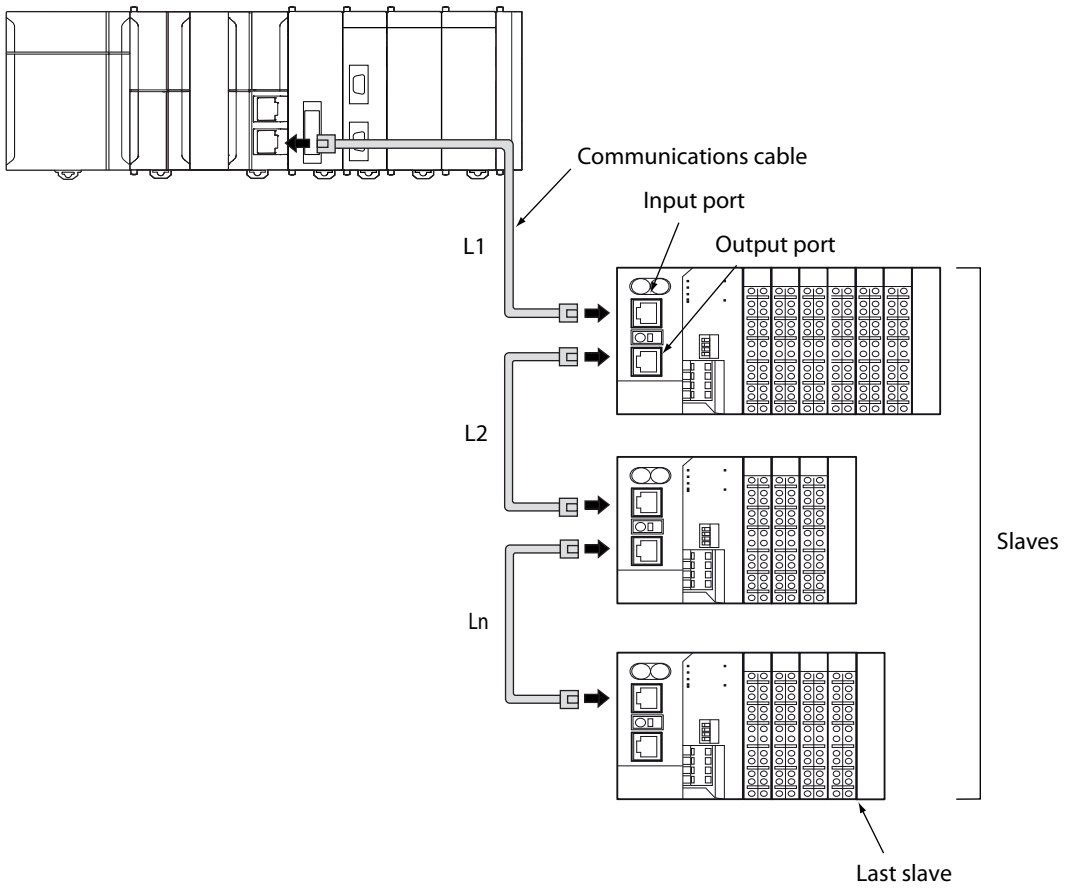
Connect a communication cable from the EtherCAT Master Unit to the [CN IN] connector of the first Slave.

● Connect all Slaves.

Connect a communication cable from each [CN OUT] connector of a Slave to the [CN IN] connector of the next Slave. The [CN OUT] connector of the last Slave can be left unconnected.

Reference

Unlike other networks there is no terminator required at the end of the network.



L1: Connection between Master and first Slave.
L2, L3: Connections between Slaves.

7-2 Installation GRT1-ECT and Units

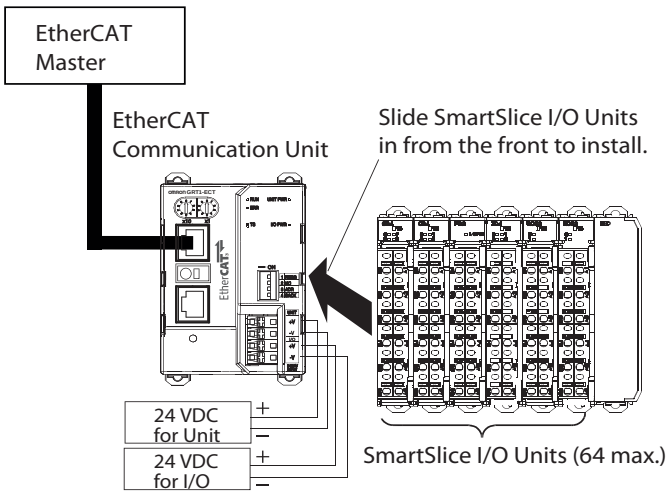
This section contains the procedures for installing the GRT1-ECT Unit and SmartSlice I/O Units.

7-2-1 Handling Precautions

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

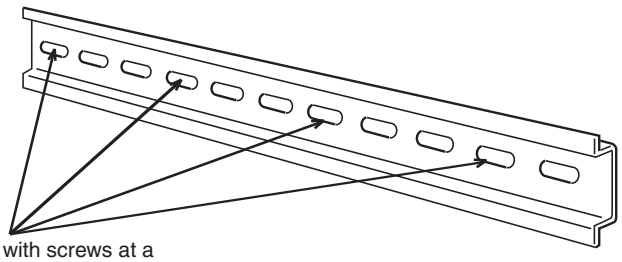
- Always turn OFF the power supply to the EtherCAT Communication Unit, the SmartSlice I/O Units and the external I/O, before mounting or dismounting a Unit or connecting or disconnecting cables.
- Do not connect or disconnect the EtherCAT Communication Unit's communication cable while the EtherCAT network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

The SmartSlice I/O system is installed and set up as an EtherCAT Slave. The EtherCAT Communication Unit's communication connector connects to the Master Unit through an EtherCAT communication cable. Up to 64 SmartSlice I/O Units can be connected to one GRT1-ECT Unit.



7-2-2 Installation on a DIN Rail

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

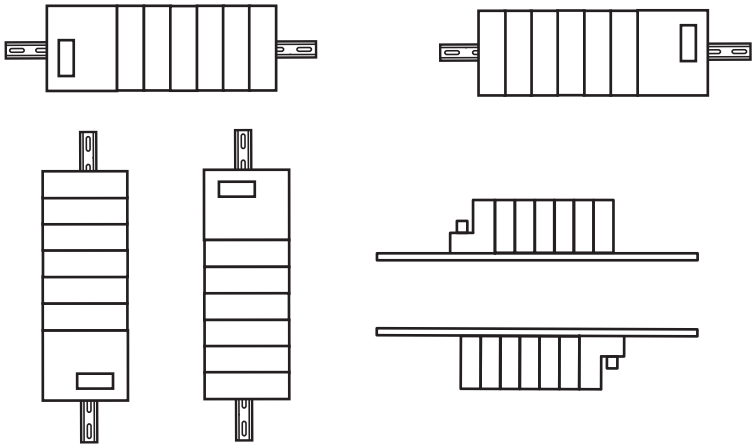


Attach the rail with screws at a maximum spacing of 105 mm between adjacent screws.

PFP-50N (50 cm) or PFP-100N (100 cm) DIN Rail

● SmartSlice I/O System Orientation

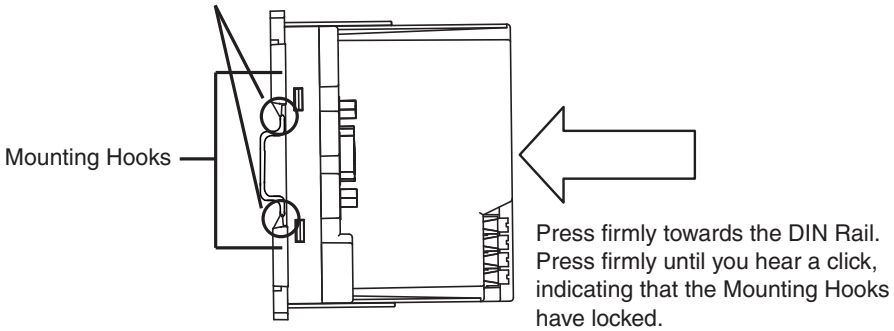
There is no restriction regarding orientation of the SmartSlice I/O System. The system can be mounted in any of the following 6 directions.



● Installing a Unit

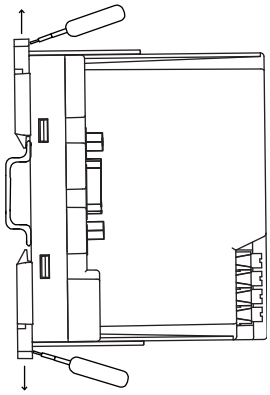
To install an EtherCAT Communication Unit on the DIN rail, press the Unit onto the DIN rail. Press the Unit firmly until it clicks, indicating that the Unit's DIN rail Mounting Hooks have all locked onto the DIN rail.

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



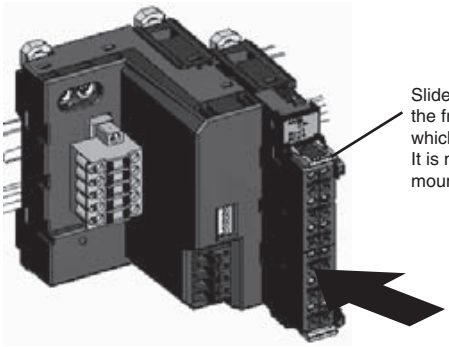
- **Removing a Unit**

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



7-2-3 Connecting the EtherCAT Unit and SmartSlice I/O Units

Connect the first SmartSlice I/O Unit to the EtherCAT Communication Unit by aligning the sides of the Units and sliding in the SmartSlice I/O Unit from the front. Additional SmartSlice I/O Units can be connected consecutively to the first.



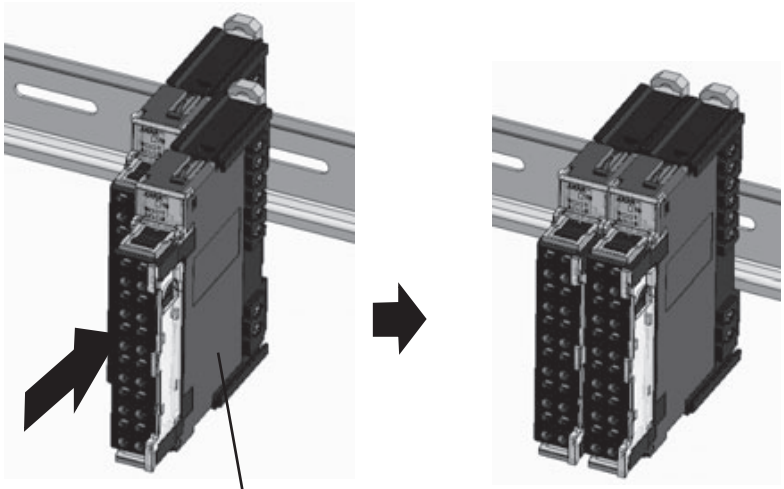
Slide the Slice I/O Unit toward the DIN Rail from the front. Insert the Unit until you hear a click, which indicates that the Unit has locked on the Rail. It is normally not necessary to release the DIN Rail mounting hook when mounting the Unit.

Precautions for Correct Use

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

7-2-4 Connecting Additional SmartSlice I/O Units

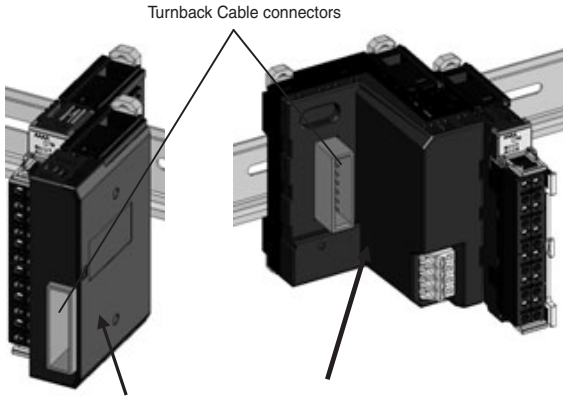
Connect additional SmartSlice I/O Units by aligning the sides of the Units and sliding in the next Unit from the front. Up to 64 SmartSlice I/O Units can be connected to one EtherCAT Communication Unit.



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

● Connecting Turnback Units

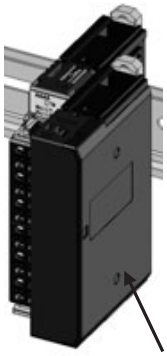
When a SmartSlice I/O System is divided into blocks, connect a GRT1-TBR Right Turnback Unit to the right end of the first block. Connect a GRT1-TBL Left Turnback Unit to the left side of the expansion block and connect additional SmartSlice I/O Units. Use a GCN2-100 Turnback Cable to connect the Turnback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



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

Connecting the End Unit

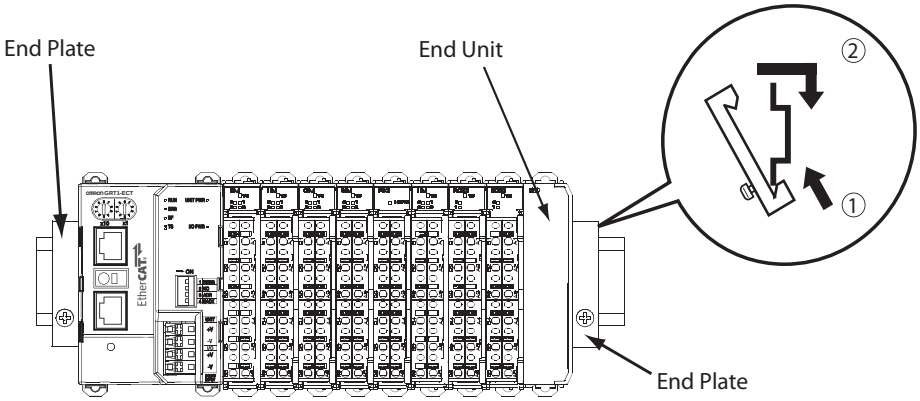
A GRT1-END End Unit must be connected at the end of the SmartSlice I/O System.



GRT1-END End Unit

Installing the End Plates

Always secure the SmartSlice I/O System on the DIN Rail by installing End Plates on both sides of the System. First hook the bottom of the End Plate on the bottom edge of the DIN Rail (1), attach the top of the End Plate, and pull the End Plate down onto the top edge of the DIN Rail (2). Tighten the End Plate's securing screw.



Precautions for Correct Use

Always secure the SmartSlice I/O System by attaching End Plates on both ends.

Installation of SmartSlice I/O Units

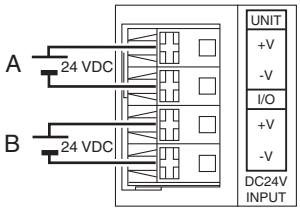
Refer to W455 GRT1-Series SmartSlice I/O Units Operation Manual.

7-3 Installing the Power Supplies

Power supplies required to operate the EtherCAT network are:

- Unit power supply: For communication and internal operation of Slaves.
- I/O power supply: For input/output operations of external I/O devices of each Slave.

The GRT1-ECT has 2 24 VDC power supply terminals:
These terminals are screwless clamp terminals.



Label	Power supply terminal	Description
A	Unit power supply terminal	These terminals supply power to the EtherCAT Communication Unit's internal circuits as well as the connected SmartSlice I/O Units' internal circuits (supplied through the SmartSlice bus)
B	External I/O power supply terminal	These terminals supply power to the external I/O that is connected to the System's SmartSlice I/O Units

This section explains how to install the Unit power supply and I/O power supply.

7-3-1 Precautions for Power Supplies

Observe following precautions when installing Power Supplies:

General Precautions

- Take sufficient safety measures.
- Ensure the allowable current of cables and connectors is not exceeded
- Check the voltage drop.
  The supplied voltage for a Slave is directly related to the distance (cable length) from the power supply. Check if voltage of the Slave most far from the power supply stays within specifications.

Multiple power supplies

- Consider the use of multiple power supplies.
  The layout and grouping of power supplies determines what stops when a power supply error occurs. If you want to avoid stopping the entire system, we recommend to set power supplies at several locations and supply power to groups of Slaves, or take similar measures.
- When the power supplied is generated by multiple power supplies, then the line current, voltage drop, and cable dimensions can be influenced. Check if all parameters stay within specifications.

7-3-2 Unit Power Supply - Calculation

Power supply specifications:

Item	Specification
Output voltage	24 VDC ± 10%
Output ripple	600 mVp-p
Output current	The capacity to supply at least the power of the total current consumption of all connected Units.
Isolation	Between output and AC power supply and between output and chassis ground

OMRON recommends the OMRON S8JX series power supplies for Slaves.

The power limit for the Unit power supply is 80W.
This power limit is related to the connected SmartSlice Units. If the limit is exceeded it is required to separate the SmartSlice Units in two or more groups. Mount Turnback Units to the SmartSlice Units that are separated and connect the Turnback Units with a Turnback Cable to continue the Unit Communication channels.

● Calculate required separation of SmartSlice I/O Units.

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

1 **Calculate the power consumption of all connected SmartSlice I/O Units.**
Refer to the *GRT1 Series SmartSlice I/O Units Operation Manual* (W455) for the power rating of each SmartSlice I/O Unit.

2 **If the total power consumption exceeds 80 W then regroup the SmartSlice I/O Units.**

(1) Create a first group with a power consumption less then 80W.

(2) Mount a Right Turnback Unit (GRT1-TBR) at the side of this first group.

(3) Mount a Left Turnback Unit (GRT1-TBL) at the left side of the second group.

(4) Connect the Right- and Left Turnback Unit with a Turnback Cable.

(5) Connect the 24 VDC Unit power supply to the Left Turnback Unit (GRT1-TBL).

Reference

- When separating SmartSlice I/O Units supply all SmartSlice groups with power from the same power supply. (See also the *Wiring Example*).
- Always use isolated power supplies for the power supplies.
- Power is not supplied through the GCN2-100 Turnback Cable (Refer to the *Wiring Example*)

7-3-3 SmartSlice I/O Power Supply - Calculation

The SmartSlice I/O power supply is limited to a total current consumption of 4 A.
This power limit is related to the connected Inputs and Outputs. If the limit is exceeded it is required to add one or more additional power supplies.

● Calculate required addition of Power Supplies.

The maximum I/O current consumption is 4 A.

1 **Calculate the total current consumption.**

Calculate all external I/O of all connected SmartSlice I/O Units, this includes other Units like Turnback Units.

Refer to the *GRT1 Series SmartSlice I/O Units Operation Manual* (W455) for the current value of each SmartSlice I/O Unit.

Reference

The current consumption calculation is important for actual occuring current consumption.
If I/O can not be activated simultaniously this can influence the calculation.
Contact Field Automation certified engineers for more details.

2 **If the current consumption exceeds 4 A provide a separate external I/O power supply.**

(1) An external I/O power supply can be mounted between SmartSlice I/O Units. OMRON advises the GRT1-PD2(G) I/O Power Supply Unit for this situation.

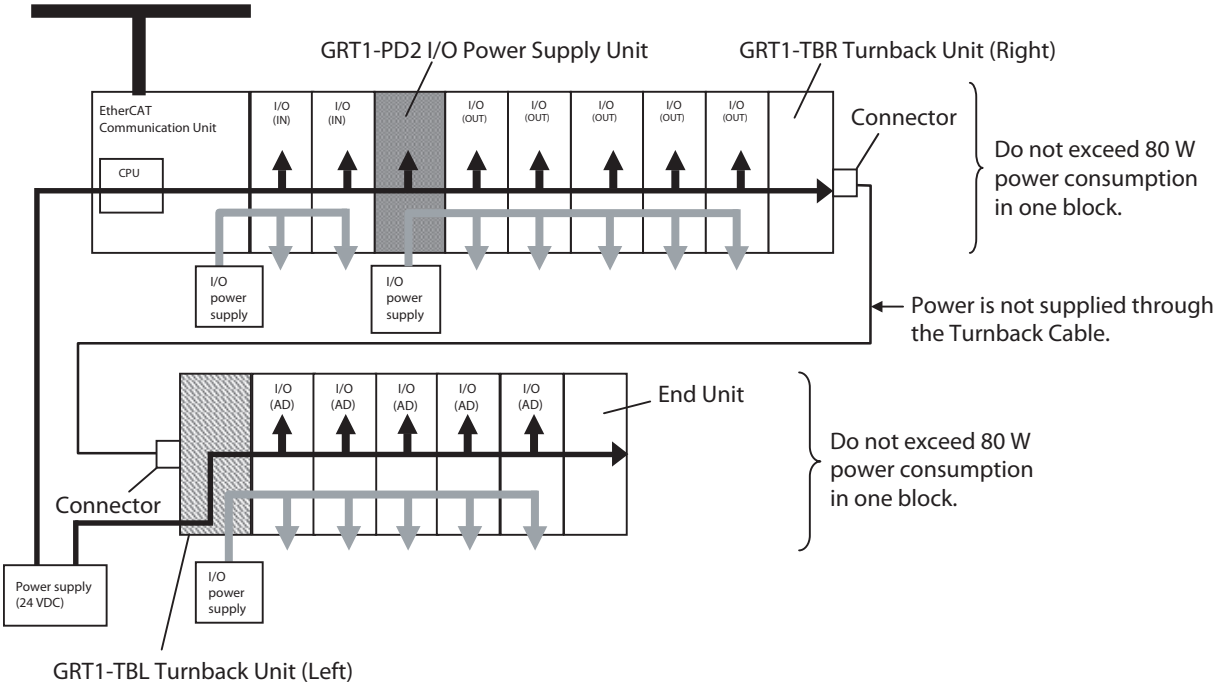
(2) External power supplies can also be connected to a Left Turnback Unit (GRT1-TBL). The GRT1-TBL is equipped with separate power supply terminals for the Unit power supply and I/O power supply.

Reference

- Creating separate hardware groups for (groups of) inputs and (groups of) outputs can also be a reason to separate the SmartSlice I/O Units.
- Always use isolated power supplies for the power supplies.
- Power is not supplied through the GCN2-100 Turnback Cable (Refer to the *Wiring Example*)

7-3-4 Power Supplies - Example

This example demonstrates the calculations and results for the Unit Power Supply and the SmartSlice I/O Power Supplies.

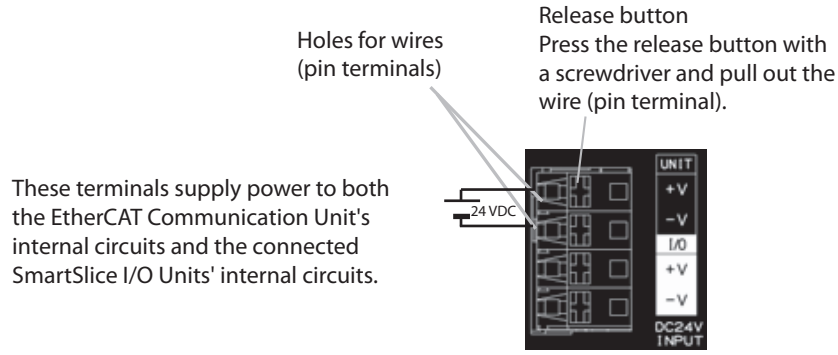


Example Power Supplies

7-3-5 Wiring Methods

● Supplying Power to the Units

Connect the power supply wires (24 VDC) to the EtherCAT Communication Unit's screwless clamping power supply terminals. If pin terminals are used on the wire ends, the pin terminals can just be inserted to wire the power.

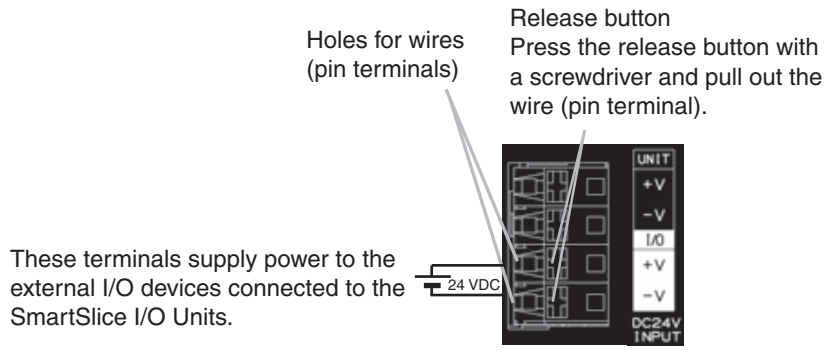


Precautions for Correct Use

The GRT1-TBL Left Turnback Unit has the same screwless clamping power supply terminals as the EtherCAT Communication Unit. These terminals are wired in the same way, by inserting the power supply wires.

● Supplying I/O Power

The power supply for I/O devices is supplied through the EtherCAT Communication Unit's screwless clamping power supply terminals. If pin terminals are used on the wire ends, the pin terminals can be inserted to wire the power.

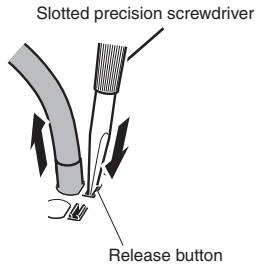


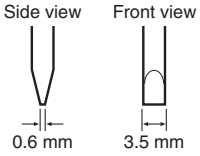
Precautions for Correct Use

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

Removing Wires

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





Recommended model: SZF1 (Phoenix Contact)

Recommended Power Supplies

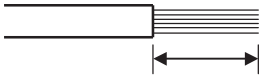
Use a SELV power supply with over current protection.
A SELV power supply has redundant or increased insulation between the I/O, an output voltage of 30 Vr.m.s and a 42.4-V peak or maximum of 60 VDC.
Recommended power supply: S82K-01524 (OMRON) or S8TS-06024 (OMRON).

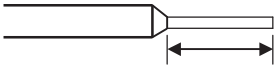
Recommended Wire

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

Strip Length
Pin Terminal Length

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


Strip 7 to 10 mm.


Pin length: 8 to 10 mm

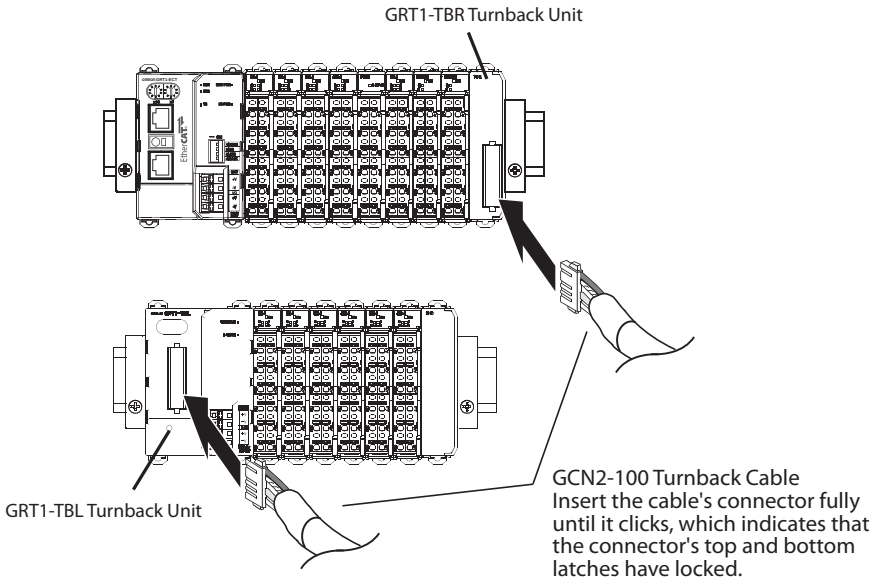
7-3-6 Connecting the Turnback Units

When a SmartSlice I/O System is divided into blocks to expand the system, connect a GRT1-TBR Right Turnback Unit to the GRT1-TBL Left Turnback Unit with a GCN2-100 Turnback Cable.

Precautions for Correct Use

Power is not supplied through the GCN2-100 Turnback Cable. Always wire (supply) the power to the GRT1-TBL Left Turnback Unit from the same power supply that supplies the EtherCAT Communication Unit.

Connect the Turnback Units with a Turnback Cable, as shown in the following diagram. A single EtherCAT Communication Unit can be expanded with up to two additional blocks, connected with two Turnback Cables (2 m total).



7-4 Replacement

7-4-1 Replacement Precautions

The EtherCAT Communication Unit is a Network device. If the Unit is damaged, it will effect the entire Network, so always ensure repairs are undertaken immediately. It is recommended to have a spare EtherCAT Communication Unit on 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.
- If a poor connection is suspected of causing the malfunction, clean the connectors using a clean, soft cloth and industrial-grade alcohol. Remove any lint or threads left from the cloth, and remount the Unit.
- When returning a faulty Unit for repair, always attach a detailed fault report to the Unit and return it to the nearest OMRON dealer.

Precautions for Correct Use

- In order to prevent faulty operation be sure to turn off the power to all master and slave devices before replacing the Unit.
- When replacing the Unit, do not reconnect it to the Network before carrying out the procedures listed below.

7-4-2 Setting the Unit after Replacement

After replacing the Unit - before re-applying the power - set the EtherCAT node address number to the same value as the previous Unit.

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

- Table Registration Function, see Section *5-2-6 Table Registration Function (1 I REGS)*
- Backup Function, see Section *5-2-7 Backup Function (4 I BACK)*
- Automatic Restore Function, see Section *5-2-8 Automatic Device Restore Function (3 I ADR)*

Execute these operations again for the new Unit.
Re-connect it to the network, and restart operation.

8

Sysmac Studio

The program Sysmac Studio gives users the possibility to configure a NJ-series CPU Unit for connection with for example a GRT1-ECT.
EtherCAT Slave Information Files (ESI files) supply Sysmac Studio with information of Slaves. With PDO Mapping the I/O data of connected slaves is configured.

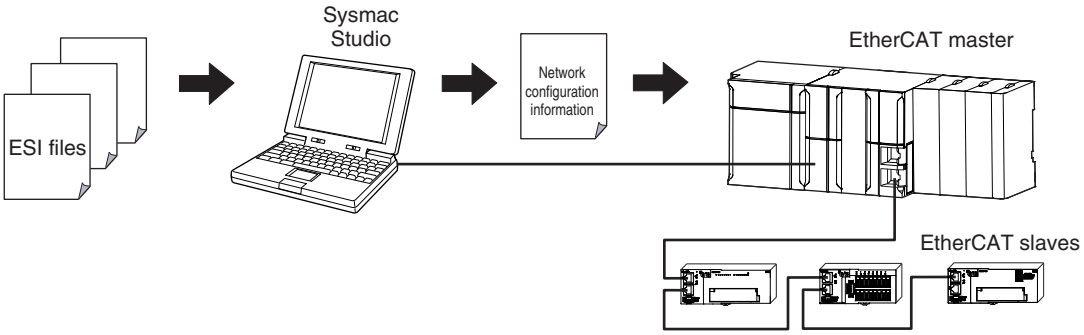
This section gives information on installing the ESI file for the GRT1-ECT, all information required for PDO Mapping and to calculate the I/O Refresh Time.
Refer to manual W504 for more detailed information on Sysmac Studio.

8-1 EtherCAT Slave Information Files

This section provides general information on EtherCAT Slave Information Files (ESI Files).
Using ESI Files in Sysmac Studio includes actions for installation and for checking ESI Files.

8-1-1 General information ESI files

Settings for EtherCAT are described and stored in EtherCAT Slave Information (ESI) files. ESI files contain a device description in XML format. ESI files are provided by the slave manufacturers. Part of the EtherCAT communication settings of the GRT1-ECT come from the ESI file.



Communications are started according to the communications settings and the network configuration in the ESI files that are installed.

You can install ESI files in Sysmac Studio and edit the EtherCAT configuration to create or change the network configuration information.
You must download the network configuration information to the EtherCAT master to configure the EtherCAT network. Contact the supplier of your slave device(s) to obtain the most recent ESI file(s).

8-1-2 ESI files library in Sysmac Studio

A configuration program like **Sysmac Studio** is used to configure the master and Slaves. For each Slave an ESI file should be available in **Sysmac Studio**.

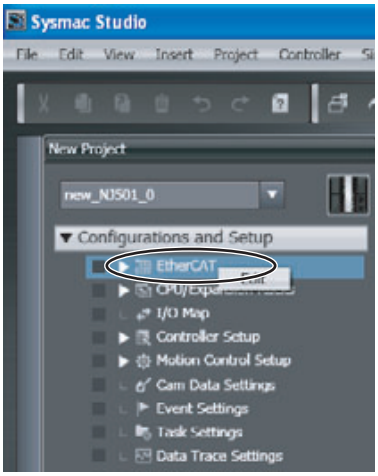
Use the following procedure to display an overview of available ESI files (slaves).

1. Start the program **Sysmac Studio**.

2. Ensure the Multiview Explorer is displayed.
Click the left bar Multiview Explorer if required.

3. Open the menu Configurations and Setup and select EtherCAT.

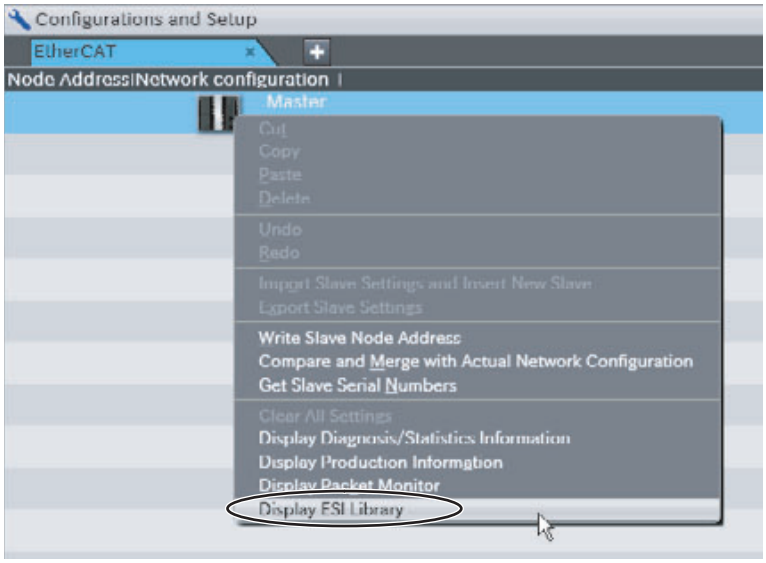
4. Doubleclick EtherCAT to open the EtherCAT tab.



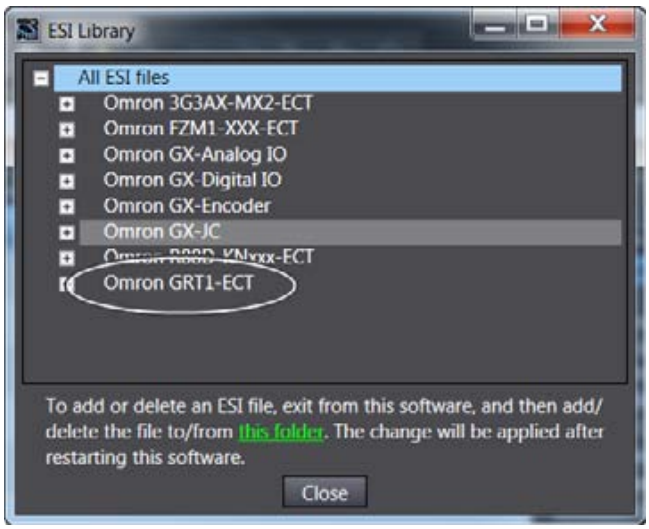
The edit pane is displayed.

Note: Another display method is Right-click **EtherCAT** and then select **Edit**.

5. Right-click the EtherCAT master that is displayed in the edit pane and select **Display ESI Library**.



6. A new window with the title ESI Library is displayed.
All available ESI files are displayed in this tree structure.



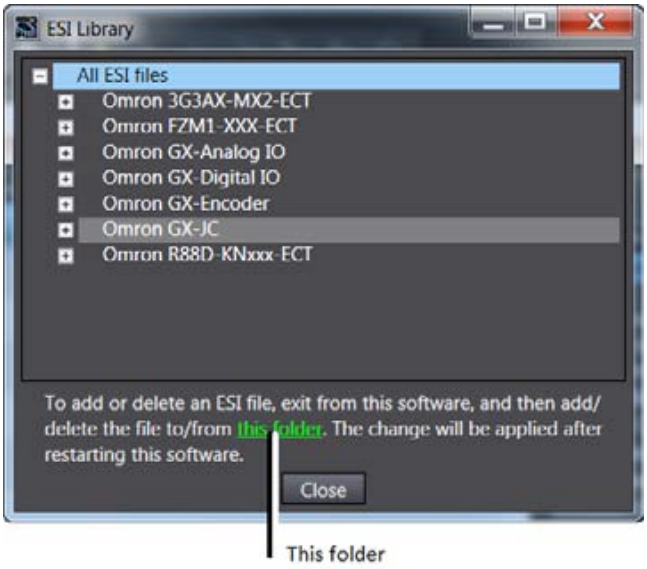
If the ESI file is not available refer to "8-1-3 ESI files - Add to Library" in Page 8 - 5.

8-1-3 ESI files - Add to Library

Use the following procedure to add an ESI file to the library in Sysmac Studio.

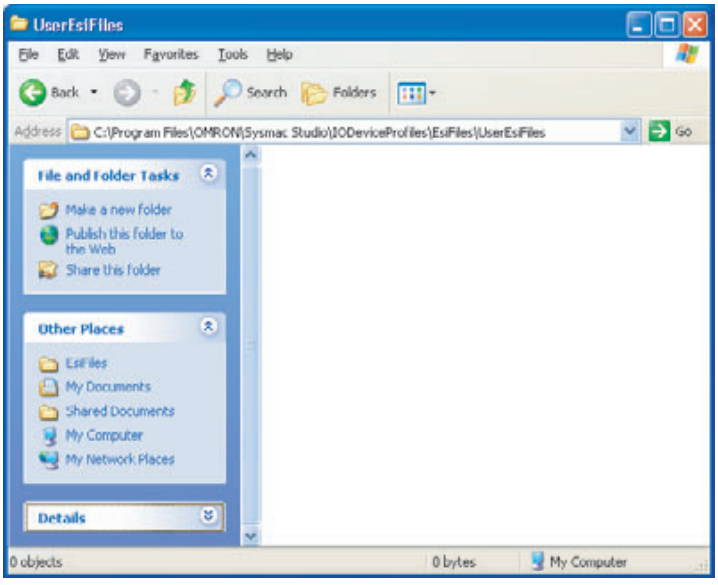
1. Display the ESI files library in Sysmac Studio.
See also § "8-1-2 ESI files library in Sysmac Studio" in Page 8 - 3

2. Click the green **this folder** link at the bottom of the ESI Library window.



An Explorer with the contents of the **UserEsiFiles** folder is displayed.

3. Copy the ESI file for the slave and paste it in this **UserEsiFiles** folder.



Additional information

For installation of the GRT1-ECT EtherCAT slave the ESI file named OMRON GRT1-ECT.xml has to be copied to this directory.

4. Save the project.

5. Restart Sysmac Studio.

The ESI file(s) that you installed is displayed in the ESI Library Dialog Box after you restart Sysmac Studio.

6. Return to the ESI Library window.

The installed slave should now be visible in the expanded tree of All ESI files.

8-1-4 ESI files - Check details

Use the following procedure to check details of an ESI file.

1. Display the ESI files library in Sysmac Studio.

See also § "8-1-2 ESI files library in Sysmac Studio" in Page 8 - 3

2. Check if no exclamation mark is displayed to the left of the name.

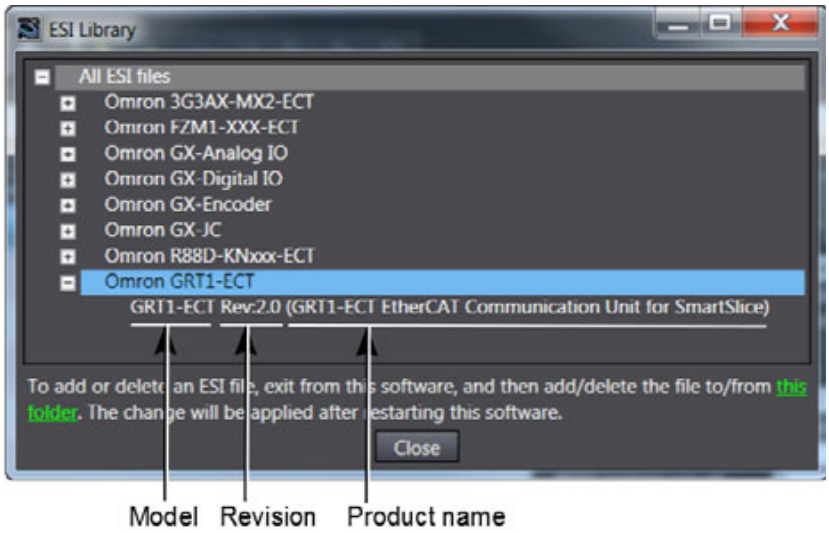
Precautions for Correct Use

If an ESI file for a slave cannot be used in Sysmac Studio, an exclamation mark is displayed. Install a new (improved) ESI file from the slave manufacturer to remove the exclamation mark.

3. Click the **+** Icon to the left of the name of the ESI file that was added.

The slave definitions in the ESI file are expanded so that you can check the following items.

- Model
- Revision
- Product name



8-2 PDO Mapping

This section gives general information on PDO mapping and specific information on how PDO mapping is used in Sysmac Studio.

8-2-1 General information PDO mapping

PDO mapping is required to be able to use connected hardware.
Mapping creates a connection between software parts (PDO) and the hardware.

Mapping Inputs and Outputs from the connected hardware makes these Inputs/Outputs usable in the GRT1-ECT. Mapped Inputs and Outputs can be used as Process Data Objects (PDO) in the configuration software.

There are six types of I/O that can be connected to the GRT1-ECT:
Digital Outputs (DO), Analog Outputs (AO), Counter Outputs (CO), Digital Inputs (DI), Analog Inputs (AI) and Counter Inputs (CI).

The GRT1-ECT can handle up to 512 digital inputs, 512 digital outputs, 64 analog inputs, 64 analog outputs and 10 counters. The combination of type and sequence number creates unique PDO names:

TYPE OF I/O	PDO NAME
Digital Outputs	DO001 to DO512
Analog Outputs	AO001 to AO064
Counter Outputs	Counter Set Value / Command 1 to 10
Digital Inputs	DI001 to DI512
Analog Inputs	AI001 to AI064
Counter Inputs	Counter Value / Status 1 to 10

The total connected hardware determines the total number of required PDO names.
E.g. For two SmartSlices with each 4 Digital Inputs it is required to map DI001 to DI008.

Additional information

Requirements for mapping:
- Mapping for each type of hardware should start with the first avaible PDOname of that type.
- The mapping should be sequential. It is not allowed to skip PDOnames.

8-2-2 Calculating required PDO mapping

The PDO mapping in the GRT1-ECT should reflect the actual situation.
If the PDO mapping is not correct the LEDs [RUN] and [ERR] on the GRT1-ECT will be blinking.

This section describes the calculation for the correct PDO mapping.

1. Make a list of the actual connected hardware.

2. Calculate the total number of DI, DO, AI, AO, CO and CI for the connected SmartSlice I/O units.
Each slave can have a different number of DI, DO, AI, AO, CI and CO.
The total quantity of each type is required for the mapping.
The table below lists the amount of digital, analog and counter I/O for all supported SmartSlice I/O Units.

Model	DO	AO	CO	DI	AI	CI
GRT1-ROS2	2					
GRT1-OD4*	4					
GRT1-OD8*	8					
GRT1-DA2*		2				
GRT1-ID4*				4		
GRT1-IA4*				4		
GRT1-ID8*				8		
GRT1-AD2					2	
GRT1-TS2*					2	
GRT1-CT1*			6			6
GRT1-CP1-L			6			6

* and similar models.
E.g. GRT1-OD4* cover models GRT1-OD4, GRT1-OD4-1, GRT1-OD4G-1 and GRT1-OD4G-3.

Additional information

Check the supplied documentation to prevent mistakes.

Example 1: Hardware GRT1-OD4 and GRT1-OD8 and GRT1-ROS2 (2 DO)

Actual connected hardware	DO	AO	DI	AI
GRT1-ROS2	2			
GRT1-OD4G-1	4			
GRT1-OD8	8			
TOTAL = PDO entries to map	**12**	**0**	**0**	**0**

Example 2:

Actual connected hardware	DO	AO	DI	AI
GRT1-OD4-1	4			
GRT1-OD4-1	4			
GRT1-OD8-1	8			
GRT1-DA2V		2		
GRT1-IA4			4	
GRT1-ID8-1			8	
GRT1-AD2				2
TOTAL = PDO entries to map	**16**	**2**	**12**	**2**

8-2-3 PDO mapping in Sysmac Studio

Mapping PDO is required to make Inputs and Outputs available in the NJ-series CPU Unit.

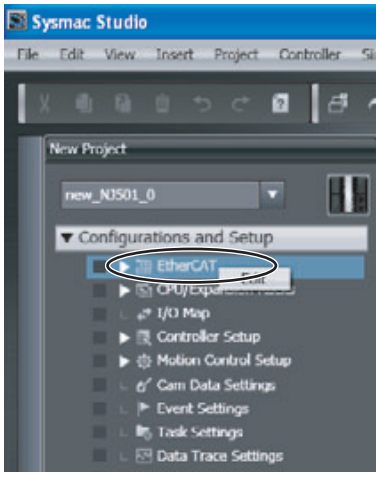
Use the following procedure to display the PDO mapping of the GRT1-ECT in Sysmac Studio.

1. Start the program **Sysmac Studio**.

2. Ensure the Multiview Exporer is displayed.
   Click the left bar Multiview Explorer if required.

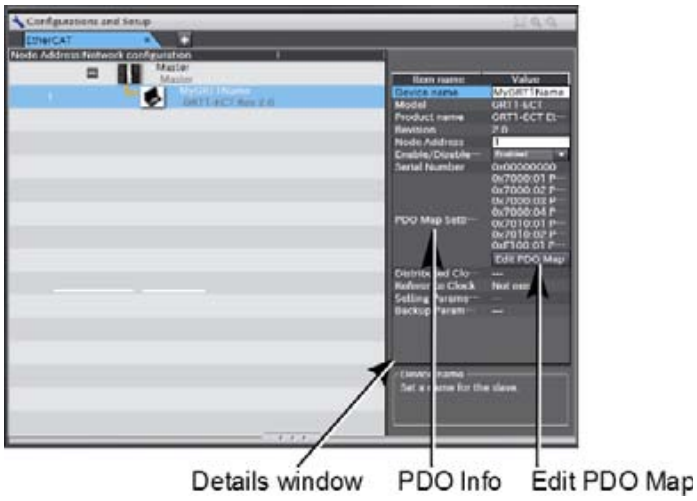
3. Open the menu Configurations and Setup and select EtherCAT.

4. Doubleclick EtherCAT to open the EtherCAT tab.



The edit pane is displayed.
Note: Another display method is Right-click EtherCAT and then select Edit.

5. Select the **GRT1-ECT** in the column **Network configuration**.

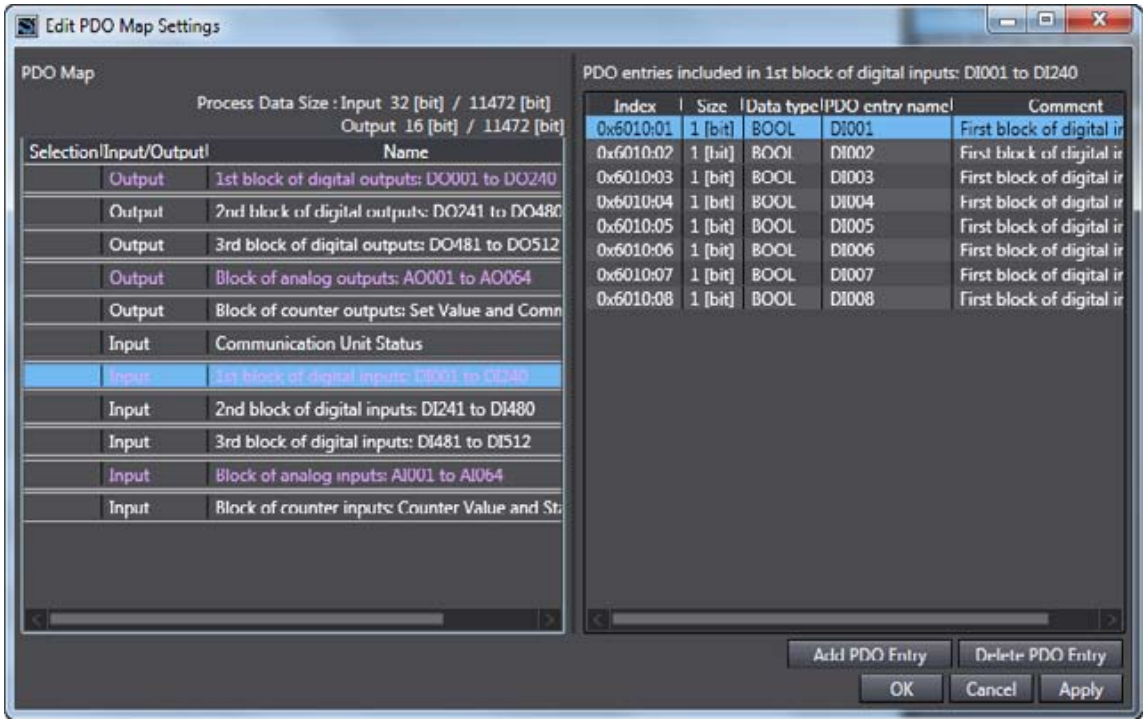


The details window shows all GRT1-ECT specific details including PDO information in the section **PDO Map Settings**.

8-2-4 PDO mapping - Edit

Select the button **Edit PDO Map** to edit the PDO Map or to view details of the PDO Map.
A new window with the title **Edit PDO Map Settings** appears.

The mapping is displayed with at the left side the available **PDO Map**s.
The right side displays the **PDO entries** for the selected **PDO Map**.



Example of a PDO Map for the GRT1-ECT

● PDO Map section

General remarks for PDO Map.
- The displayed available **PDO Map**s are unit specific.
- The colored lines have content.

● PDO Entries section

General remarks for PDO Entries.
- The displayed **PDO entries** are already selected PDO entries for the selected PDO Map.
- PDO entries for Inputs and Outputs use an Input list and an Output list.
  The top part of these lists display Digital IO, then Analog IO, then Counter IO.

● GRT1-ECT specific remarks

Remarks for the GRT1-ECT.
- The GRT1 can handle 512 Digital Outputs and 512 Digital Inputs, each divided in three blocks (001 to 240, 241 to 480, 481 to 512).
- The middle PDO map **Input I Communication Unit status** is always added by the system and not editable.
- If the total number of bits of the selected PDO entries is not a multiple of 8 then the system adds an extra PDO entry that is not editable for users. The size of the added entry makes the total size of the PDO entries a multiple of 8.

8-2-5 PDO mapping - Add PDO Entry

This section describes the procedure to add a PDO entry.

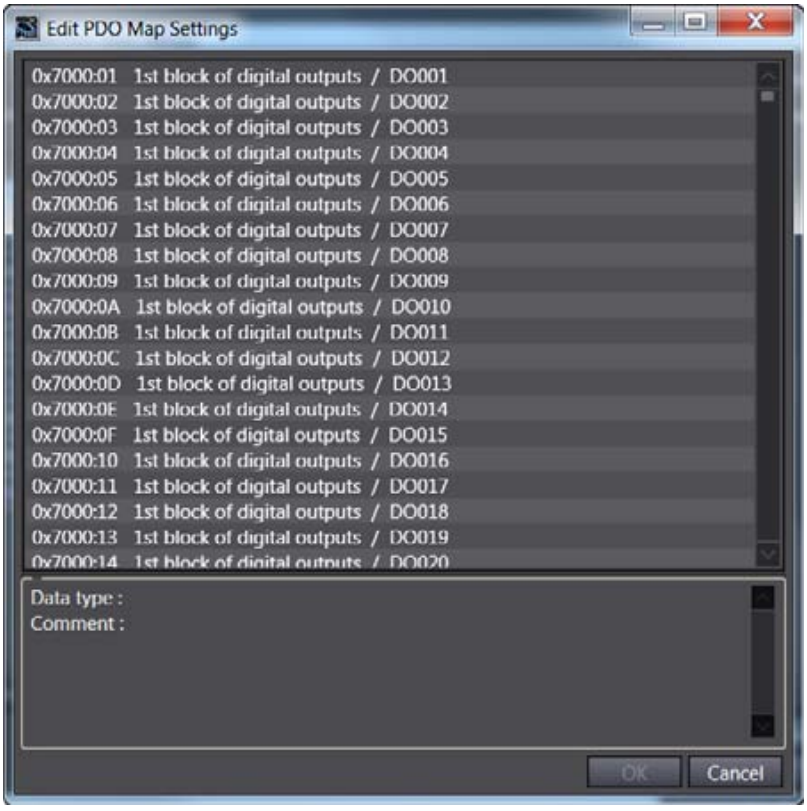
1. Calculate the total number of DI, DO, AI and AO for the connected SmartSlice I/O units.

Each slave can have a different number of DI, DO, AI and AO.
The total quantity of each type is required for the mapping.

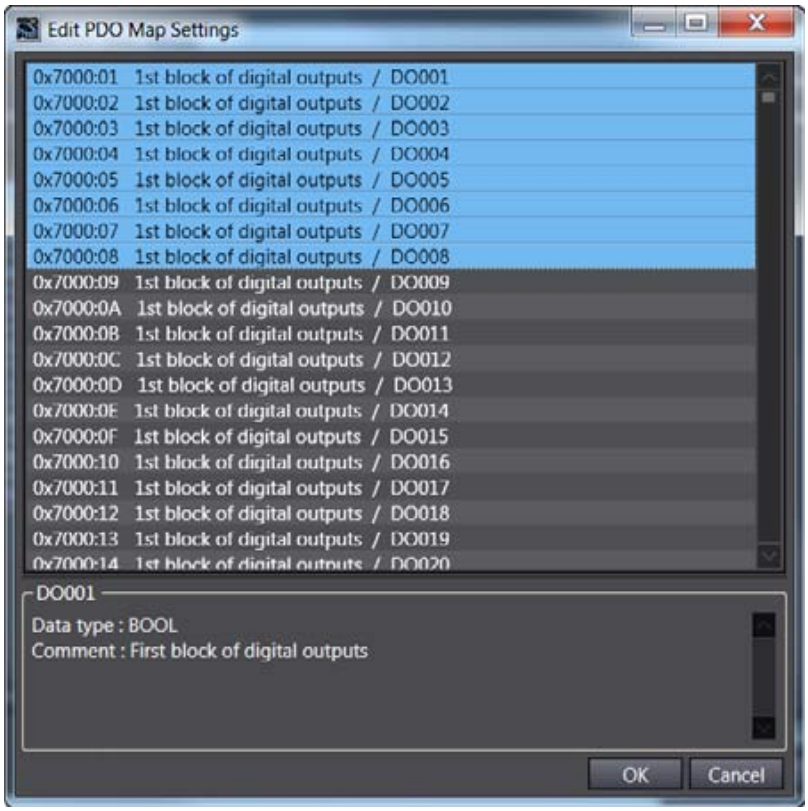
Refer to “Calculating required PDO mapping” for more details.

2. Select the correct PDO Map in the **PDO Map** overview.

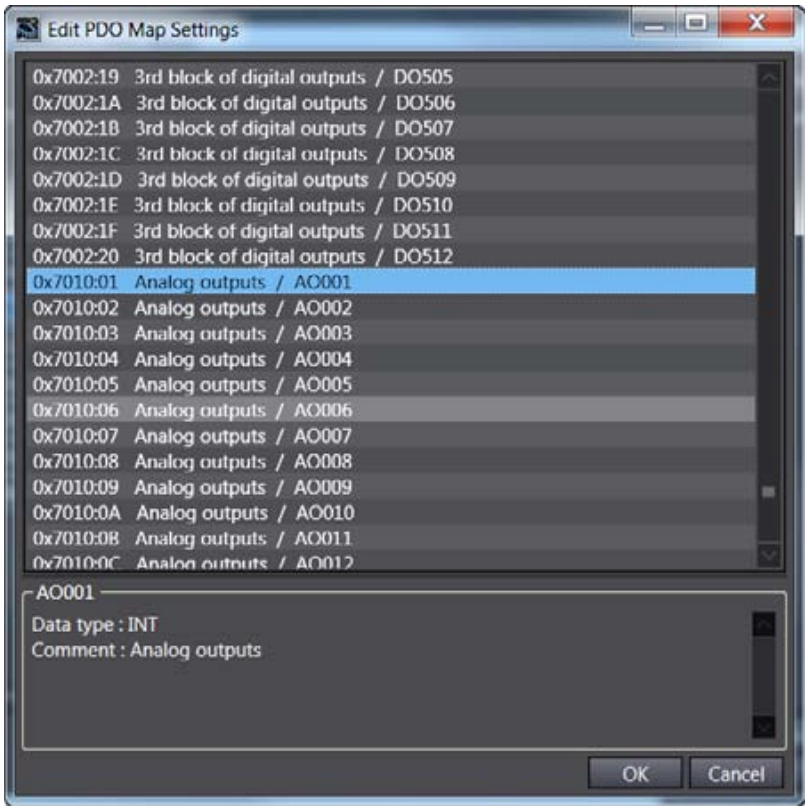
3. Select the button **Add PDO entry** in the **Edit PDO Map Settings** window.
A window with a listing of available PDOs appears.



4. Use the mouse or keyboard (arrows, <home>, <end>, <shift>) to select the desired PDOs.

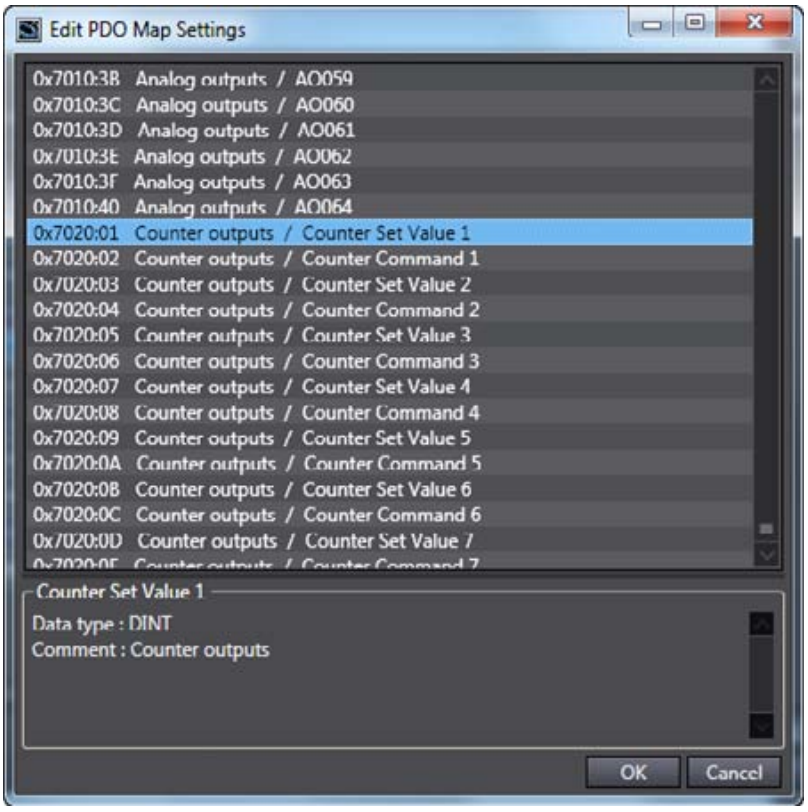


Digital IOs are presented at the top of the list.
To select Analog IO scroll down to the analog IO part of the list.



Tip:
To select large number of IOs you can select (click) on the first item and then use <shift> click on the last item (selecting all items in-between).

To select Counter IO scroll down to the counter IO part of the list.



Each Counter SmartSlice Unit (GRT1-CT1(-1) and GRT1-CP1-L) always requires 2 output objects (Set value and Command) and 2 input objects (Data and Status) to be mapped.

Additional information

- Ensure all PDOs are selected.
- Unused PDOs are only allowed at the end of the total range.

5. Select **OK** when the number of PDOs to add is correct

6. Select each PDO map in the PDO Map window and add the desired number of PDOs.
See step 1 of this procedure for the desired number.

Use the option “Add PDO entry” or Delete PDO until the mapping is correct.

8-2-6 PDO mapping - Delete PDO Entry

This section describes the procedure to delete a PDO entry.

1. Select the button **Edit PDO Map** to edit the PDO Map or to view details of the PDO Map.
   A new window with the title **Edit PDO Map Settings** appears.
2. Select the correct PDO Map in the **PDO Map** overview.
3. Use the mouse or keyboard (arrows, <home>, <end>, <shift>) to select the PDO entries to delete in the **PDO entries** overview.
4. Select the button **Delete PDO entry** in the **Edit PDO Map Settings** window.
   Note: Also the <Delete> key will remove selected PDO entries.
5. Select **OK** when the number of PDOs to add is correct.

Additional information

- Ensure all selected PDO entries are selected sequential.
- Unused PDOs are only allowed at the end of the total range.

Use the option “Add PDO entry” or Delete PDO until the mapping is correct.

8-3 Calculating I/O Refresh Time

This section describes the calculation of the I/O Refresh Time for a SmartSlice configuration.

8-3-1 Introduction

The I/O Refresh Time is the time required to process the Outputs, transmitting the EtherCAT data and processing the Inputs.

The I/O Refresh Time depends on the hardware configuration of the Slave.
For more information refer to manual W501 (NJ-series Software user's Manual).

8-3-2 Calculation I/O Refresh Time

To calculate the I/O Refresh Time:

1. Define the SmartSlice configuration.

2. List for all available units the input size and the output size.
The input- and output size are the number of bits required for the signal.

Additional information

- One digital Input or Output has a I/O size of 1 bit. (On / Off)
- One Analog Input or Output has a I/O size of 2 bytes.
- One Counter Unit has an Input size of 6 bytes and an Output size of 6 bytes.
- 1 byte = 8 bits

Calculate the IN_size

3. Calculate the total number of bytes for Inputs, named *IN_size.*
IN_size = Size Digital Inputs + Size Analog Inputs + Size Communication Unit status

- *Size Digital Inputs (DI)*
  The *IN_size* is in bytes, the actual unit is bits, so conversion from bits to bytes is required.
  - Add all digital inputs together.
  - Convert the result from bits to bytes.
    = (Total number of DI / 8) and then round to next integer value.

- *Size Analog Inputs (AI)*
  Each analog SmartSlice Input uses 2 bytes.
  One analog SmartSlice unit has 2 analog inputs and therefore an Analog Inputs Size of 4 bytes.
  - Add all Analog inputs together.
  - Multiply AI by 2.

- *Size Counter Inputs (CI)*
  Each Counter SmartSlice Unit uses 6 bytes.
  - Add all Counter Units together.
  - Multiply AI by 6.

- *Size Communication Unit status*
  2 bytes for the Communication Unit status.

Additional information

Example: Three GRT1-ID4 units + One GRT1-AD2 unit + Three GRT1-OD4 units
3 x (GRT1-ID4 = 4 bits) + 1 x (GRT1-AD2 = 4 bytes) + Not Applicable.

- Total Digital Input = 3 x 4 bits = 12 bits
  Convert to bytes = round (12 / 8) = 2 bytes
- Total Analog Input = 4 bytes
- Input for Communication Unit status = 2 bytes

IN_size = Total DI + Total DO + CommStatus
IN_size = 2 bytes + 4 bytes + 2 bytes = 8 bytes

Calculate the OUT_size

4. Calculate the total number of bytes for Outputs, named *OUT_size.*
OUT_size = Size Digital Outputs + Size Analog Outputs.

- *Size Digital Outputs*
  The required unit is bytes, the actual unit is bits, so conversion from bits to bytes is required.
  - Add all digital outputs together.
  - Convert the result from bits to bytes.
    = (Total number of DO / 8) and then round to next integer value.
- *Size Analog Outputs*
  Each analog SmartSlice Output Unit uses 4 bytes.
  One analog SmartSlice unit has 2 analog outputs and therefor an Analog Outputs Size of 4 bytes.
  - Add all Analog outputs together.
  - Multiply by 2.
- *Size Counter Outputs*
  Each Counter SmartSlice Unit uses 6 bytes.
  - Add all Counter Units together.
  - Multiply by 6.

Additional information

Example: One unit GRT1-OD4 + One unit GRT1-ROS2
GRT1-OD4 = 4 bits + GRT1-ROS2 = 2 bits
Total Output bits = 6
Convert to bytes = round (6 / 8) = 1 byte.

Calculate the IO_size

5. Calculate IO data size

The IO data size (*IO_size* in bytes) is defined as the maximum of the input data size (*IN_SIZE*) and the output data size (*OUT_size*)

Calculate the I/O refresh time

6. Calculate I/O refresh time.

I/O refresh time = *Pack* + *Unpack* + *Xmit*

Required are the calculations of OUT_size, IN_size and IO_size.

- Pack
  Pack is the time required by the EtherCAT master to generate the OUT data.
  Pack = 0.007 * *OUT_size* (byte)
- Unpack
  Unpack is time required by the EtherCAT master to retrieve the IN data.
  Unpack = 0.009 * *IN_size* (byte)
- Xmit
  Xmit is the time required to transmit the EtherCAT data
  Xmit = Processing time per slave + transfer time per byte
  Xmit = 1.24 + 0.082 * *IO_size* (byte)

8-3-3 Example calculation I/O refresh time

Please refer to the following example.

1. Define the SmartSlice configuration

In this example:
GRT1-ID4 + GRT1-ID4 + GRT1-ID4 + GRT1-OD4 + GRT1-OD4 + GRT1-OD8 + GRT1-DA2V + GRT1-AD2

2. Calculate input Add all digital indata size

- puts together
  ID4 (4 bits) + ID4 (4 bits) + ID4 (4 bits) = 12 bits
- Divide the total number of digital inputs by 8 and round to the next integer value.
  12 bits / 8 = 1.5, resulting in 2 bytes of digital input data
- Add the analog input data, 4 bytes per analog SmartSlice Input Unit
  2 bytes (digital) + 4 bytes (analog) = 6 bytes
- Add 2 bytes for the Communication Unit status
  6 bytes (digital + analog) + 2 bytes (Communication Unit status) = 8 bytes
- So *IN_size* = 8

3. Calculate output data size

- Add all digital outputs together
  OD4 (4 bits) + OD4 (4 bits) + OD4 (8 bits) = 16 bits
- Divide the total number of digital outputs by 8 and round to the next integer value.
  16 bits / 8 = 2 bytes of digital output data
- Add the analog output data, 4 bytes per analog SmartSlice Input Unit
  2 bytes (digital) + 4 bytes (analog) = 6 bytes
- So *OUT_size* = 6

4. Calculate IO data size

IN_size (8) > *OUT_size* (6), resulting in *IO_size* = 8

5. Calculate I/O refresh time

Pack = 0.007 * *OUT_size* = 0.007 * 6 = 0.042
Unpack = 0.009 * *IN_size* = 0.009 * 8 = 0.072
Xmit = 1.24 + 0.082 * *IO_size* = 1.24 + 0.082 * 8 = 1.896
I/O refresh time per slave = *Pack* + *Unpack* + *Xmit* = 0.042 + 0.072 + 1.896 = 2.0us

A

Appendix EtherCAT Terminology

A1-1 EtherCAT Terminology

Use the following list of EtherCAT terms for reference.

Term	Abbreviation	Description
object	–	Abstract representation of a particular component within a device, which consists of data, parameters, and methods.
object dictionary	OD	Data structure addressed by Index and Sub-index that contains description of data type objects, communication objects and application objects.
service data object	SDO	CoE asynchronous mailbox communication where all objects in the object dictionary can be read and written.
index	–	Address of an object within an application process.
subindex	–	Sub-address of an object within the object dictionary.
Process data	–	Collection of application objects designated to be transferred cyclically or acyclically for the purpose of measurement and control.
Process data object	PDO	Structure described by mapping parameters containing one or several process data entities.
Receive PDO	RxPDO	A process data object received by an EtherCAT Slave.
Transmit PDO	TxPDO	A process data object sent from an EtherCAT Slave.
sync manager	SM	Collection of control elements to coordinate access to concurrently used objects.
distributed clock	DC	Clock distribution mechanism used to synchronize EtherCAT Slaves and the EtherCAT Master Units.
device profile	–	Collection of device dependent information and functionality providing consistency between similar devices of the same device type.
fieldbus memory management unit	FMMU	Function which establishes single or multiple communication between logical address and physical memory
physical device internal interface	PDI	A series of elements to access data link services from the application layer.
CAN in Automation	CiA	CiA is the international users' and manufacturers' group that develops and supports higher-layer protocols.
CAN application protocol over EtherCAT	CoE	A CAN application protocol service implemented on EtherCAT.
EEPROM	EEPROM	Electrically erasable PROM. (Writable ROM)
EtherCAT Technology Group	ETG	The ETG is a global organization in which OEM, End Users and Technology Providers join forces to support and promote the further technology development.
EtherCAT slave controller	ESC	A controller for EtherCAT slave communication.
EtherCAT state machine	ESM	An EtherCAT communication state machine.
EtherCAT slave information	ESI	An XML file that contains setting information for an EtherCAT Slave.

A

Appendix EtherCAT Specifications

This chapter explains EtherCAT communication specifications, Slaves performance specifications, and the specifications of common areas.

A2-1 Specifications

A2-1-1 EtherCAT Specifications

This section gives the EtherCAT Specifications.

Item	Specification
Communication protocol	Dedicated protocol for EtherCAT
Modulation	Base band
Baud rate	100 Mbps
Physical layer	100BASE-TX (IEEE802.3)
Connectors	RJ45 × 2 (Shielded) CN IN: EtherCAT input CN OUT: EtherCAT output
Topology	Daisy chain
Communication media	Category 5 or higher (cable with double, aluminum tape and braided shielding is recommended.)
Communication distance	Distance between nodes (Slaves): 100 m max.
Noise immunity	Conforms to IEC 61000-4-4, 1 kV or higher
Node address setting method	Set with decimal rotary switch or Configuration Tool
Node address range	1 to 99: Set with rotary switch 1 to 65535: Set with Configuration Tool
Indicator	PWR × 2 (Unit PWR, I/O PWR) L/A IN (Link/Activity IN) × 1 L/A OUT (Link/Activity OUT) × 1 RUN × 1 ERR × 1
Process data	Configurable PDO mapping / automatically detected
PDO size	2 byte to 130 byte
Mailbox	SDO requests, SDO responses, and SDO information
Synchronization mode	Free Run mode (asynchronous)

A

Appendix GRT1-ECT Specifications

This section gives detailed specifications for the GRT1-ECT and it's environment.

A3-1 Specifications GRT1-ECT

This section explains the communication specifications of the GRT1-series EtherCAT Slave.

A3-1-1 Installation specifications

Item	Specification
Unit type	SmartSlice GRT1 series
Model	GRT1-ECT
Mounting position	DIN Rail mounted
Power supply	24 Vdc +10% -15% (20.4 to 26.4 Vdc)
Current consumption	130 mA typical at 24 VDC
Dimensions (W x H x D)	58 x 80 x 70mm
Weight	130g (typical)

A3-1-2 Environment specifications

Item	Specification
Ambient operating temperature	–10 to 55°C (no icing or condensation)
Ambient operating humidity	25% to 85% Relative Humidity
Storage temperature	10 to 57Hz, 0.7-mm amplitude 57 to 150Hz, acceleration: 49 m/s^2
Shock resistance	150 m/s^2
Dielectric strength	500 VAC (between isolated circuits)
Conformance to EMC and Electrical safety standards	EN61131-2:2007
Enclosure rating	IP20

A3-1-3 SmartSlice I/O System specifications

Item	Specification
Number of connectable SmartSlice I/O Units	64 Units max. Connected directly to the GRT1-ECT or via turnback extension units.
Communication distance	SmartSlice I/O Units: 64 Units coupled (about 2 m max.) Turnback Cable: 2 m max. (2 cables, 1 m each)
Turnback Cable	Length 1 m max., up to 2 cables can be connected.
SmartSlice I/O Unit connections	Building-block style configuration with slide connectors (Units connect with Turnback Cables).
Baseblock power supply	Voltage: 24 V DC Current: 4 A max
Number of I/O data	512 digital inputs and 512 digital outputs max. Total I/O data size 64 words (128 bytes)

A3-1-4 Supported SmartSlice I/O Units

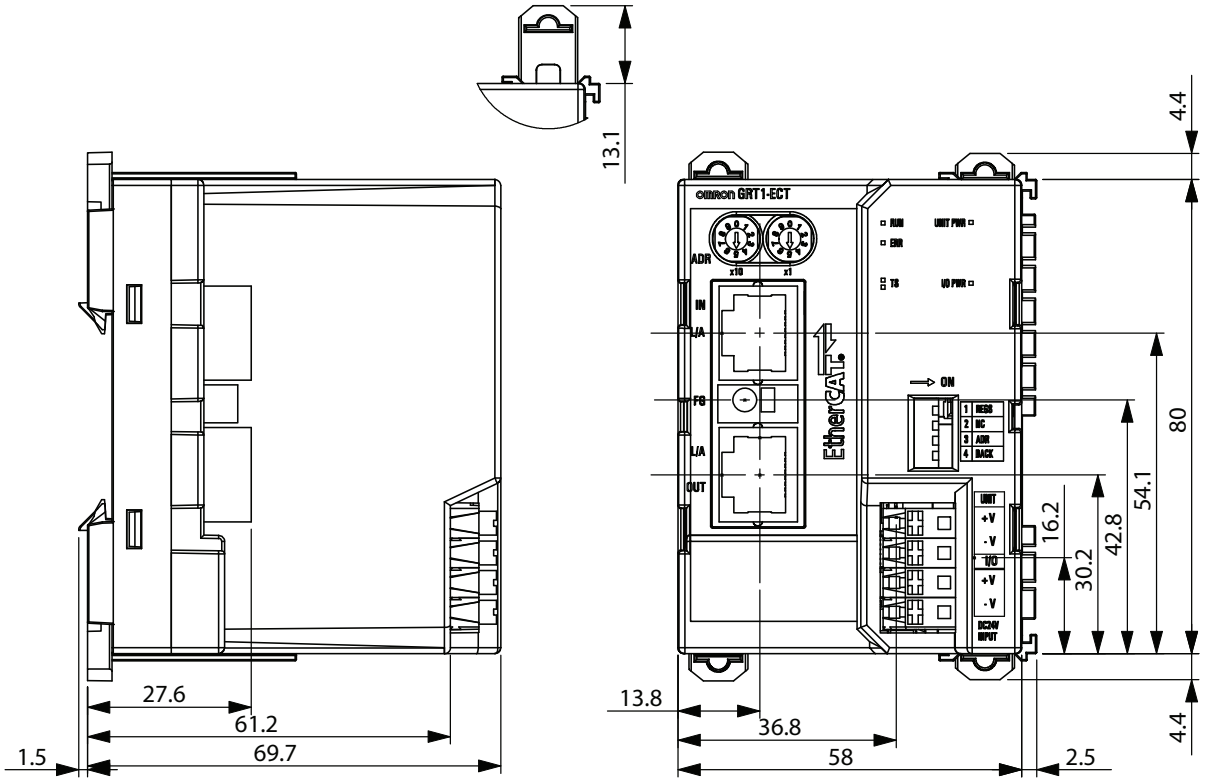
The GRT1-ECT supports a sub-set of the available SmartSlice I/O Units. The table below lists all models supported.

Model	Function	Specification
GRT1-ID4	4 NPN inputs	24 VDC, 6 mA, 3-wire connection
GRT1-ID4-1	4 PNP inputs	24 VDC, 6 mA, 3-wire connection
GRT1-ID8	8 NPN inputs	24 VDC, 4 mA, 1-wire connection + 4xG
GRT1-ID8-1	8 PNP inputs	24 VDC, 4 mA, 1-wire connection + 4xV
GRT1-OD4	4 NPN outputs	24 VDC, 500 mA, 2-wire connection
GRT1-OD4-1	4 PNP outputs	24 VDC, 500 mA, 2-wire connection
GRT1-OD4G-1	4 PNP outputs with shortcircuit protection	24 VDC, 500 mA, 3-wire connection
GRT1-OD4G-3	4 PNP outputs with shortcircuit protection	from 4 x 2.0 A at 30°C to 4 x 1.0 A at 55°C
GRT1-OD8	8 NPN outputs	24 VDC, 500 mA, 1-wire connection + 4xV
GRT1-OD8-1	8 PNP outputs	24 VDC, 500 mA, 1-wire connection + 4xG
GRT1-OD8G-1	8 PNP outputs with shortcircuit protection	24 VDC, 500 mA, 1-wire connection + 4xG
GRT1-ROS2	2 relay outputs	240 VAC, 2A, normally-open contacts
GRT1-AD2	2 analog inputs, current/voltage	10 V, 0-10 V, 0-5 V, 1-5 V, 0-20 mA, 4-20 mA
GRT1-DA2V	2 analog outputs, voltage	10 V, 0-10 V, 0-5 V, 1-5 V
GRT1-DA2C	2 analog outputs, current	0-20 mA, 4-20 mA
GRT1-IA4-1	Four-point AC Input Unit	100 to 120 VAC 50/60 Hz
GRT1-IA4-2	Four-point AC Input Unit	200 to 240 VAC 50/60 Hz
GRT1-TS2P	Two-point Temperature Input Unit	Resistance thermometer input, Input type: PT100 (−200 to 850°C) or PT100 (−200 to 200°C)
GRT1-TS2PK	Two-point Temperature Input Unit	Resistance thermometer input, Input type: PT1000 (−200 to 850°C) or PT1000 (−200 to 200°C)
GRT1-TS2T	Two-point Temperature Input Unit	Thermocouple input, Input type: R, S, K J, T, E, B, N, L, U, W, or PL2
GRT1-CT1[1)]	60 kHz Counter unit, NPN	A+B encoder inputs + 1 Z/control input + 1 output (NPN-type)
GRT1-CT1-1[1)]	60 kHz Counter unit, PNP	A+B encoder inputs + 1 Z/control input + 1 output (PNP-type)
GRT1-CP1-L[1)]	100 kHz Counter / Positioner unit	A+B+Z encoder inputs (line driver or 24 V selectable) + 1 control input + 2 outputs (PNP-type)
GRT1-END	End plate	One unit required per bus interface
GRT1-PD2	I/O power feed Unit, separates power supply between groups of I/O units	
GRT1-PD2G	I/O power feed Unit with electronic overload protection, separates power supply between groups of I/O units	
GRT1-PD8	I/O power feed and distribution Unit, separates power supply between groups of I/O units, 8xV + 4xG	
GRT1-PD8-1	I/O power feed and distribution Unit, separates power supply between groups of I/O units, 8xV + 4xG	
GRT1-PC8	I/O power connection Unit, 8xV + 4xG	
GRT1-PC8-1	I/O power connection Unit, 4xV + 8xG	
GRT1-TBR	Turnback Unit, right-hand side	
GRT1-TBL	Turnback Unit, left-hand side	
GCN2-100	Turnback cable, one meter	

[1)] Supported from GRT1-ECT version 2.1

A3-1-5 External dimensions

The external dimensions are in mm.



A

Appendix Object Dictionary

A4-1 Object Dictionary

A4-1-1 Object Dictionary Area

The CAN application protocol over EtherCAT (CoE) uses the object dictionary. Each object is assigned with an index of four-digit hexadecimal value. The indexes are defined in the areas below.

Indexes	Area	Contents
0000 hex-0FFF hex	Data Type area	Definitions of data types
1000 hex-1FFF hex	CoE Communication area	Definitions of variables that can be used by all servers for designated communication
2000 hex-2FFF hex	Manufacturer Specific area 1	Variables defined for all OMRON products
3000 hex-5FFF hex	Manufacturer Specific area 2	Variables defined for the GRT1-series EtherCAT Communication Unit
6000 hex-9FFF hex	Device Profile area	Variables defined for CiA401 generic I/O module device profiles (profile specifying the CAN application protocol interface for devices with digital I/Os and analog I/Os)
A000 hex-EFFF hex	Reserved area	Area reserved for future use
F000 hex-FFFF hex	Modular Device Profile area	Variables for the Modular Device Profile part of the GRT1-series EtherCAT Communication Unit

A4-1-2 Data Types

This profile uses the following data types.

Data Types	Code	Size	Range
Boolean	BOOL	1 bit	true(1), false(0)
Unsigned8	U8	1 byte	0 to 255
Unsigned16	U16	2 bytes	0 to 65535
Unsigned32	U32	4 bytes	0 to 4294967295
Integer8	INT8	1 byte	−128 to 127
Integer16	INT16	2 bytes	−32768 to 32767
Integer32	INT32	4 bytes	−2147483648 to 2147483647
Visible string	VS	–	–

A4-1-3 Object Description Format

In this manual, objects are described in the following format.

Object description format

<Index>	<Object name>		
Range: <Setting range>	Unit: <Unit>	Default: <Default setting>	Attribute: <Data attribute>
Size: <Size>	Access: <Access>	PDO map: <Possible/Not possible>	

Object description format with sub-indexes

<Index>	<Object name>		
Sub-index 0			
Range: <Setting range>	Unit: <Unit>	Default: <Default setting>	Attribute: <Data attribute>
Size: <Size>	Access: <Access>	PDO map: <Possible/Not possible>	
• • •			
Sub-index N			
Range: <Setting range>	Unit: <Unit>	Default: <Default setting>	Attribute: <Data attribute>
Size: <Size>	Access: <Access>	PDO map: <Possible/Not possible>	

The following values are indicated within the pointed brackets <>.

Indexes : An object index given by a four-digit hexadecimal number
Object name : The object name
Range : The possible range of settings
Unit : Physical unit
Default : Default value set before product shipment
Attribute : The timing when a change is updated in a writable object
A: Always enabled
C: Timing of pre-operational state → safe-operational state
R: Updated after the power supply is reset
-: Read only
Size : The object size is given in bytes
Access : Indicates whether the object is read only, or read and write
RO: Read only
RW: Read and write
PDO map : Indicates the PDO mapping possibility

A4-1-4 Communication Objects

1000 hex	Device type		
Range: –	Unit: –	Default: 04561389 hex	Attribute: –
Size: 4 bytes (U32)	Access: RO	PDO map: Not possible	

- Indicates the CoE device profile number.

1008 hex	Manufacturer device name		
Range: –	Unit: –	Default: “GRT1-ECT”	Attribute: –
Size: 20 bytes (VS)	Access: RO	PDO map: Not possible	

- Indicates the Slave model number.

1009 hex	Manufacturer hardware version		
Range: –	Unit: –	Default: “A”	Attribute: –
Size: 20 bytes (VS)	Access: RO	PDO map: Not possible	

- Indicates the version of the Slave hardware.

100A hex	Manufacturer software version		
Range: –	Unit: –	Default: “2.10”	Attribute: –
Size: 20 bytes (VS)	Access: RO	PDO map: Not possible	

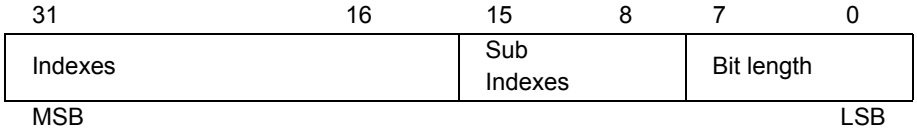
- Indicates the version of the Slave software.

1018 hex	Identity object		
Sub-index 0: Number of entries			
Range: –	Unit: –	Default: 04 hex	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 1: Vendor ID			
Range: –	Unit: –	Default: 00000083 hex	Attribute: –
Size: 4 bytes (U32)	Access: RO	PDO map: Not possible	
Sub-index 2: Product code			
Range: –	Unit: –	Default: 00000060 hex	Attribute: –
Size: 4 bytes (U32)	Access: RO	PDO map: Not possible	
Sub-index 3: Revision number			
Range: –	Unit: –	Default: 00020001 hex	Attribute: –
Size: 4 bytes (U32)	Access: RO	PDO map: Not possible	
Sub-index 4: Serial number			
Range: –	Unit: –	Default: 00000000 hex	Attribute: –
Size: 4 bytes (U32)	Access: RO	PDO map: Not possible	

- Indicates the device information.
- Sub-index 1(Vendor ID) gives the manufacturer identifier.
- Sub-index 2 (Product Code) gives the value assigned to each Slave type.
- Sub-index 3 (Revision number) gives the Unit revision number.
  Bits 0 to 15: Minor revision number of the device
  Bits 16 to 31: Major revision number of the device
- Sub-index 4 (Serial number) gives a serial number for each product (always 00000000 hex)

A4-1-5 PDO Mapping Object

Indexes 1600 hex to 17FF hex are used for Receive PDO mapping, and indexes 1A00 hex to 1BFF hex are used for Transmit PDO mapping. Sub-indexes after sub-index 1 provide information about the application object being mapped.



Bits 0 to 7 : Bit length of the mapped object.
(For example, for 32 bits, 20 hex is given.)
Bits 8 to 15 : Sub-index of the mapped object.
Bits 16 to 31 : Index of the mapped object.

16kk hex	RxPDO mapping parameter digital outputs [n..n+hh], where n=kk*240+1		
Sub-index 0: Number of objects			
Range: –	Unit: –	Default: hh (+1 when padding is used)	Attribute: –
Size: 1 byte (U8)	Access: RW	PDO map: Not possible	
Sub-index 1: Digital output n			
Range: –	Unit: –	Default: 70kk0101 hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	
Sub-index ...			
Range: –	Unit: –	Default: ...	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	
Sub-index hh: Digital output n+hh			
Range: –	Unit: –	Default: 70kkhh01 hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	
Sub-index hh+1: Padding bits to make object size a multiple of 8 bits (optional)			
Range: –	Unit: –	Default: 000000[01..07] hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	

- The number of RxPDO mapping entries for digital outputs depends on the total number of digital outputs connected to the GRT1-ECT. When no digital outputs are connected, object 1600 hex will contain 0 entries.
- The RxPDO mapping for digital outputs will only hold 240 entries maximum per index. When the index is completely filled, it will ‘overflow’ into the next object which again can contain a maximum of 240 entries, and so on. Value range (depends on the total number of digital outputs): (kk = 00..02) hex, (hh = 01..F0) hex

1610 hex	RxPDO mapping parameter analog outputs [1..hh]		
Sub-index 0: Number of objects			
Range: –	Unit: –	Default: hh	Attribute: –
Size: 1 byte (U8)	Access: RW	PDO map: Not possible	
Sub-index 1: Analog output 1			
Range: –	Unit: –	Default: 70100110 hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	
Sub-index ...			
Range: –	Unit: –	Default: ...	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	
Sub-index n: Analog output n			
Range: –	Unit: –	Default: 7010hh10 hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	

- The number of RxPDO mapping entries for analog outputs depends on the total number of analog outputs connected to the GRT1-ECT. When no analog outputs are connected, object 1610 hex will contain 0 entries.
- Value range (depends on the total number of analog outputs): (hh = 01..40) hex

1620 hex	RxPDO mapping parameter counter outputs [1..hh]		
Sub-index 0: Number of objects			
Range: –	Unit: –	Default: hh	Attribute: –
Size: 1 byte (U8)	Access: RW	PDO map: Not possible	
Sub-index 1: Counter output 1			
Range: –	Unit: –	Default: 70200120 hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	
Sub-index 2: Counter output 2			
Range: –	Unit: –	Default: 70200210 hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	
Sub-index n: Counter output n			
Range: –	Unit: –	Default: 7020hh10 hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	

- The number of RxPDO mapping entries for counter outputs depends on the total number of counter outputs connected to the GRT1-ECT. When no countter outputs are connected, object 1620 hex will contain 0 entries.
- Value range (depends on the total number of counter outputs): hh = 01..20

1A00 hex	TxPDO mapping parameter Communication status		
Sub-index 0: Number of objects			
Range: –	Unit: –	Default: 01 hex	Attribute: –
Size: 1 byte (U8)	Access: RW	PDO map: Not possible	
Sub-index 1: 1st object (Output object 1)			
Range: –	Unit: –	Default: F1000110 hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	

- The GRT1-ECT status flags give the status of the connection between the GRT1-ECT and the SmartSlice I/O Units, and the status of the SmartSlice I/O Units.

1Akk hex	RxPDO mapping parameter digital inputs [m..m+hh], where m=(kk-10 hex)*240+1		
Sub-index 0: Number of objects			
Range: –	Unit: –	Default: hh (+1 when padding is used)	Attribute: –
Size: 1 byte (U8)	Access: RW	PDO map: Not possible	
Sub-index 1: Digital output m			
Range: –	Unit: –	Default: 60kk0101 hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	
Sub-index ...			
Range: –	Unit: –	Default: ...	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	
Sub-index hh: Digital output m+hh			
Range: –	Unit: –	Default: 60kkhh01 hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	
Sub-index hh+1: Padding bits to make object size a multiple of 8 bits (optional)			
Range: –	Unit: –	Default: 000000[01..07] hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	

- The number of RxPDO mapping entries for digital inputs depends on the total number of digital inputs connected to the GRT1-ECT. When no digital inputs are connected, object 1A10 hex will contain 0 entries.
- The RxPDO mapping for digital inputs will only hold 240 entries maximum per index. When the index is completely filled, it will ‘overflow’ into the next object which again can contain a maximum of 240

entries, and so on. Value range (depends on the total number of digital outputs): (kk = 10..12) hex , (hh = 01..F0) hex

1A20 hex	RxPDO mapping parameter analog inputs [1..hh]		
Sub-index 0: Number of objects			
Range: –	Unit: –	Default: hh	Attribute: –
Size: 1 byte (U8)	Access: RW	PDO map: Not possible	
Sub-index 1: Analog input 1			
Range: –	Unit: –	Default: 60200110 hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	
Sub-index ...			
Range: –	Unit: –	Default: ...	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	
Sub-index n: Analog input n			
Range: –	Unit: –	Default: 6020hh10 hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	

- The number of RxPDO mapping entries for analog outputs depends on the total number of analog outputs connected to the GRT1-ECT. When no analog outputs are connected, object 1610 hex will contain 0 entries.
- Value range (depends on the total number of analog outputs): (hh = 01..40) hex

1A30 hex	RxPDO mapping parameter counter inputs [1..hh]		
Sub-index 0: Number of objects			
Range: –	Unit: –	Default: hh	Attribute: –
Size: 1 byte (U8)	Access: RW	PDO map: Not possible	
Sub-index 1: Counter input 1			
Range: –	Unit: –	Default: 60300120 hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	
Sub-index 2: Counter input 2			
Range: –	Unit: –	Default: 60300210 hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	
Sub-index n: Counter input n			
Range: –	Unit: –	Default: 6030hh10 hex	Attribute: –
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	

- The number of RxPDO mapping entries for counter inputs depends on the total number of inputs outputs connected to the GRT1-ECT. When no counter inputs are connected, object 1A30 hex will contain 0 entries.
- Value range (depends on the total number of counter inputs): hh = 01..20

A4-1-6 Sync Manager Communication Object

The communication memory of EtherCAT is set by the objects from 1C00 hex to 1C13 hex.

1C00 hex	Sync manager communication type		
Sub-index 0: Number of used sync manager channels			
Range: –	Unit: –	Default: 04 hex	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 1: Communication type SM0			
Range: –	Unit: –	Default: 01 hex	Attribute: –
Size: 4 bytes (U8)	Access: RO	PDO map: Not possible	
Sub-index 2: Communication type SM1			
Range: –	Unit: –	Default: 02 hex	Attribute: –
Size: 4 bytes (U8)	Access: RO	PDO map: Not possible	
Sub-index 3: Communication type SM2			
Range: -	Unit: -	Default: 03 hex	Attribute: –
Size: 4 bytes (U8)	Access: RO	PDO map: Not possible	
Sub-index 4: Communication type SM3			
Range: -	Unit: -	Default: 04 hex	Attribute: –
Size: 4 bytes (U8)	Access: RO	PDO map: Not possible	

- The sync manager has the following settings.
  - SM0 : Mailbox receive (EtherCAT Master Unit to Slave)
  - SM1 : Mailbox transmit (EtherCAT Slave to Master Unit)
  - SM2 : Process data output (EtherCAT Master Unit to Slave)
  - SM3 : Process data input (EtherCAT Slave to Master Unit)

1C10 hex	Sync manager 0 PDO assignment		
Sub-index 0: Number of assigned PDOs			
Range: 00 hex	Unit: –	Default: 00 hex	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	

- It indicates the number of PDO mappings used by this sync manager.
- Mailbox reception sync manager does not have PDOs.

1C11 hex	Sync manager 1 PDO assignment		
Sub-index 0: Number of assigned PDOs			
Range: 00 hex	Unit: –	Default: 00 hex	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	

- It indicates the number of PDO mappings used by this sync manager.
- Mailbox transmit sync manager does not have PDOs.

1C12 hex	Sync manager 2 PDO assignment		
Sub-index 0: Number of assigned RxPDOs			
Range: 00 hex to 04 hex	Unit: –	Default: 05 hex	Attribute: –
Size: 1 byte (U8)	Access: RW	PDO map: Not possible	
Sub-index 1: Assignment of digital outputs			
Range: 1600 hex to 17FF hex	Unit: –	Default: 1600 hex	Attribute: –
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	
Sub-index 2: Assignment of digital outputs			
Range: 1600 hex to 17FF hex	Unit: –	Default: 1601 hex	Attribute: –
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	
Sub-index 3: Assignment of digital outputs			
Range: 1600 hex to 17FF hex	Unit: –	Default: 1602 hex	Attribute: –
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	
Sub-index 4: Assignment of analog outputs			
Range: 1600 hex to 17FF hex	Unit: –	Default: 1610 hex	Attribute: –
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	
Sub-index 5: Assignment of counter outputs			
Range: 1600 hex to 17FF hex	Unit: –	Default: 1620 hex	Attribute: –
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- It indicates the RxPDOs used by this sync manager.

1C13 hex	Sync manager 3 PDO assignment		
Sub-index 0: Number of assigned TxPDOs			
Range: 00 hex to 05 hex	Unit: –	Default: 06 hex	Attribute: –
Size: 1 byte (U8)	Access: RW	PDO map: Not possible	
Sub-index 1: Assignment of com status			
Range: 1A00 hex to 1BFF hex	Unit: –	Default: 1A00 hex	Attribute: –
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	
Sub-index 2: Assignment of digital inputs			
Range: 1A00 hex to 1BFF hex	Unit: –	Default: 1A10 hex	Attribute: –
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	
Sub-index 3: Assignment of digital inputs			
Range: 1A00 hex to 1BFF hex	Unit: –	Default: 1A11 hex	Attribute: –
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	
Sub-index 4: Assignment of digital inputs			
Range: 1A00 hex to 1BFF hex	Unit: –	Default: 1A12 hex	Attribute: –
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	
Sub-index 5: Assignment of analog inputs			
Range: 1A00 hex to 1BFF hex	Unit: –	Default: 1A20 hex	Attribute: –
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	
Sub-index 6: Assignment of analog inputs			
Range: 1A00 hex to 1BFF hex	Unit: –	Default: 1A30 hex	Attribute: –
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- It indicates the TxPDOs used by this sync manager.

A4-1-7 Manufacturer Specific Objects

This section explains the CiA401 generic I/O module device profile implemented in the GRT1-series EtherCAT Communication Unit.

● Device Profile area

60[kk hex	Digital inputs [n..n+hh], where kk=10..12 hex, n=(kk-10 hex)*240+1		
Sub-index 0: Number of digital inputs [n..n+hh]			
Range: 00 hex to 04 hex	Unit: –	Default: hh	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 1: Digital input n			
Range: 0 to 1	Unit: –	Default: –	Attribute: –
Size: 1 bit (BOOL)	Access: RO	PDO map: Possible	
Sub-index ...			
Range: 0 to 1	Unit: –	Default: –	Attribute: –
Size: 1 bit (BOOL)	Access: RO	PDO map: Possible	
Sub-index hh: Digital input n+hh			
Range: 0 to 1	Unit: –	Default: –	Attribute: –
Size: 1 bit (BOOL)	Access: RO	PDO map: Possible	

- These objects contain the actual value for each digital input connected to the GRT1-ECT. The size and number of digital input objects depends on the total number of connected digital inputs. When no digital inputs are connected, only object 6010 hex will be created, containing 0 entries.
- Each digital input object will only hold 240 entries maximum. When the object is completely filled, a new object will be created containing again a maximum of 240 entries, and so on. Value range (depends on the total number of digital inputs): (kk = 10..12)hex , (hh = 01..F0) hex

6020 hex	Analog inputs		
Sub-index 0: Number of analog inputs [1..hh]			
Range: –	Unit: –	Default: 01 hex	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 1: Analog input 1			
Range: 0000 hex to FFFF hex	Unit: –	Default: –	Attribute: –
Size: 2 bytes (INT16)	Access: RO	PDO map: Possible	
Sub-index ...			
Range: 0000 hex to FFFF hex	Unit: –	Default: –	Attribute: –
Size: 2 bytes (INT16)	Access: RO	PDO map: Possible	
Sub-index n: Analog input n			
Range: 0000 hex to FFFF hex	Unit: –	Default: –	Attribute: –
Size: 2 bytes (INT16)	Access: RO	PDO map: Possible	

- These objects contain the actual value for each analog input connected to the GRT1-ECT. The size and number of analog input objects depends on the total number of connected analog inputs. When no analog inputs are connected, object 6020 hex will contain 0 entries.
- Value range (depends on the total number of analog inputs): (hh = 01..40) hex

6030 hex	Counter inputs		
Sub-index 0: Number of counter inputs [1..hh]			
Range: –	Unit: –	Default: 01 hex	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 1: Counter input 1			
Range: 00000000 hex to FFFFFFFF hex	Unit: –	Default: –	Attribute: –
Size: 4 bytes (INT32)	Access: RO	PDO map: Possible	

Sub-index 2: Counter input 2			
Range: 0000 hex to FFFF hex	Unit: –	Default: –	Attribute: –
Size: 2 bytes (U16)	Access: RO	PDO map: Possible	
Sub-index n: Counter input n			
Range: 0000 hex to FFFF hex	Unit: –	Default: –	Attribute: –
Size: 2 bytes (U16)	Access: RO	PDO map: Possible	

- These objects contain the actual value for each counter input connected to the GRT1-ECT. The size and number of counter input objects depends on the total number of connected counter inputs. When no counter inputs are connected, object 6030 hex will contain 0 entries.
  Value range (depends on the total number of analog inputs): hh = 01..20

70[kk hex	Digital outputs [n..n+hh], where kk=0..2 hex, n=kk*240+1		
Sub-index 0: Number of digital outputs [n..n+hh]			
Range: 00 hex to 04 hex	Unit: –	Default: hh	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 1: Digital output n			
Range: 0 to 1	Unit: –	Default: –	Attribute: –
Size: 1 bit (BOOL)	Access: RO	PDO map: Possible	
Sub-index ...			
Range: 0 to 1	Unit: –	Default: –	Attribute: –
Size: 1 bit (BOOL)	Access: RO	PDO map: Possible	
Sub-index hh: Digital output n+hh			
Range: 0 to 1	Unit: –	Default: –	Attribute: –
Size: 1 bit (BOOL)	Access: RO	PDO map: Possible	

- These objects contain the actual value for each digital output connected to the GRT1-ECT. The size and number of output objects depends on the total number of connected digital outputs. When no digital outputs are connected, only object 7000 hex will be created, containing 0 entries.
- Each digital output object will only hold 240 entries maximum. When the object is completely filled, a new object will be created containing again a maximum of 240 entries, and so on. Value range (depends on the total number of digital outputs): (kk = 0..2)hex , (hh = 01..F0) hex

7010 hex	Analog outputs		
Sub-index 0: Number of analog outputs [1..hh]			
Range: –	Unit: –	Default: 01 hex	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 1: Analog output 1			
Range: 0000 hex to FFFF hex	Unit: –	Default: –	Attribute: –
Size: 2 bytes (INT16)	Access: RO	PDO map: Possible	
Sub-index ...			
Range: 0000 hex to FFFF hex	Unit: –	Default: –	Attribute: –
Size: 2 bytes (INT16)	Access: RO	PDO map: Possible	
Sub-index n: Analog output n			
Range: 0000 hex to FFFF hex	Unit: –	Default: –	Attribute: –
Size: 2 bytes (INT16)	Access: RO	PDO map: Possible	

- These objects contain the actual value for each analog output connected to the GRT1-ECT. The size and number of analog output objects depends on the total number of connected analog outputs. When no analog outputs are connected, object 7010 hex will contain 0 entries.
- Value range (depends on the total number of analog outputs): (hh = 01..40) hex

7020 hex	Counter outputs		
Sub-index 0: Number of counter outputs [1..hh]			
Range: –	Unit: –	Default: 01 hex	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 1: Counter output 1			
Range: 00000000 hex toFFFF FFFF hex	Unit: –	Default: –	Attribute: –
Size: 4 bytes (INT32)	Access: RO	PDO map: Possible	
Sub-index 2: Counter output 2			
Range: 0000 hex to FFFF hex	Unit: –	Default: –	Attribute: –
Size: 2 bytes (U16)	Access: RO	PDO map: Possible	
Sub-index n: Counter output n			
Range: 0000 hex to FFFF hex	Unit: –	Default: –	Attribute: –
Size: 2 bytes (U16)	Access: RO	PDO map: Possible	

- These objects contain the actual value for each counter output connected to the GRT1-ECT. The size and number of counter output objects depends on the total number of connected counter outputs. When no counter outputs are connected, object 7020 hex will contain 0 entries.
- Value range (depends on the total number of counter outputs): hh = 01..20

A4-1-8 Modular Device Profile area

The following objects are part of the Modular Device Profile and contain data and settings specifically for the SmartSlice I/O units.

F050 hex	Detected SmartSlice I/O unit list		
Sub-index 0: Number of detected SmartSlice I/O units			
Range: 00 hex to 40 hex	Unit: –	Default: hh	Attribute: –
Size: 1 byte (U8)	Access: RO		PDO map: Not possible
Sub-index 1: Product ID of the first SmartSlice I/O unit			
Range: –	Unit: –	Default: –	Attribute: –
Size: 2 bytes (U32)	Access: RO		PDO map: Not possible
Sub-index ...			
Range: –	Unit: –	Default: –	Attribute: –
Size: 2 bytes (U32)	Access: RO		PDO map: Not possible
Sub-index hh: Product ID of the hh SmartSlice I/O unit			
Range: –	Unit: –	Default: –	Attribute: –
Size: 2 bytes (U32)	Access: RO		PDO map: Not possible

- Contains the list of all SmartSlice I/O units connected to the GRT1-ECT
- Value range (depends on the total number of slices connected to the slice bus): (hh = 01..40) hex
- List of supported SmartSlice I/O units and their Producty ID's:

Model	ID	Specification
GRT1-ID4	056D hex	Four-point DC Input Unit (NPN)
GRT1-ID4-1	056E hex	Four-point DC Input Unit (PNP)
GRT1-OD4	056F hex	Four-point Transistor Output Unit (NPN)
GRT1-OD4-1	0570 hex	Four-point Transistor Output Unit (PNP)
GRT1-OD4G-1	05E0 hex	Four-point Transistor Output Unit (PNP) with overcurrent and short-circuit protection
GRT1-OD4G-3	060D hex	Four-point 2-A Transistor Output Unit (PNP) with overcurrent and short-circuit protection
GRT1-ID8	05E3 hex	Eight-point DC Input Unit (NPN)
GRT1-ID8-1	05E1 hex	Eight-point DC Input Unit (PNP)
GRT1-OD8	05E6 hex	Eight-point Transistor Output Unit (NPN)
GRT1-OD8-1	05E5 hex	Eight-point Transistor Output Unit (PNP)
GRT1-OD8G-1	05E2 hex	Eight-point Transistor Output Unit (PNP) with overcurrent and short-circuit protection
GRT1-IA4-1	060B hex	Four-point AC Input Unit (Input voltage: 100 to 120 VAC 50/60 Hz)
GRT1-IA4-2	060C hex	Four-point AC Input Unit (Input voltage: 200 to 240 VAC 50/60 Hz)
GRT1-ROS2	0574 hex	Two-point Relay Output Unit
GRT1-AD2	0571 hex	Two-point Analog Output Unit
GRT1-DA2V	0573 hex	Two-point Analog Voltage Output Unit
GRT1-DA2C	0572 hex	Two-point Analog Current Output Unit
GRT1-TS2P	0609 hex	Two-point Temperature Input Unit, Resistance thermometer input Input type: PT100 (−200 to 850°C) or PT100 (−200 to 200°C)
GRT1-TS2PK	060A hex	Two-point Temperature Input Unit, Resistance thermometer input Input type: PT1000 (−200 to 850°C) or PT1000 (−200 to 200°C)
GRT1-TS2T	060F hex	Two-point Temperature Input Unit, Thermocouple input Input type: R, S, K J, T, E, B, N, L, U, W, or PL2
GRT1-CT1	05DD hex	Counter Unit with one counter (with encoder A and B inputs), 1 input settable to an encoder Z input or a digital input, and 1 digital output (NPN)
GRT1-CT1-1	05DE hex	Counter Unit with one counter (with encoder A and B inputs), 1 input settable to an encoder Z input or a digital input, and 1 digital output (PNP)
GRT1-CP1-L	05DF hex	Positioning Unit with one counter (with encoder A, B, and Z inputs), 1 digital input, and 2 digital outputs (PNP)

F060 hex	SmartSlice I/O Unit participation list		
Sub-index 0: Number of SmartSlice I/O Units			
Range: –	Unit: –	Default: hh	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 1: Participation state of SmartSlice unit 1			
Range: 0 to 1	Unit: –	Default: –	Attribute: –
Size: 1 bit (BOOL)	Access: RO	PDO map: Not possible	
Sub-index ...			
Range: 0 to 1	Unit: –	Default: –	Attribute: –
Size: 1 bit (BOOL)	Access: RO	PDO map: Not possible	
Sub-index 1: Participation state of SmartSlice Unit hh			
Range: 0 to 1	Unit: –	Default: –	Attribute: –
Size: 1 bit (BOOL)	Access: RO	PDO map: Not possible	

- When a Unit does not participate in I/O data exchange, its Participation index will go FALSE.

F061 hex	SmartSlice I/O unit withdrawal list		
Sub-index 0: Number of SmartSlice I/O Units			
Range: –	Unit: –	Default: 01 hex	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 1: Withdrawal state of SmartSlice unit 1			
Range: 0 to 1	Unit: –	Default: –	Attribute: –
Size: 1 bit (BOOL)	Access: RO	PDO map: Not possible	
Sub-index ...			
Range: 0 to 1	Unit: –	Default: –	Attribute: –
Size: 1 bit (BOOL)	Access: RO	PDO map: Not possible	
Sub-index 1: Withdrawal state of SmartSlice Unit hh			
Range: 0 to 1	Unit: –	Default: –	Attribute: –
Size: 1 bit (BOOL)	Access: RO	PDO map: Not possible	

- When a Unit withdraws from I/O communication during replacement, the corresponding SmartSlice I/O Unit Communication Withdrawn index will go TRUE and the EtherCAT Communication Unit's TS indicator will flash red.

F100 hex	Communication Unit status		
Sub-index 0: Number of objects			
Range: –	Unit: –	Default: 01 hex	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 1: Communication Status			
Range: 0000 hex to FFFF hex	Unit: –	Default: –	Attribute: –
Size: 2 bytes (U16)	Access: RO	PDO map: Possible	

- The GRT1-ECT status flags give the status of the connection between the GRT1-ECT and the SmartSlice I/O Units, and the status of the SmartSlice I/O Units.

Bit	Name	Contents
0	SmartSlice I/O Bus Communication Error	Monitors the status of SmartSlice I/O communication
1	-	Reserved
2	SmartSlice I/O Unit Warning 0: Normal 1: Error detected	Indicates a minor SmartSlice I/O Unit error. This flag goes ON when there is an error in any one of the connected SmartSlice I/OUnits.
3	-	Reserved
4	SmartSlice I/O Unit Alarm 0: Normal 1: Error detected	Indicates a major SmartSlice I/O Unit error. This flag goes ON when there is an error in one of the connected SmartSlice I/O Units.
5-11	-	Reserved
12	Unit Maintenance 0: Normal 1: Error (monitor value reached)	Monitors the operating time threshold that is set with the Unit power ON time monitor function

Bit	Name	Contents
13	Automatic Restore Monitor 0: Restore successful 1: Restore failed	Indicates whether or not the automatic parameter restore to the SmartSlice I/O Units was completed successfully
14	Communication Unit Error 0: Normal 1: Error occurred	This flag is ON if one of the other flags (bits 0 to 13) is ON
15	I/O Refreshing 0: I/O communication stopped 1: I/O communication normal	Indicates whether I/O data is exchanged normally

F200 hex	Device control		
Sub-index 0: Number of objects			
Range: –	Unit: –	Default: 01 hex	Attribute: –
Size: 1 byte (U8)	Access: RO		PDO map: Not possible
Sub-index 1: Enable output hold			
Range: 0 to 1	Unit: –	Default: 0	Attribute: –
Size: 1 byte (U8)	Access: RO		PDO map: Not possible

- When set to 1 (‘Hold’), all output data will hold their value when hold/clear function becomes active. When set to 0 (‘Clear’) all output data will be zeroed.
- When set to 2, the IDLE-command will be sent to the slice master when the hold/clear function becomes active, to trigger individual slice hold/clear reaction depending on its configuration.

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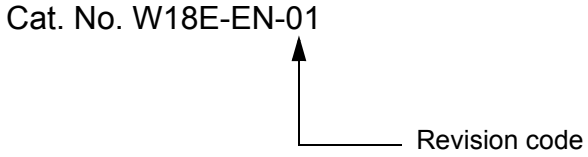
Revision History

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



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

Revision code	Date	Revised content
01	October 2011	First release
02	March 2012	GRT1-ECT Version 2.1: GRT1-CT1(-1) and GRT1-CP1-L added

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