Magnescale®

EtherCAT® Interface unit Main module

MG50-EC

Distribution module

MG51

Read all the instructions in the manual carefully before use and strictly follow them.
Keep the manual for future references.

Instruction Manual

Introduction

Thank you for purchasing the MG50-EC EtherCAT Interface unit Main module.
This manual contains information required to use the MG50-EC.
Please read this manual carefully and be sure you understand the information provided before attempting to use the MG50-EC.
After reading this manual, keep it in a safe and convenient location for future reference.

Intended Audience

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

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

How to Read the Manual

Page Structure

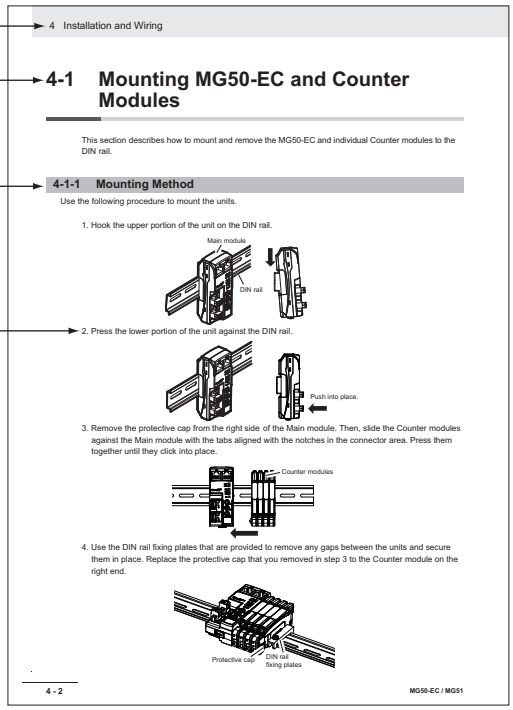
This manual's page structure consists of the following.

Chapter title

Clause title
Indicates the clause title of the current page.

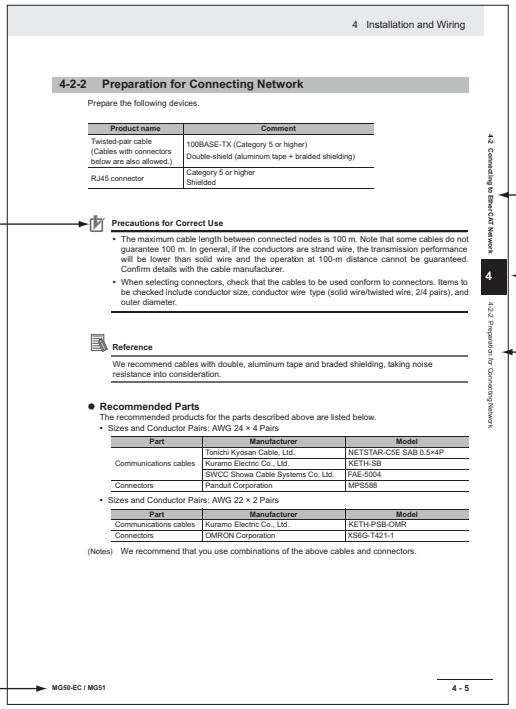
Section title

Operation procedure number
Indicates operation procedure.



Icon
(Refer to the following section.)

Name of manuals



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.

Icons

The following icons are used in this manual.

Precautions for Safe Use

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

Precautions for Correct Use

Precautions on what to do and what not to do to ensure proper operation and performance.

Additional Information

Convenient information or information for reference in product application.

Structure of This Manual

This manual consists of the following chapters.

Chapters		Contents
Chapter 1	EtherCAT Network	Explains about the EtherCAT features and the network configuration.
Chapter 2	About the MG50-EC	Overviews the MG50-EC EtherCAT Main module and its various types.
Chapter 3	Basic Usage Procedures	Explains the setup method and usage procedures by using simple system setup examples.
Chapter 4	Installation and Wiring	Explains how to install slave units, and how to connect and wire the EtherCAT network and power supply.
Chapter 5	EtherCAT Communications	Explains the details of EtherCAT communications.
Chapter 6	Hardware Specifications of MG50-EC	Explains the MG50-EC Hardware specifications.
Chapter 7	MG50-EC Function Specifications	Explains the MG50-EC Functional specifications.
Chapter 8	Troubleshooting and Maintenance	This contains troubleshooting and inspection methods intended for individuals to handle abnormalities and conduct regular inspections.
Appendices	Appendices	The appendices give an overview of the objects and precautions on their use, and describes the specifications of the MG51 Distribution module.

Terms and Conditions Agreement

General precautions

When using Magnescale Co., Ltd. products, observe the following general precautions along with those given specifically in this manual to ensure proper use of the products.

- Before and during operations, be sure to check that our products function properly.
- Provide adequate safety measures to prevent damages in case our products should develop malfunctions.
- Use outside indicated specifications or purposes and modification of our products will void any warranty of the functions and performance as specified of our products.
- When using our products in combination with other equipment, the functions and performances as noted in this manual may not be attained, depending on operating and environmental conditions.

For foreign customers

Note: This product (or technology) may be restricted by the government in your country. Please make sure that end-use, end user and country of destination of this product do not violate your local government regulation.

Safety Precautions

Labels and Meanings to Ensure Safe Usage

To ensure safe usage of the EtherCAT slave unit, 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.

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

Symbols

The circle and slash symbol indicates operations that you must not do.
The specific operation is shown in the circle and explained in text.
This example indicates prohibiting disassembly.

The triangle symbol indicates precautions (including warnings).
The specific operation is shown in the triangle and explained in text.
This example indicates a general precaution.

The filled circle symbol indicates operations that you must do.
The specific operation is shown in the circle and explained in text.
This example shows a general precaution for something that you must do.

⚠ Caution

Do not touch the terminals or disassemble the unit and touch any internal components while power is being supplied.
Doing so may result in electric shock.

Do not attempt to disassemble, repair, or modify any units. Any attempt to do so 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.
When the 24-VDC output (service power supply to the PLC) is overloaded or short-circuited, the voltage may drop and result in the outputs being turned OFF. As a countermeasure for such problems, external safety measures must be provided to ensure safety in the system.
Implement proper measures as part of your communications system or in your program to ensure safety in the system even when a communications error or malfunction occurs during remote I/O communication.

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, slave units 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.
  - Removing or attaching the terminal blocks or connectors to slave unit.
  - Setting the DIP switch or the node address 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, communications 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 unit 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 communications 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 communications cable.
  - Separate the communications cables from the power lines or high-tension lines.
  - Do not bend the communications cables past their natural bending radius.
  - Do not pull on the communications cables.
  - Do not place heavy objects on top of the communications cables.
  - Always lay communications cable inside ducts.
- Turn OFF the power of PLC and all the slave units before wiring the communication cables.
- Do not apply voltages to the input slave units 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 slave units 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.
- Always use the DIN rail fixing plate that are provided, and make sure that the unit is mounted securely to the DIN rail.
- Confirm voltage specifications when wiring communications, 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 lines.
- 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 Directive

Concepts

EMC Directive

The Interface unit is an electrical device that is built into other machines. To enable more easily building it into other machines, it has been checked for conformity to EMC standards.*
EMC-related performance of the unit will vary depending on the configuration, wiring, and other conditions of the equipment or control panel on which it is installed.
The customer must, therefore, perform the final check to confirm that devices and the overall machine conform to EMC standards.

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

Conformance to EC Directives

The Interface unit complies with EC Directives. To ensure that the machine in which the unit is used complies with EC Directives, the unit must be installed as follows:

- The unit must be installed within a control panel.
- You must use reinforced insulation or double insulation for the DC power supplies for communications, internal power, and I/O. The DC power supplies must provide stable power even when a momentary power interruption of 10 ms occurs in the input.
- Products complying with EC Directives also conform to the emission standards (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.
- Compliance was confirmed for I/O wiring of less than 30 m.
- Attach two ferrite cores (TDK ZCAT1730-0730 or equivalent) to the power supply cable of the device.
- Attach a ferrite core (TDK ZCAT2035-0930 or equivalent) to the EtherCAT cable.

1

EtherCAT Network

1-1 Overview of EtherCAT Networks

EtherCAT (Ethernet Control Automation Technology) is a high-performance industrial network system based on Ethernet system and can realize faster and more efficient communications.
Each node achieves a short communications cycle time by transmitting Ethernet frames at high speed. Furthermore, even though EtherCAT is a unique protocol, it offers excellent general-purpose applicability. For example, you can use Ethernet cables because EtherCAT utilizes standard Ethernet technology for the physical layer. And the effectiveness of EtherCAT can be fully utilized not only in large control systems that require high processing speeds and system integrity, but also in small and medium control systems.

1-1-1 Features of EtherCAT

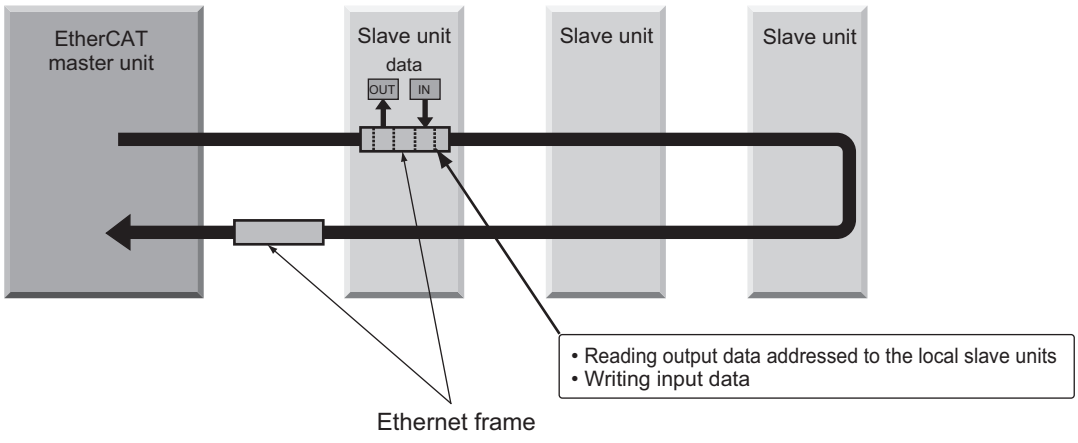
EtherCAT has the following features.

- **Extremely high-speed communications with speed of 100 Mbps**
  It dramatically shortens the I/O response time from generation of input signals to transmission of output signals. By fully utilizing the optimized Ethernet frame bandwidth to transfer data using a high-speed repeat method, it is possible to efficiently transmit a wide variety of data.

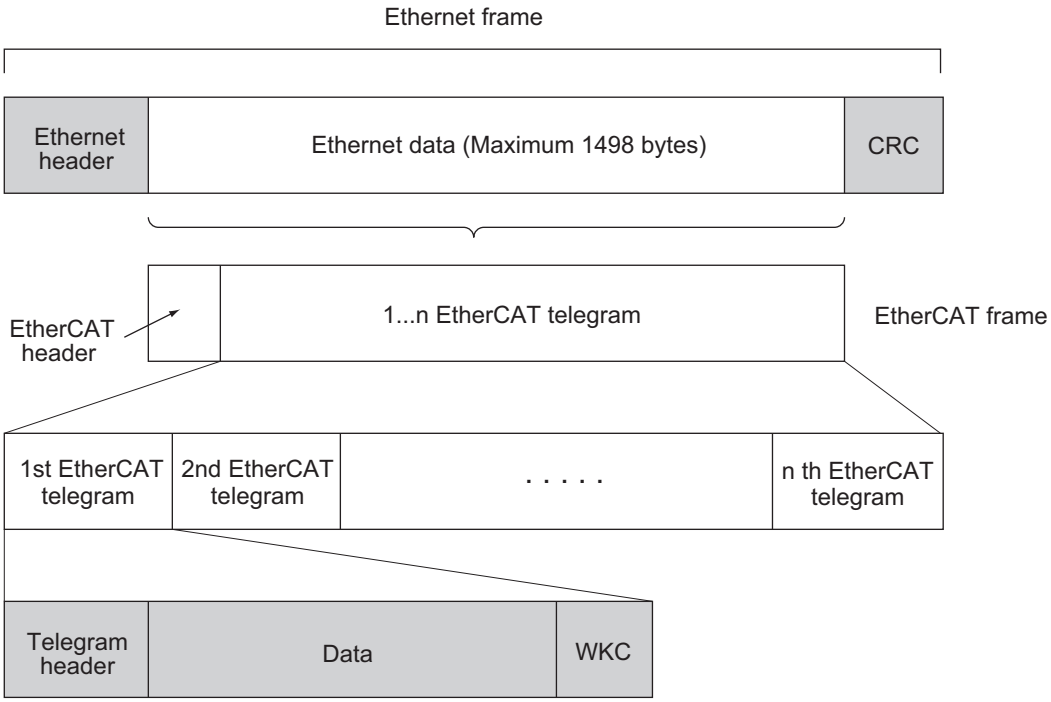
- **Extremely High Compatibility with Ethernet**
  EtherCAT is an open network with extremely high compatibility with conventional Ethernet systems.

1-1-2 Structure of EtherCAT

EtherCAT does not send data to individual slave nodes on the network, instead, it passes Ethernet frames through all of the slave nodes.
When frame passes through a slave node, the slave node reads and writes data in the areas allocated to it in the frames in a few nanoseconds.
Ethernet frames sent from the EtherCAT master unit go through all the EtherCAT Main modules without stopping on the way. Once they reach the final slave unit, they are sent back from the final slave unit, pass through all slave units 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 slave units.
Each "EtherCAT telegram" is configured with telegram header (data length, including address of one or more slave units, etc.), data, working counter (check bit).
When an Ethernet frame is compared to a "train", an EtherCAT telegram can be considered as "railway car."



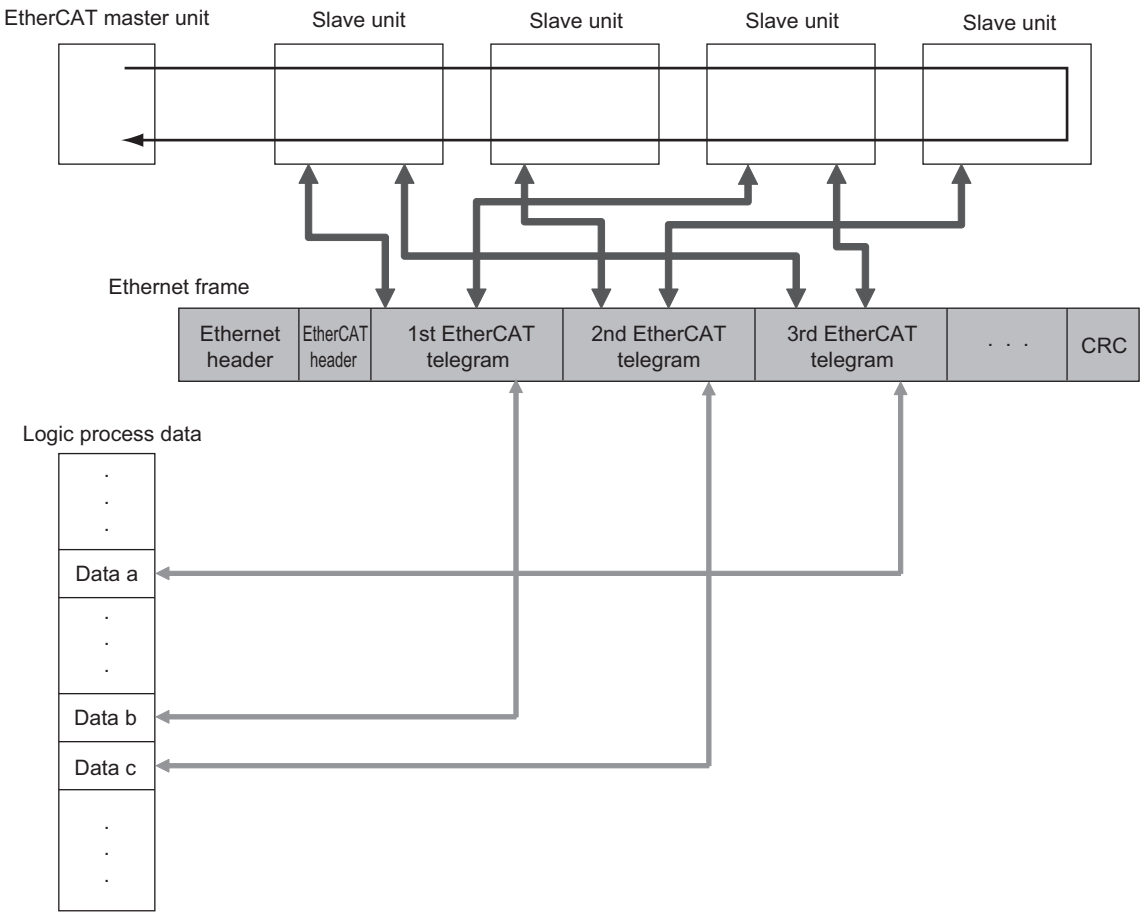
WKC : Working counter

1-1-3 Communications Types of EtherCAT

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

Process data communications functions (PDO communications)

This 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 communications among the EtherCAT master unit and slave units.



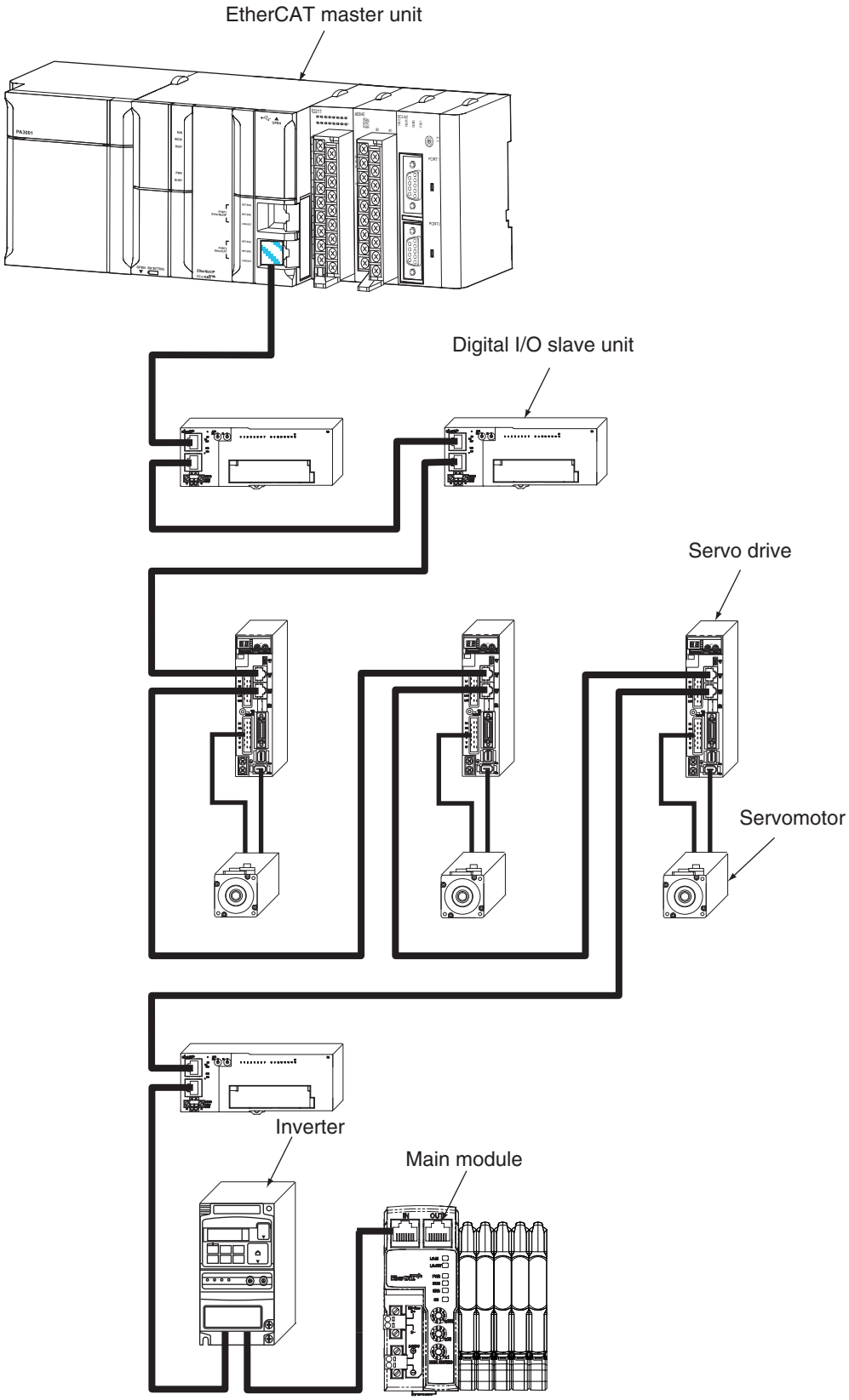
Mailbox communications functions (SDO communications)

It refers to message communications.
At any timing, the EtherCAT master unit transmits commands to slave units and the slave units return responses to the EtherCAT master unit.
It performs the following data communications:

- Read and write process data
- Make slave unit setting
- Monitor slave unit state

1-1-4 Connection Examples of EtherCAT

This section explains the connection examples of EtherCAT network.

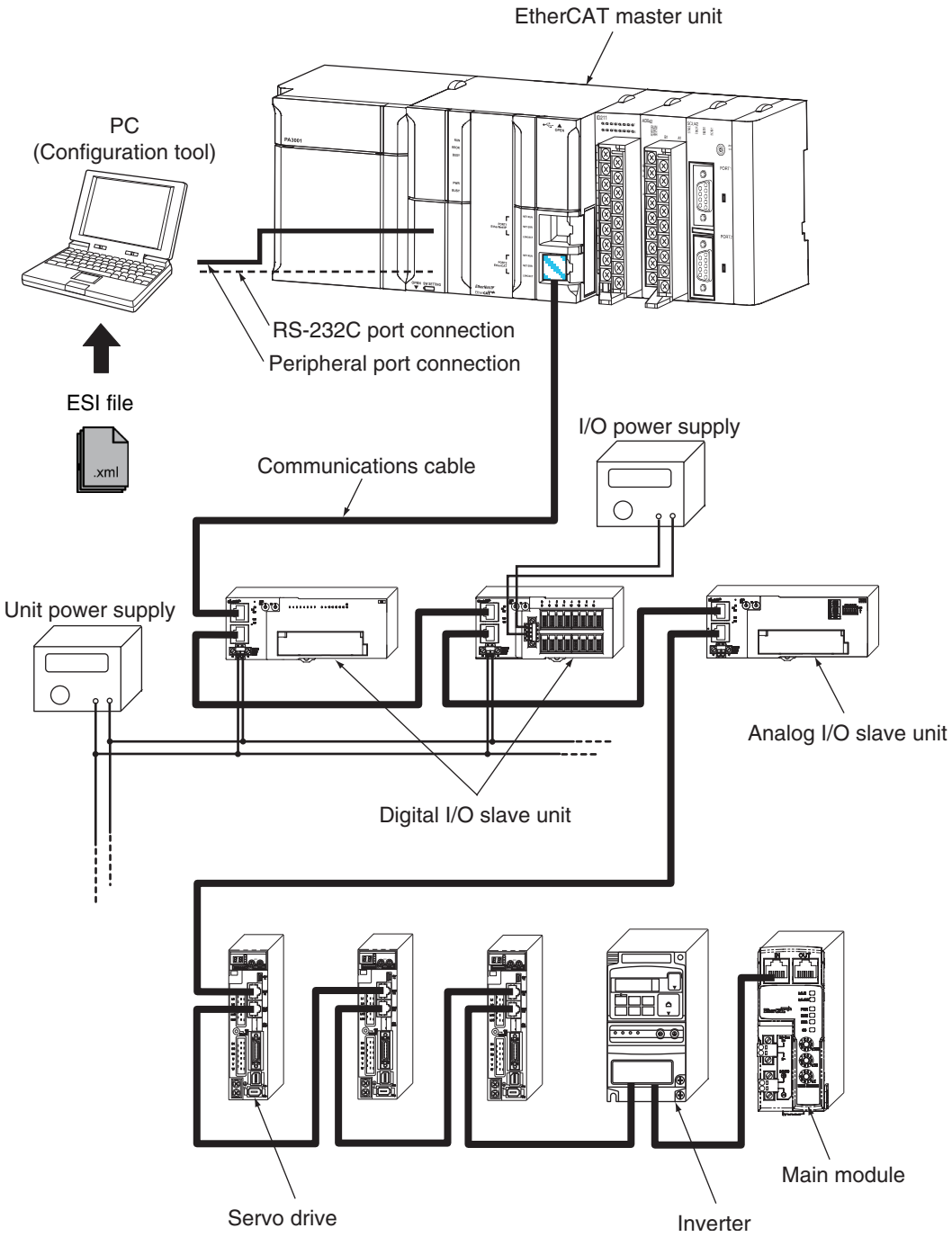


1-2 Configuration Elements of EtherCAT Network

This section explains the configuration devices and usages of EtherCAT network.

1-2-1 Configuration Devices of EtherCAT Network

The devices composing an EtherCAT network are shown in the figure below.



1-2-2 Overview of Configuration Devices

The overview of each configuration device is as follows:

EtherCAT master unit

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

EtherCAT slave unit

Outputs data received from the EtherCAT master unit through the EtherCAT network, or sends input data to the EtherCAT slave unit through the EtherCAT network.
There are Digital I/O slave unit and Analog I/O slave unit. The MG50-EC is also classified as a EtherCAT slave unit.

Configuration tool

It is a PC software for making setting of the EtherCAT network and each slave unit.
It can be used either by connecting to the EtherCAT master unit or as a substitute of the EtherCAT master unit.

Communications cable

Uses cables of Ethernet category 5 (100BASE-TX) or higher, with double-shield (aluminum tape and braided shielding), which are connected straight.

ESI (EtherCAT slave information) file

Describes information specific to EtherCAT Main modules in XML format.
You can load an ESI file into the configuration tool to easily allocate slave process data and make other settings.

Unit power supply

Provides power for communications of each slave unit 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 slave units.
Separate from unit power supply when wiring.
The MG50-EC does not require an I/O power supply.

2

About the MG50-EC

2-1 Overview of MG50-EC

This section explains the overview of MG50-EC.

2-1-1 Features of MG50-EC EtherCAT Main Modules

This Main module is a communications slave that processes EtherCAT communications between measuring units and a PLC to monitor the ON/OFF output status and detection values, write parameters, and operate the measuring units.

The PDOs in EtherCAT communications allow you to monitor the ON/OFF status of the outputs or the detection values without any programming. The SDOs give you the ability to read and write to any specified parameter.

2-2 Connectable Counter Modules

2-2-1 List of Counter Modules

Type	Model number
Counter Module	MF10-CM

2-2-2 Number of Connected Counter Modules

This Main module allows you to connect up to 30 Counter modules, including those that are connected to the Distribution modules.
You can connect up to 10 measuring units to a Distribution module.

3

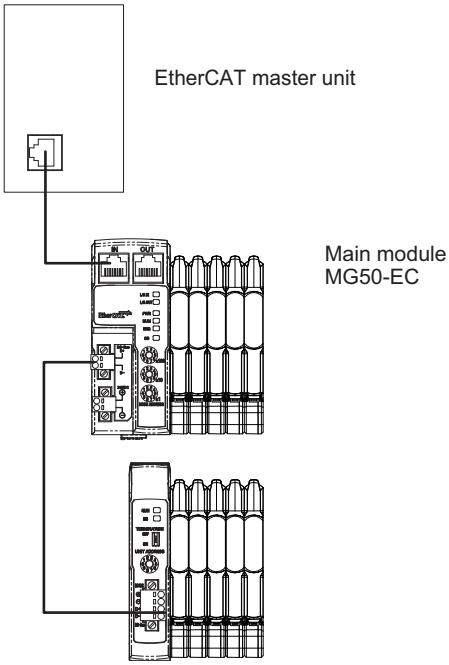
Basic Usage Procedures

3-1 Setup Examples and Basic Procedure

This section explains the setup method by using simple system setting examples.

3-1-1 System Setting Examples

Connect each of the following slave unit to the EtherCAT master unit and make the settings.



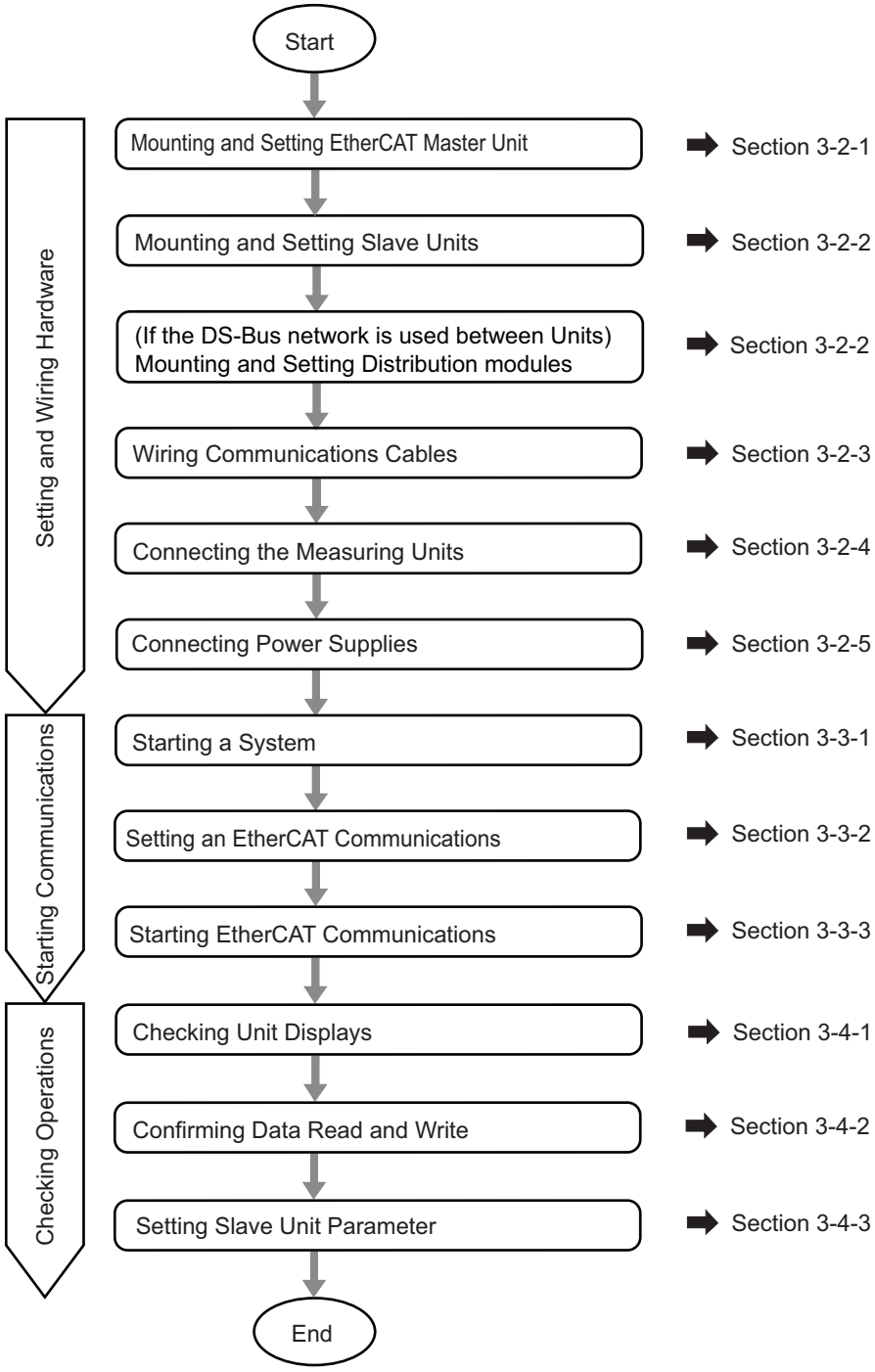
Although it is not shown in the figure above, supply the power to MG50 / MG51 separately.

Reference

The setting example explained here is the basic setting of MG50-EC EtherCAT main modules. If more detailed settings are required in actual operation, refer to the manual of the EtherCAT master unit. Moreover, if your system configuration includes slave units other than our products, make the setting upon referring to the manual of the relevant slave units.

3-1-2 Basic Procedure

This is the flow of the procedures explained in the following sections.



3-2 Setting and Wiring Hardware

Make settings and wiring of the EtherCAT master unit and slave units, and power supply.

3-2-1 Mounting and Setting EtherCAT Master Unit

Mount the EtherCAT master unit at the prescribed location and make settings of unit No. and so on.
For the detailed explanation, refer to the manual of the EtherCAT master unit to be used.

3-2-2 Mounting and Setting Slave Units

Mount each slave and Distribution module in their designated locations, and then set the node addresses and other settings.
For details, refer to each item below.

- **Mounting**
  "4-1 Mounting MG50-EC and Counter Modules" in page 4 - 2

- **Setting**
  Pages in Chapter 6 to Chapter 7 which explain the general specification and details of each type of slave units.

3-2-3 Wiring Communications Cables

Connect communications cables to the EtherCAT master, slaves, and the Distribution modules.
Refer to "4-2 Connecting to EtherCAT Network" in page 4 - 4 for wiring procedures.

3-2-4 Connecting the Measuring Units

After connecting the Counter modules to the Main module, connect the measuring units. For connection methods, refer to your Counter module manual.

3-2-5 Connecting Power Supplies

Connect the unit power supply to the EtherCAT master, slaves, and the Distribution modules.
In addition, connect the I/O power supply to each slave unit as required.
For the connection method, refer to "4-3 Connecting to Unit Power Supply" in page 4 - 9 or the wiring diagram of each slave unit (in pages explaining the details).

3-3 Starting Communications

Start the system, allocate I/O data of slave units, and then start the EtherCAT communications.
For operational state and details of it, refer to "5-3 Communications State Transitions" in page 5 - 4.

3-3-1 Starting a System

Turn ON the power supply to the units in order.

(1) Unit power supply of slave units (When the power is supplied, slave unit's [PWR] indicator is lit.)
- If you are using Distribution modules, turn ON the power supply to the Distribution modules as well.

(2) Unit power supply of EtherCAT master units

3-3-2 Setting EtherCAT Communications

The following communications are performed in EtherCAT.

- **PDO communications (remote I/O communications)**
  Allocate I/O data of slave units to the EtherCAT master unit (PDO mapping) and perform PDO communication (remote I/O communications).
  For the detailed explanation of I/O data of each slave unit, refer to "I/O Data Allocation (PDO Mapping)" in Chapter 7.
  Note that the ESI file are used to allocate I/O data.
  For the detailed explanation of the procedure, refer to the manual of the EtherCAT master unit to be used and the manual of the configuration tool.
  The maximum assignable PDO size for the MG50-EC is 350 bytes. (Refer to "7-2-3 Mode Setting Functions for PDO Communications" in page 7 - 5 for details.) Do not assign PDOs that exceed the maximum assignable PDO size.

- **SDO communications (message communications)**
  For the method of using, refer to the manual of the EtherCAT master unit to be used.
  Refer to "Appendix A - 1 Object Dictionary" for the detailed explanation of objects implemented on MG50-EC EtherCAT Main modules.
  Note that the SDO communications can be used in the pre-operational state or more.

3-3-3 Starting EtherCAT Communications

Shift to the operational state (EtherCAT communications possible) to start the EtherCAT communications.
For how to shift to the operational state, refer to the manual of the EtherCAT master unit to be used.

3-4 Checking Operations

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

3-4-1 Checking Unit Displays

● EtherCAT master unit

Refer to the manual of the EtherCAT master unit to be used.

● EtherCAT Main modules

Check that the status indicator of each slave unit is as follows.

Indicator	State
PWR	ON
L/A IN	Flickering
L/A OUT	Flickering (turned OFF for the terminal slave unit only)
RUN	ON
ERR	OFF
SS	Lit red. (The number of actual connections does not agree with the number of connections that were detected when the unit was started.) Lit green. (The number of actual connections agrees with the number of connections that were detected when the unit was started.)

● Distribution module

Make sure the status indicators on each slave are as described in the following table.

Indicator	State
RUN	Lit.
SS	Lit red. (The number of actual connections does not agree with the number of connections that were detected when the unit was started.) Lit green. (The number of actual connections agrees with the number of connections that were detected when the unit was started.)

3-4-2 Confirming Data Read and Write

Use a Configuration tool to read input and output data from the EtherCAT master to make sure the I/O data is being read and written correctly.

3-4-3 Setting Slave Unit Parameter

Make parameter settings for each slave unit as required via the SDO communications.
Refer to Chapter 7 MG50-EC Function Specifications and the pages that provide details in the Appendix for further information on the parameters that can be set. Always set the following objects in your initial settings for the MG50-EC.

- If you intend to use a dummy, make sure to register the dummy.

4

Installation and Wiring

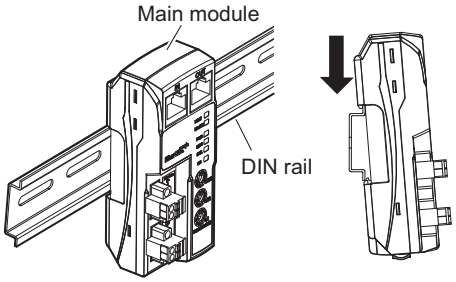
4-1 Mounting MG50-EC and Counter Modules

This section describes how to mount and remove the MG50-EC and individual Counter modules to the DIN rail.

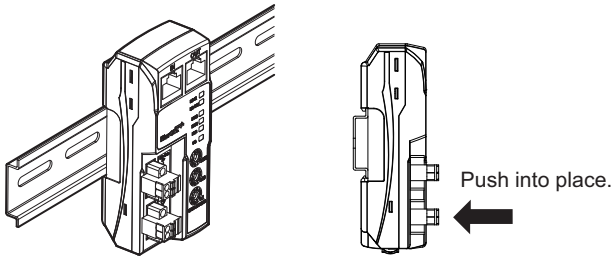
4-1-1 Mounting Method

Use the following procedure to mount the units.

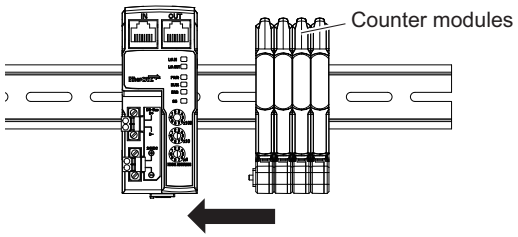
1. Hook the upper portion of the unit on the DIN rail.



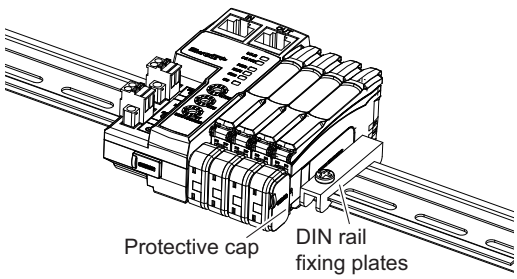
2. Press the lower portion of the unit against the DIN rail.



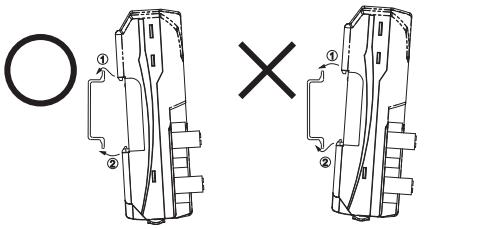
3. Remove the protective cap from the right side of the Main module. Then, slide the Counter modules against the Main module with the tabs aligned with the notches in the connector area. Press them together until they click into place.



4. Use the DIN rail fixing plates that are provided to remove any gaps between the units and secure them in place. Replace the protective cap that you removed in step 3 to the Counter module on the right end.



CHECK! Do not perform steps 1 and 2 in the reverse order. This may reduce the mounting strength.



Perform step 1 and then step 2.

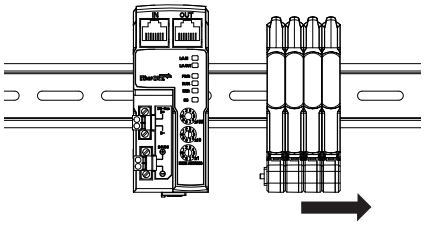
Do not perform step 2 before step 1.

After you finish these steps, make sure the MG50-EC is securely in place.

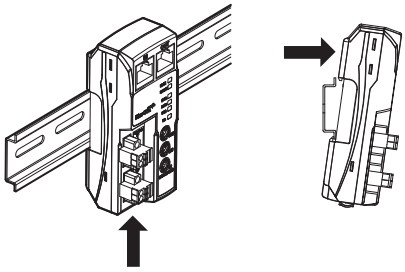
4-1-2 Removal Method

Use the following procedure to remove the units.

1. Slide the Counter modules away and remove the Main module first.



2. Keep the Main module pressed against the DIN rail as you lift it up, and then off.



4-2 Connecting to EtherCAT Network

This section explains how to lay down EtherCAT network.

4-2-1 Precautions for Network Connection

Observe the precautions below when laying down the EtherCAT network.

Precautions at laying down network

- When laying down an EtherCAT network, take sufficient safety measures and construct the network according to the standards. We recommend to request specialized constructors familiar with the safety measures and standards to perform the laying operation.
- Do not lay down EtherCAT network devices near any devices generating noise.
  If there is no choice but to lay them down in a noisy environment, make sure to take noise measures such as housing each device in metal cases.

Precautions at laying down communications cables

- Check the following items for communications cables to be used.
  - Are there any disconnected cables?
  - Are any cables short-circuited?
  - Are there any problems in connector connections?
- To connect a cable to communications connector of each device, insert it securely until the connector of the communications cable is locked.
- Lay down and wire the communications cables separately from high-voltage electrical power lines.
- Do not lay down the cables near devices generating noise.
- Do not lay down the cables in high-temperature and high-humidity environment.
- Use the cables in locations without powder dust and oil mist.
- There is a limit to the bending radius of communications cables. Check the specification of communications cables to be used for the information on bending radius.

4-2-2 Preparation for Connecting Network

Prepare the following devices.

Product name	Comment
Twisted-pair cable (Cables with connectors below are also allowed.)	100BASE-TX (Category 5 or higher) Double-shield (aluminum tape + braided shielding)
RJ45 connector	Category 5 or higher Shielded

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.

Reference

We recommend cables with double, aluminum tape and braded shielding, taking noise resistance into consideration.

● Recommended Parts

The recommended products for the parts described above are listed below.

- Sizes and Conductor Pairs: AWG 24 × 4 Pairs

Part	Manufacturer	Model
Communications cables	Tonichi Kyosan Cable, Ltd.	NETSTAR-C5E SAB 0.5×4P
	Kuramo Electric Co., Ltd.	KETH-SB
	SWCC Showa Cable Systems Co. Ltd.	FAE-5004
Connectors	Panduit Corporation	MPS588

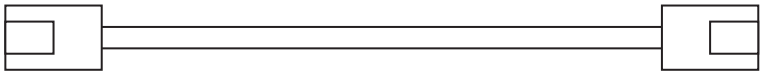
- Sizes and Conductor Pairs: AWG 22 × 2 Pairs

Part	Manufacturer	Model
Communications cables	Kuramo Electric Co., Ltd.	KETH-PSB-OMR
Connectors	OMRON Corporation	XS6G-T421-1

(Notes) We recommend that you use combinations of the above cables and connectors.

4-2-3 Connecting Communications Cables and Connectors

Connect a communications 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

* Connect both ends of cable shielded wires to the connector hoods.

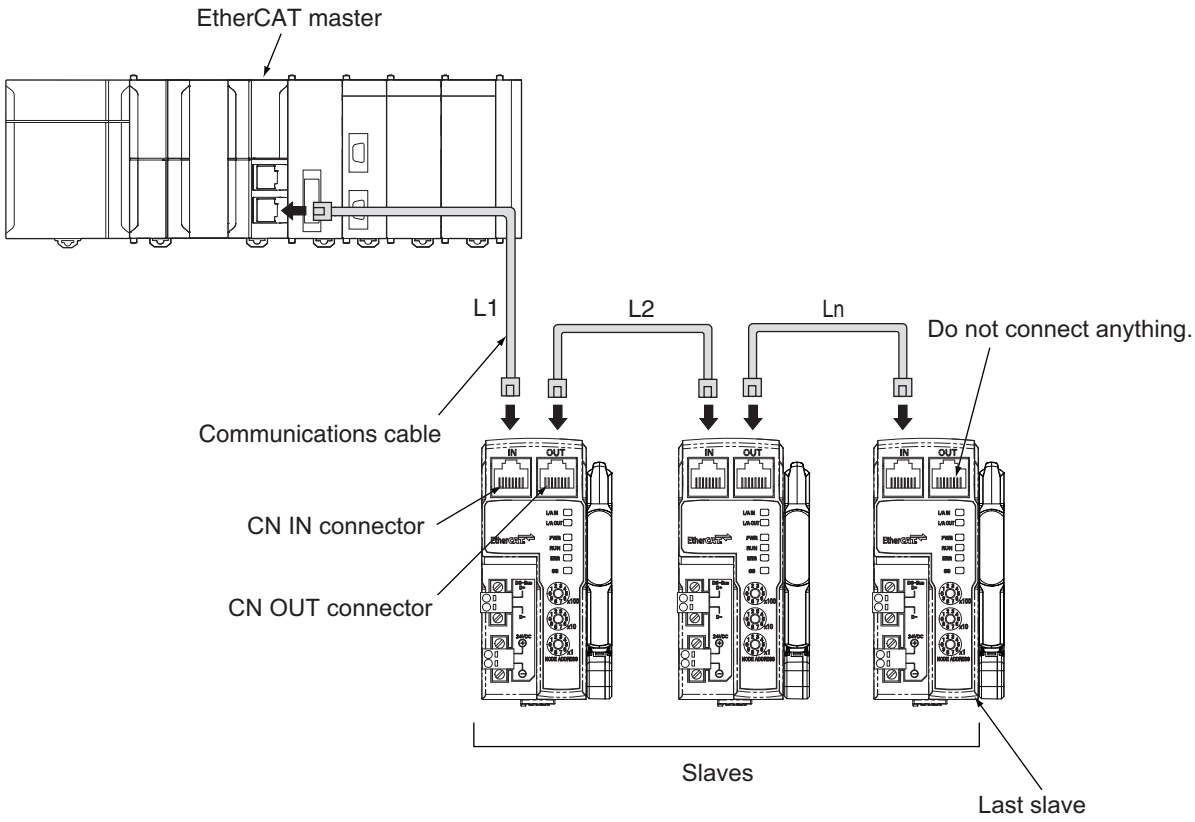
Reference

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.

4-2-4 Connecting to Communications Cables

EtherCAT networks allow free wiring in any connection forms. Connection before and after the MG50-EC EtherCAT Main modules shall be made in daisy chain connection.

Connect the communications cable from the EtherCAT master unit to the [CN IN] connector of the slave units. Connect another the communications cable from the [CN OUT] connector of the first slave unit to the [CN IN] connector of the next slave unit.
Note that nothing should be connected to the [CN OUT] connector of the slave unit at the terminal end of the network.

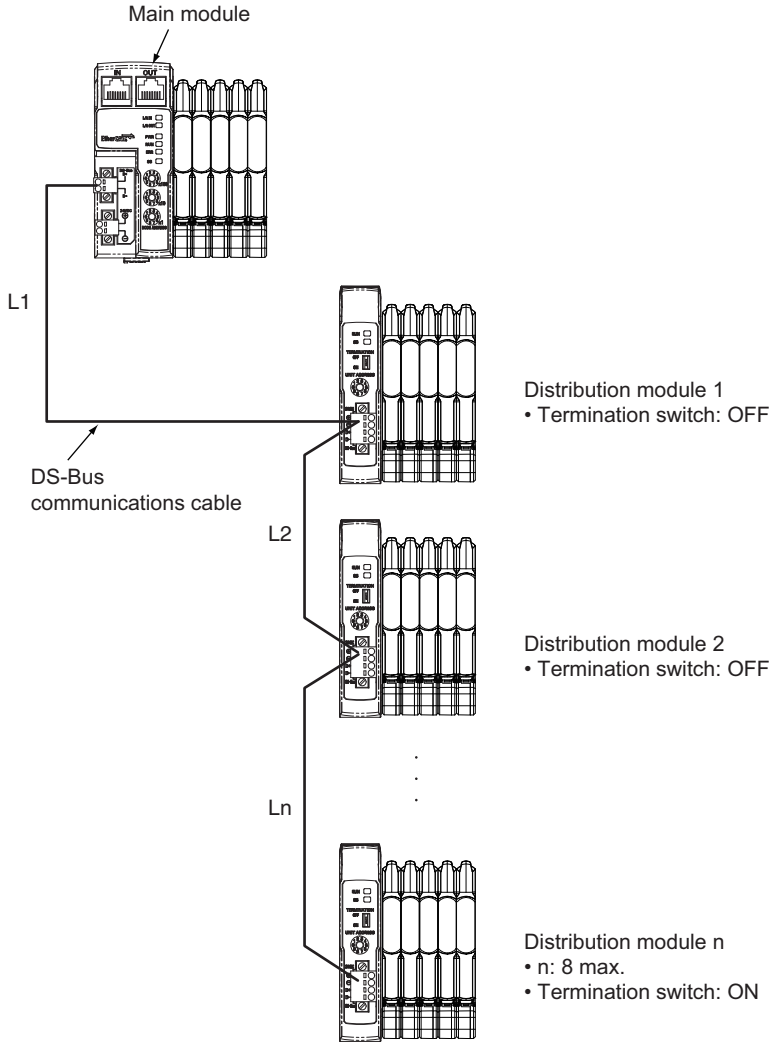


Precautions for Correct Use

- The cable length between each slave unit (L1, L2, ... Ln) must be within 100 m.
- Connect cables securely until communications cable connectors click and are fixed in place.
- When you wire the communications cables, observe their specifications (bending radius and so on) defined by the cable manufacturer.

4-2-5 Connecting to Distribution modules

The Main module and Distribution modules are connected by a DS-Bus network.
Connect the DS-Bus connector (D+ and D−) on the Main module to the D+ and D− terminals on the power supply/communications connector on the first Distribution module. Connect the Distribution modules with multidrop connections, i.e., connect the D+ and D− terminals between consecutive units.
Supply power to the Distribution modules from a unit power supply (24 VDC).



Precautions for Correct Use

- You can connect a maximum of eight Distribution modules to the Main module.
- Do not exceed a total length (L1 + L2 + ... + Ln) of 30 m for the DS-Bus cable.
- Turn ON the DS-Bus termination switch only on the last Distribution module on the DS-Bus network. Turn it OFF on all other Distribution modules.

4-3 Connecting to Unit Power Supply

The following power supplies are required to operate the EtherCAT network.

- Unit power supply: For communication and internal operation of slave units.

This section explains how to supply the unit power supply.

4-3-1 Precautions at Supplying Unit Power

When supplying the unit power supply, take the followings into consideration for allowable current of cables and connectors, voltage drop, and layout of power supplies.

- **Consideration to cable voltage drop**
  The power supply voltage of a slave unit farthest to the power supply must be within the allowable variation range.
- **Supplying unit power supply from multiple sources**
  When the unit power is supplied from multiple power supplies instead of from one power supply, the line current, voltage drop, and cable size can be reduced. Moreover, it is effective to secure safety of the system at power supply errors.
- **If power supply errors occur**
  Consideration on layout and grouping of power supplies differ by whether you want to stop the entire system or not 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 slave units, or take similar measures.
  This has also the effects of reducing voltage drop and cable size and so on.

4-3-2 Unit Power Supply Specifications

Use a general purpose power supply that satisfies the following specifications.

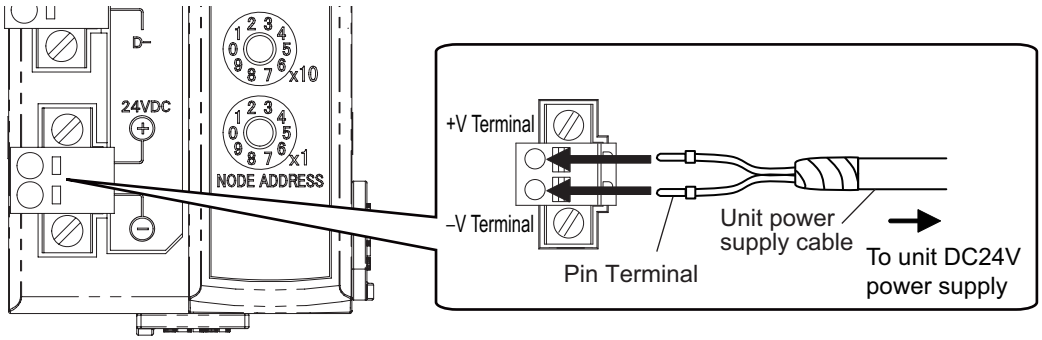
Item	Specification
Output voltage	24 VDC ± 10%
Output ripple	600 mVp-p
Output current	Has the capacity to supply power more than the total current consumption of each slave unit
Isolation	Between output and AC power supply as well as between output and chassis ground

Precautions for Correct Use

- When calculating the output current for the unit power supply, always include the current consumption of the MG50 and the current consumption of all Counter modules and measuring units in the unit power supply consumption current.
- Make sure that the power supply has sufficient capacity to handle the inrush current when the system is started.

4-3-3 Connecting the Unit Power Supply

Connect a cable from the 24-VDC unit power supply to the unit power supply connector on each slave unit, and supply power to individual slave units.



Mount a pin terminal, or equivalent to the unit power supply cable so that it will not be displaced.
Do not wire a power supply to the communications path of the Distribution modules. The units may be damaged.

- **Recommended product**
  The following pin terminals are recommended for the unit power supply cables.

Model	Applicable wire size	Crimping tool	Manufacturer
AI0,5-10WH	0.5 mm^2/AWG20	CRIMPFOX UD6 (Product No. 1204436) or CRIMPFOX ZA3 series	Phoenix Contact GmbH&Co.KG
H0.5/16 orange	0.5 mm^2/AWG20	Crimper PZ1.5 (Product No. 900599)	Weidmueller Interface GMbH&Co. KG

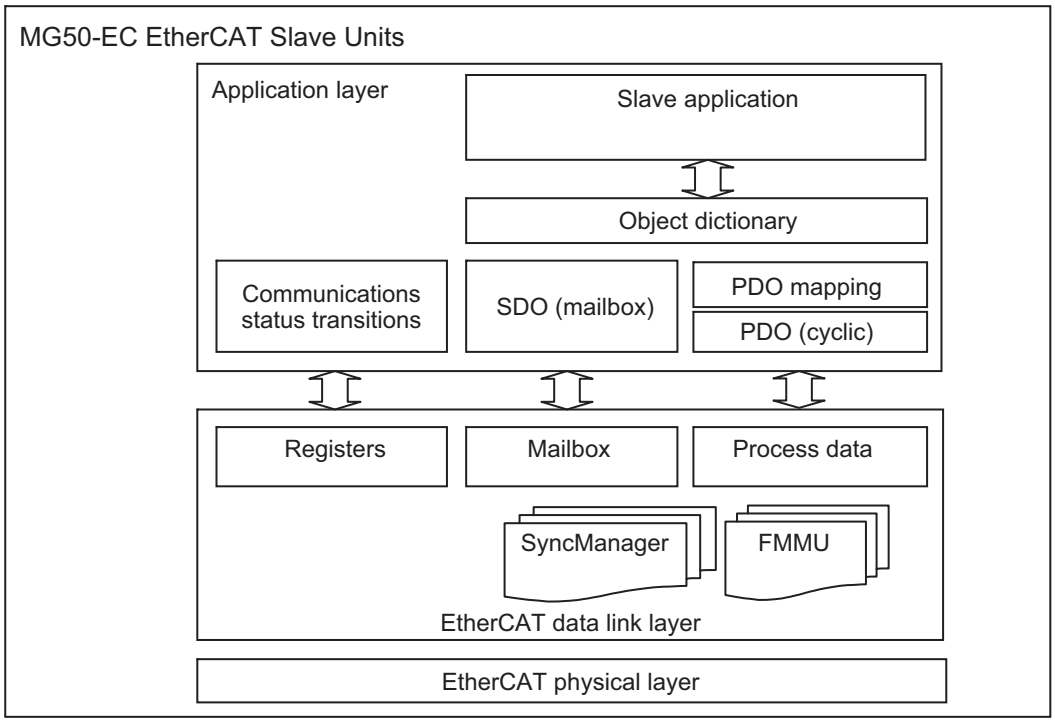
5

EtherCAT Communications

5-1 Structure of CAN Application Protocol Over EtherCAT (CoE)

Normally, multiple protocols can be transferred by EtherCAT. But MG50-EC EtherCAT Main modules use "CAN application protocol over EtherCAT (CoE)", a communication interface to be applied for EtherCAT devices, as the device profile of the open network standard "CAN application protocol."

The figure below shows the structure of CoE in MG50-EC EtherCAT Main modules.

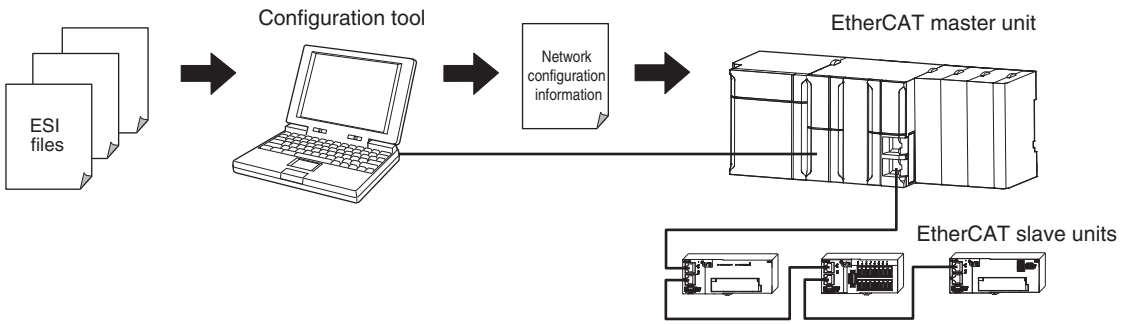


CAN application protocol has two types of object dictionaries, PDO (Process Data Object) and SDO (Service Data Object) .
PDO is composed of object dictionaries that can be mapped. The process data is defined by PDO mapping.
PDO is primarily used in PDO communications for regularly exchanging process data.
Moreover, SDO is able to read and write all object dictionaries and is used in non-fixed-cycle type SDO (event type messages) communications.

By using the CoE interface to set object SDO and PDO dictionaries, EtherCAT can provide EtherCAT devices with the same device profile as CAN application protocol.

5-2 EtherCAT Slave Information File (ESI File)

An EtherCAT slave information (ESI) file contains the setting information of an EtherCAT slave unit. Various EtherCAT communications setting can be defined from the ESI files of connected slave units and the network connection information.
ESI files are installed in the configuration tool to create network configuration information.
You can download the network configuration information to the EtherCAT master unit to configure the EtherCAT network.

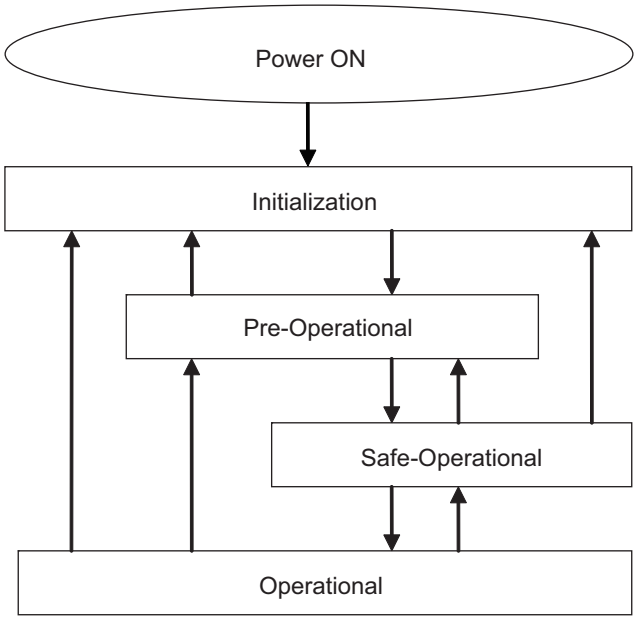


The ESI files described in this manual can be downloaded from the Magnescale website (http://www.magnescale.com/mgs/language/english/product/ under “Digital Gauge”).

5-3 Communications State Transitions

The EtherCAT State Machine (ESM) indicates the state transition model of EtherCAT slave unit communications control. It is controlled by EtherCAT master unit.

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



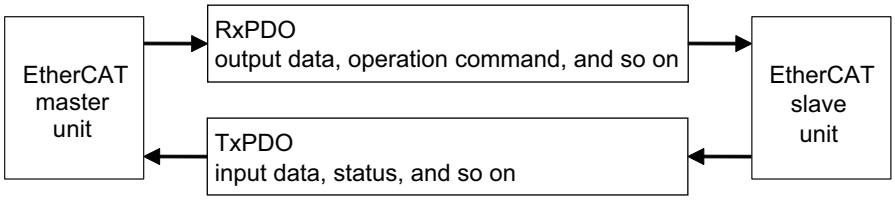
State	SDO communications	PDO transmission	PDO reception	Contents
Initialization (Init)	Not possible.	Not possible.	Not possible.	Communications are being initialized. Communications are not possible.
Pre-Operational (Pre-Op)	Possible	Not possible.	Not possible.	SDO (message) communications are possible in this state. This state is entered after initialization has been completed. It is used to initialize network settings.
Safe-Operational (Safe-Op)	Possible	Possible	Not possible.	In this state, PDO transmissions are possible in addition to SDO (message) communications. PDO sendings can be used to send information such as status from the slave unit.
Operational (Op)	Possible	Possible	Possible	Normal communication state PDO communications can be used to control the I/O data.

MG50-EC can’t trance the state of Operational, when Counter module does not exist.

5-4 Process Data Objects (PDO)

5-4-1 Overview

The process data objects (PDO) are used for real-time data transfer via cyclic communications.
PDOs include RxPDOs, which are used by the slaves to receive data from the EtherCAT master, and TxPDOs, which are used by the slaves to send data to the EtherCAT master.

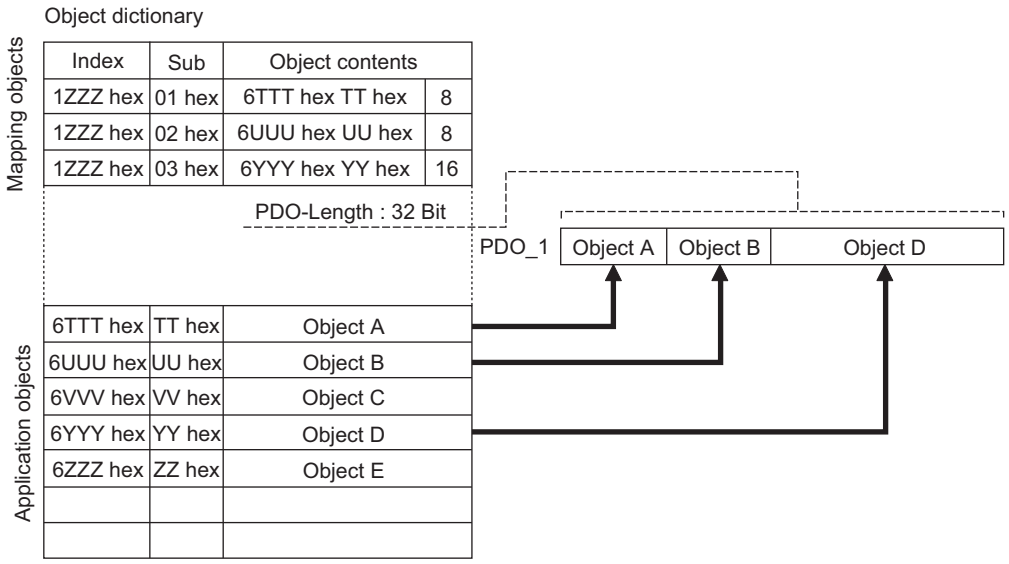


It is possible to hold multiple objects in the EtherCAT application layer so that various process data of EtherCAT Main modules can be transferred. The details of process data are described in PDO Mapping Objects and Sync Manager PDO Assignment Objects.
MG50-EC EtherCAT Main modules support PDO mapping for I/O control.

5-4-2 PDO Mapping Settings

The PDO mapping indicates the mapping for application objects (realtime 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.

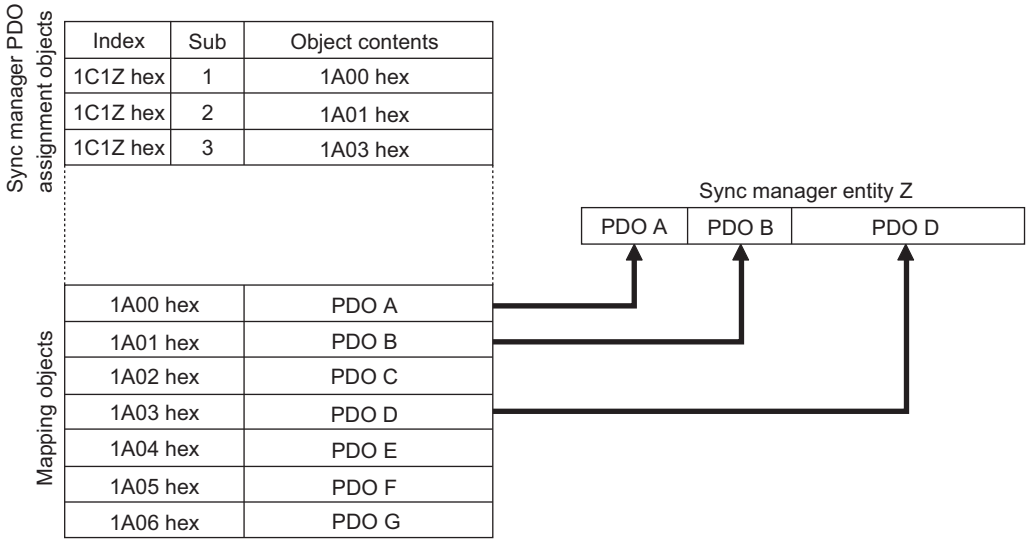
The figure below shows an example of PDO mapping.



5-4-3 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.



5-4-4 PDO Mapping

The tables below show the details of PDO mapping for MG50-EC EtherCAT Main modules.

● PDO mapping

261th Transmit PDO Mapping (1B04 hex)	No.1 measuring unit Input 1 No.1 measuring unit Input 2 ..... No.8 measuring unit Input 1 No.8 measuring unit Input 2	Read Input bits (3020 hex)
262th Transmit PDO Mapping (1B05 hex)	No.9 measuring unit Input 1 No.9 measuring unit Input 2 ..... No.16 measuring unit Input 1 No.16 measuring unit Input 2	Read Input bits (3020 hex)
266th Transmit PDO Mapping (1B09 hex)	Measuring unit Communication Status	Measuring unit Communication Status (3000 hex)
267th Transmit PDO Mapping (1B0A hex)	Number of measuring units setting Number of measuring units setting with Dummy	Number of measuring units (3001 hex)
268th Transmit PDO Mapping (1B0B hex)	Measuring unit Warning Status	Measuring unit Status (300B hex)
273rd Transmit PDO Mapping (1B10 hex)	No. 1 measuring unit Detection Value Input 1	Detection Value (4001 hex)
275th Transmit PDO Mapping (1B12 hex)	No. 2 measuring unit Detection Value Input 1	Detection Value (4081 hex)
. . .	. . .	. . .
287th Transmit PDO Mapping (1B1E hex)	No. 8 measuring unit Detection Value Input 1	Detection Value (4381 hex)

5-5 Service Data Object (SDO)

5-5-1 Overview

MG50-EC EtherCAT Main modules support the SDO communications.
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 communications.

5-5-2 Abort Codes

The table below shows abort codes of SDO communications errors.

Code	Meaning
0503 0000 hex	Toggle bit not changed
0504 0000 hex	SDO protocol timeout
0504 0001 hex	Client/Server command specifier not valid or unknown
0504 0005 hex	Out of memory
0601 0000 hex	Unsupported access to an object
0601 0001 hex	Attempt to read a write only object
0601 0002 hex	Attempt to write to a read only object
0602 0000 hex	The object does not exist in the object directory.
0604 0041 hex	The object cannot be mapped into the PDO.
0604 0042 hex	The number and length of the objects to be mapped would exceed the PDO length.
0604 0043 hex	General parameter incompatibility reason
0604 0047 hex	General internal incompatibility in the device.
0606 0000 hex	Access failed due to a hardware error.
0607 0010 hex	Data type does not match, length of service parameter does not match.
0607 0012 hex	Data type does not match, length of service parameter too high.
0607 0013 hex	Data type does not match, length of service parameter too low.
0609 0011 hex	Sub-index does not exist.
0609 0030 hex	Value range of parameter exceeded (only for write access)
0609 0031 hex	Value of parameter written too high
0609 0032 hex	Value of parameter written too low
0609 0036 hex	Maximum value is less than minimum value.
0800 0000 hex	General error
0800 0020 hex	Data cannot be transferred or stored to the application.
0800 0021 hex	Data cannot be transferred or stored to the application because of local control.
0800 0022 hex	Data cannot be transferred or stored to the application because of the present device state.
0800 0023 hex	Object dictionary dynamic generation fails or no object dictionary is present.

The following table gives the abort codes for when sending commands to a Counter module fails.

Value	Meaning
0800 0021 hex	An unsupported command was sent or the Counter module is in a condition under which the command cannot be accepted. Check the command.
0609 0030 hex	A parameter value is out of range. Check the setting range of the parameter.
0800 0020 hex	A communications error or other error occurred. Implement retry processing.

5-6 EtherCAT Master Unit - Slave Unit Communications

This section explains the communication modes between the master unit and MG50-EC EtherCAT slave unit.

5-6-1 FREE RUN Mode

In the FREE RUN mode, a slave unit operates asynchronously with the EtherCAT master unit.

To calculate the input and output response time* of the entire system, refer to the relevant values in the manual of the host system (EtherCAT master or CPU unit) to be used.

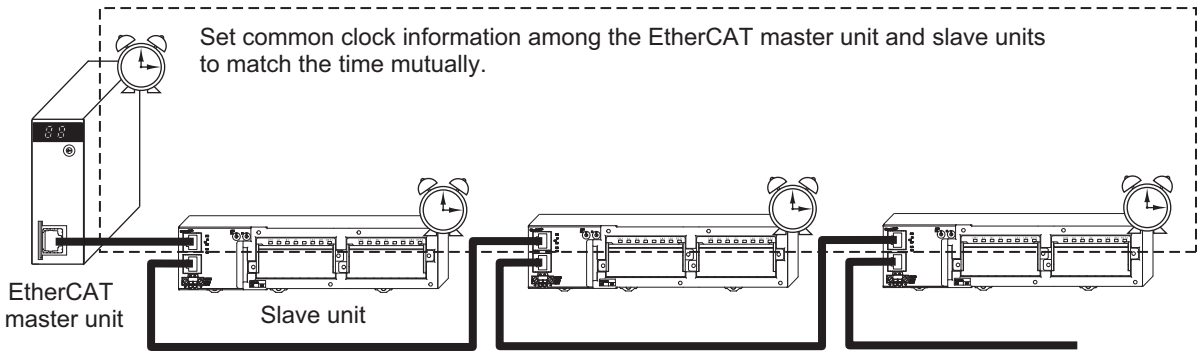
* This is the time which takes for an input signal from an Input slave unit to be processed by the PLC of the master unit and output to an Output slave unit.

5-6-2 DC Mode

In the DC mode, a slave unit operates synchronously with the EtherCAT master unit.

A mechanism called distributed clock (DC), where the EtherCAT master unit and slave units share the same clock, is used for synchronization.
Each of DC mode-ready slave units connected to EtherCAT shares the clock information.
By generating interrupt signals and executing input/output processing inside each slave unit according to the clock, it becomes possible to synchronize the input/output timing with other slave units.

The DC mode supported by MG50-EC units is DC mode 1.



- **Communications cycle**

  The communications cycle is determined by setting output frequency of Sync0 signal (interrupt signal in DC mode 1).

  500 μs, 1 ms, 2 ms, 4 ms

  The settings are performed on the EtherCAT master unit side. For the setting method, refer to the manual of the EtherCAT master unit to be used.

5-7 Emergency Messages

MG50-EC EtherCAT Main modules are able to notify emergency messages to the EtherCAT master unit by using the SDO communications if they detect errors.

5-7-1 Emergency Message Notification

It is possible to set whether or not to notify emergency messages via the SDO communications.
Target indexes are sub-index 05 hex: (Flags) in 10F3 hex (Diagnostic History).

The setting values are shown in the table below.

Set value	Emergency message notification
0000 hex	Not notify.
0001 hex	Notify.

When the power to it is turned on, a slave unit always starts up in the "Not notify" setting. If you want to use a slave unit in the "Notify" setting, set it to "Notify" each time you turn on the power.
Note that an emergency message cannot be sent during an EtherCAT communications errors are occurring.

An emergency message is composed of 8-byte data as shown below.

Byte	0	1	2	3	4	5	6	7
Contents	Emergency error code		Error register (Object 1001 hex)	Reserved.				

For contents of emergency message, refer to "8-1-4 Emergency Error Code" in page 8 - 8.

5-7-2 Diagnosis History

A MG50-EC EtherCAT slave unit can save up to eight emergency messages in non-volatile memory inside the slave unit. The saved messages can be read with SDO communications.
Indexes to be read are sub-indexes 06 hex to 0D hex (Diagnosis messages 1 to 8) among 10F3 hex (Diagnosis History).

Diagnosis history is stored from Diagnosis message 1. If 8 errors are stored in order up to Diagnosis message 8, the 9th error onward are saved from Diagnosis message 1 again.

History is saved even if emergency messages cannot be sent to the EtherCAT master unit due to EtherCAT communications errors or emergency messages are set to "Not notify."
Errors that occur for non-volatile memory are not saved in the diagnosis history.

6

Hardware Specifications of MG50-EC

6-1 EtherCAT Communications Specifications

Item	Specification
Communication protocol	Dedicated protocol for EtherCAT
Modulation	Base band
Baud rate	100 Mbps
Physical layer	100BASE-TX (IEEE802.3u)
Connectors	RJ45 × 2 (Shielded) CN IN: EtherCAT input CN OUT: EtherCAT output
Topology	Daisy chain
Communications media	Category 5 or higher (cable with double, aluminum tape and braided shielding is recommended.)
Communications distance	Distance between nodes 100 m max.
Noise immunity	Conforms to IEC 61000-4-4, 1 kV or higher
Node address setting method	Set with decimal rotary switches or software. *1
Node address range	000 to 192 *2
Indicator	PWR × 1 L/A IN (Link/Activity IN) × 1 L/A OUT (Link/Activity OUT) × 1 RUN × 1 ERR × 1
Process data	PDO mapping
PDO size/node	350 byte (max)
Mailbox	Emergency messages and SDO requests, SDO response
SYNCHRONIZATION mode	Free Run mode (asynchronous) and DC mode 1

*1 The software setting is used when the node address setting switches are set to 0.

*2 The range depends on the EtherCAT master that is used. Refer to "6-3-2 Node Address Setting Switches" in page 6 - 6.

6-2 General Specifications

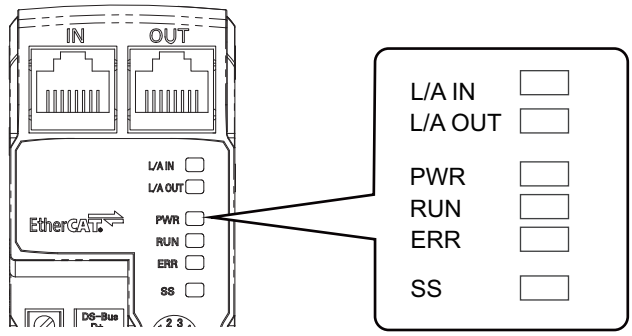
Item	Specification
Unit power supply voltage	24 VDC (20.4 to 26.4 VDC)
Power and current consumption	2.4 W max. (Does not include power supplied to measuring units.), 100 mA max. at 24 VDC (Does not include current supplied to measuring units.)
Noise immunity	Conforms to IEC 61000-4-4, 1 kV (power line).
Vibration resistance (destruction)	10 to 60 Hz with a 0.7 mm double amplitude, 50 m/s^2 at 60 to 150 Hz, for 1.5 hours each in X, Y, and Z directions
Shock resistance (destruction)	150 m/s^2 for 3 times each in X, Y, and Z directions
Dielectric strength	500 VAC at 50/60 Hz for 1 min
Insulation resistance	20 MΩ or more (at 500 VDC)
Ambient operating temperature	0 to 55 °C*1
Ambient operating humidity	25% to 85% (with no condensation or icing)
Ambient operating atmosphere	No corrosive gases
Storage temperature	–30 to 70 °C (with no condensation or icing)
Storage humidity	25% to 85% (with no condensation or icing)
Installation method	35 mm DIN rail mounting

* The temperature is limited by the number of Counter modules that are connected.
For 1 to 2 Counter modules: 0 to 55°C; 3 to 10 Counter modules: 0 to 50°C; 11 to 16 Counter modules: 0 to 45°C; 17 to 30 Counter modules: 0 to 40°C.

6-3 Hardware Specifications

6-3-1 Status Indicators

It indicates the current state of an EtherCAT slave 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 unit.

[L/A IN] indicator

Indicates the communication state (input side).

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

[L/A OUT] indicator

Indicates the communication state (output side).

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

[RUN] indicator

It 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 "5-3 Communications State Transitions" in page 5 - 4.

[ERR] indicator

It indicates the information of an error.

Color	State	Contents
Red	OFF	No error
	Blinking	Communications setting error
	Single flash	Synchronization error or communications data error
	Flickering	Boot error
	ON	PDI WDT timeout

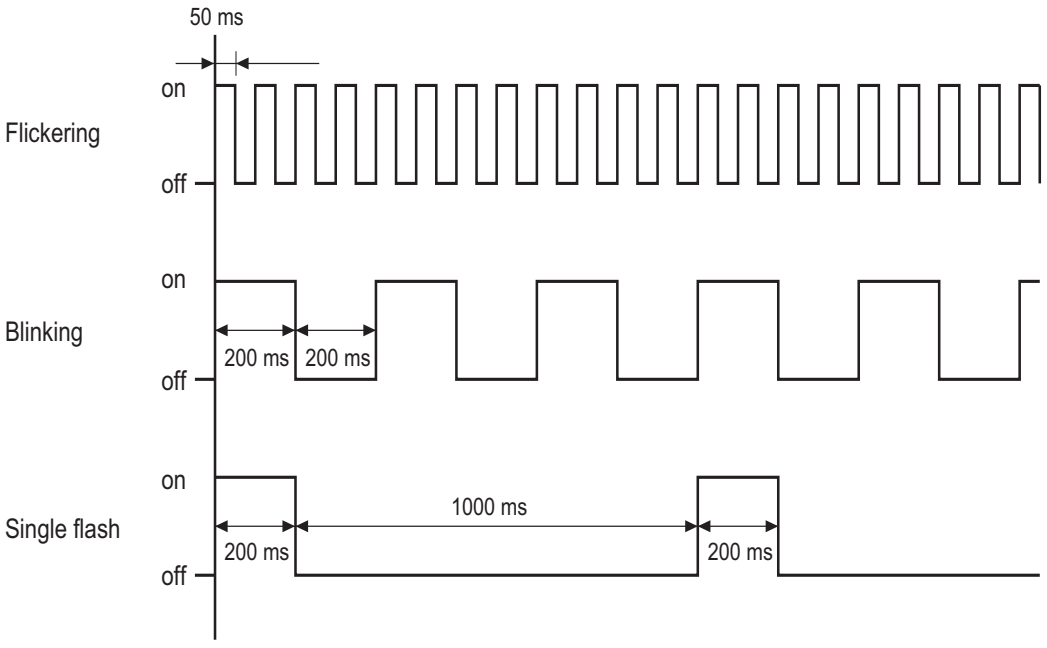
[SS] indicator

It indicates the information of an measuring unit status.

Color	State	Contents
	OFF	Power OFF or Initial status of measuring unit connection
Green	ON	Normal
Red	ON	Measuring unit Error: Number of connecting measuring units is different form setting.

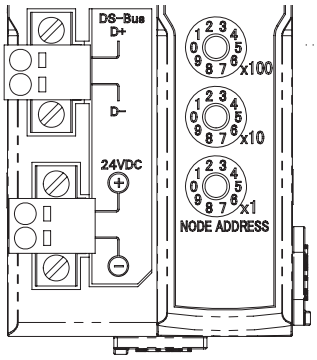
Reference

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



6-3-2 Node Address Setting Switches

These switches are used to set node addresses of slave units in the EtherCAT network (decimal).
Set the node address switches as follows: Top switch for the 100s digit, middle switch for the 10s digit, and the bottom switch for the 1s digit.
Setting range is 000 to 997. (Default setting: 000)



Setting the node address (×100)

Setting the node address (×10)

Setting the node address (×1)

Node address switch setting	Set value for node address
	EtherCAT master unit
000	Setting with the Configuration Tool
001 to 997	(The switch setting has no effect.)

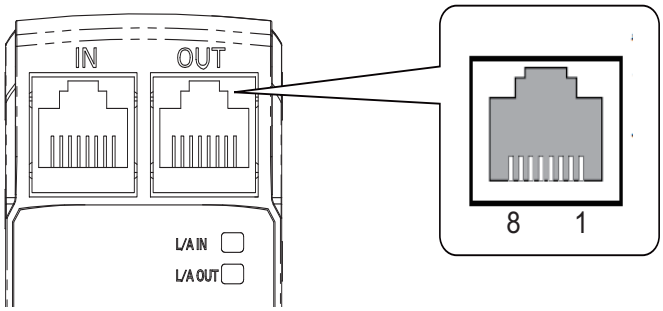
(Notes) The system will not operate correctly if the node address switches are set to 998 or 999.

Precautions for Correct Use

- The setting on the node address switches is read only once when the power 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.

6-3-3 Communications Connectors

The Connectors are used to connect the communications cables.



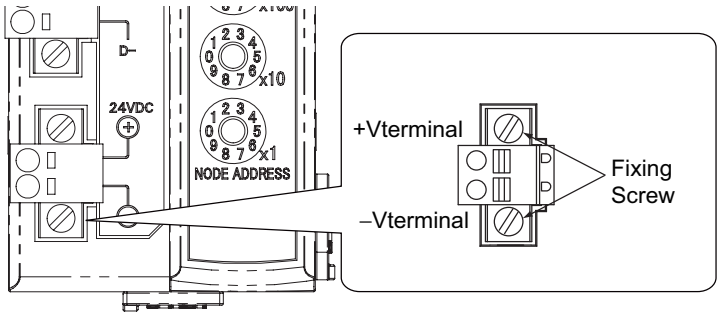
The specifications are shown below.

- Electrical characteristics: Conforms to the IEEE 802.3u 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

6-3-4 Unit Power Supply Connector

The Connector is used to connect the unit power supply (24 VDC).



Name	Specification
+V	24 VDC
–V	0 VDC

- Connector type: Spring connection connector with fixing screw (2-pin)
- Supported pin terminal diameter: 0.25 mm^2 to 0.5 mm^2/AWG24 to AWG20
  (Pin terminal with isolation sleeve used)

For types of recommended pin terminals, refer to "4-3-3 Connecting the Unit Power Supply" in page 4 - 10.

7

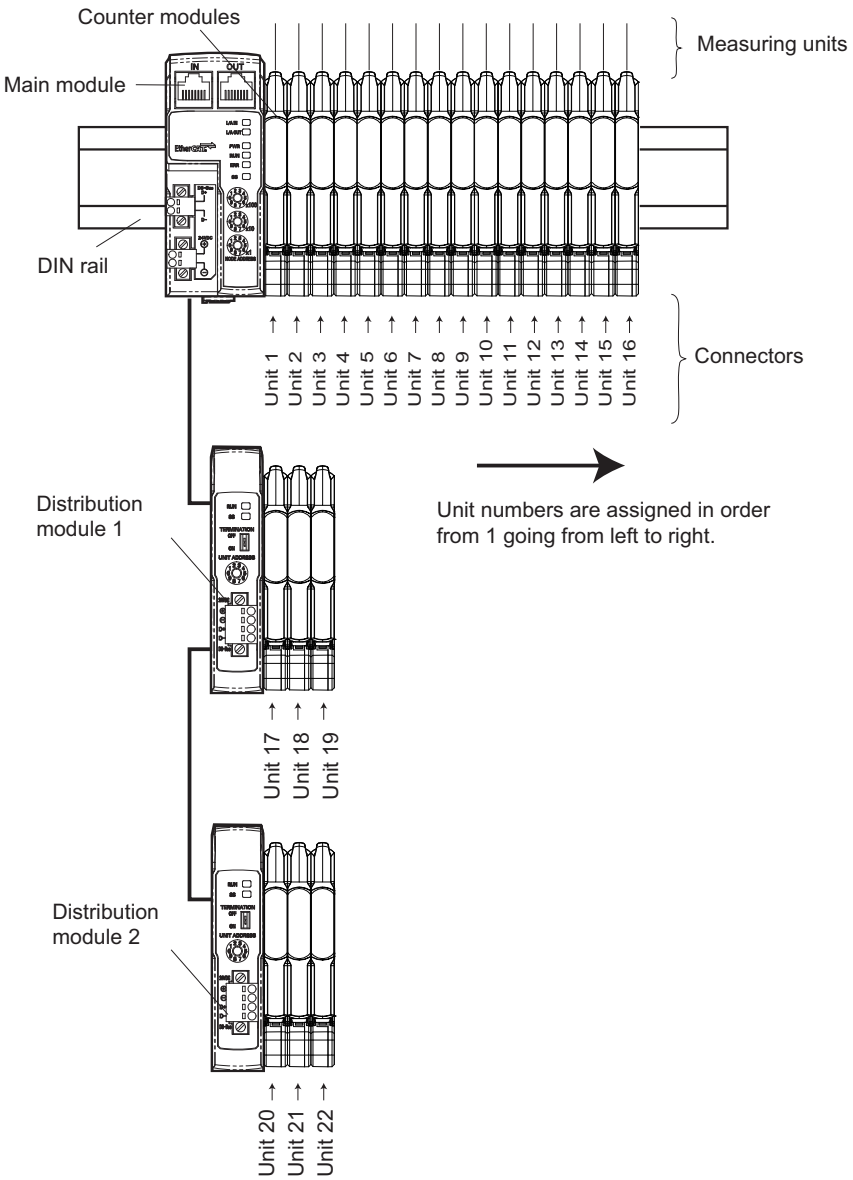
MG50-EC Function Specifications

7-1 I/O Data Allocation (PDO Mapping)

I/O data of Digital I/O slave units are allocated to the input/output areas of the I/O memory of the EtherCAT master unit, respectively. For the detailed explanation of allocation method, refer to the manual of EtherCAT master unit to be connected.

7-1-1 Input Data Allocation

Measuring unit Numbers



The Main module identifies each connected Counter module by its unit number. The unit numbers for the measuring units are numbered in order starting from 1. Each Counter module that is assigned a unit number has an input 1 (measuring unit output 1) and input 2 (measuring unit output 2). The unit numbers of the Counter modules that are connected to a Distribution module are numbered sequentially, in the order shown below, following the unit numbers of the Counter modules that are connected to the Main module.

Main module -> Distribution module 1 -> Distribution module 2 -> ... -> Distribution module 8

You can connect a maximum of 30 Counter modules. (Refer to 2-2-2 Number of Connected Counter modules.)

You can connect a maximum of eight Distribution modules to the MG50-EC.

Input data allocation example

The following table lists the items that you can assign to the MG50-EC.
You can assign a maximum of 350 bytes of PDOs. (Refer to "7-2-3 Mode Setting Functions for PDO Communications" in Page 7 - 5.) Refer to *"A-1-5 PDO Mapping Object" in Page A - 7* for detailed object specifications.
Refer to the specific manual for your master for information on changing the PDO mappings.

Index	Transmit PDO mapping	Name	Size	Applicable Counter modules
				MF10-CM
1B00 hex	257th	Read input 1st Word (Bits 00 to 15)	U16	Yes
1B01 hex	258th	Read input 2nd Word (Bits 16 to 31)	U16	Yes
1B02 hex	259th	Read input 3rd Word (Bits 32 to 47)	U16	Yes
1B03 hex	260th	Read input 4th Word (Bits 48 to 59)	U16	Yes
1B04 hex	261st	Read input bits (Bits 00 to 15)	U16	Yes
1B05 hex	262nd	Read input bits (Bits 16 to 31)	U16	Yes
1B06 hex	263rd	Read input bits (Bits 32 to 47)	U16	Yes
1B07 hex	264th	Read input bits (Bits 48 to 59)	U16	Yes
1B08 hex	265th	Measuring unit Communications Status	U8	Yes
1B09 hex	266th	8-bit measuring unit Communications Status	U8	Yes
1B0A hex	267th	Number of measuring units Setting Number of measuring units with Dummy	U16	Yes
1B0B hex	268th	Measuring unit Warning Status	U32	Yes
1B0D hex	270th	Measuring unit Warning Status 1 to 16	U16	Yes
1B4C hex 1B4D hex 1B4E hex . . . 1BA5 hex	333rd 334th 335th . . . 422nd	Unit 01 Threshold 1 Settings of Input 1 Unit 01 Threshold 2 Settings of Input 1 Unit 01 Threshold 1 Settings of Input 2 . . . Unit 30 Threshold 1 Settings of Input 2	INT32	Yes
1BA6 hex 1BA7 hex . . . 1BC3 hex	423rd 424th . . . 452nd	Unit 01 Detection Values (4 bytes) Unit 02 Detection Values (4 bytes) . . . Unit 30 Detection Values (4 bytes)	INT32	Yes

7-2 Functions of MG50-EC

Digital I/O slave units have the following convenient functions, in addition to the I/O signal processing.

7-2-1 Input Filter

Overview of functions

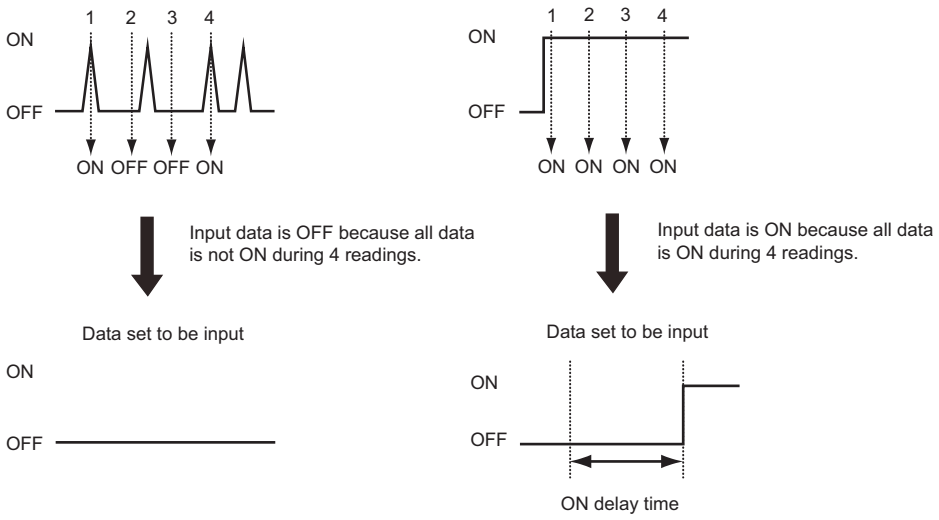
- **Purpose**

  This function prevents data changes and unstable data, which may be caused by fluctuation of input data and unstable contact state due to chattering and noise. This function is available in Free Run Mode.

- **Details of functions**

  This function reads inputs (ON/OFF) within a certain set time and turn ON the inputs if they are all same (all ON or all OFF), and turn them OFF if not.
  Note that this function works for all inputs of slave units at the same time.

  When the input shifts from OFF to ON (or ON to OFF), it is read 4 times from that point at an interval of 1/4 of the set time. When all read results are ON (or OFF), the input is turned ON (or OFF).



Setting method

The input filter is set through SDO communications.
The applicable index is 3002 hex.
Refer to the applicable index (Input Filter in Free-Run Mode) in "A-1 Object Dictionary" in Page A - 2 for the set values.

7-2-2 Dummy Setting

Overview of functions

- **Purpose**
  This function provides keeping I/O map, when number of measuring unit change by customer option, sensing point degrees and so on.

- **Details of functions**
  MG50-EC can be set dummy, so I/O map keep by using dummy measuring unit setting.

Setting method

The settings are made using the SDO communication.
The target index is 3004 hex.
For the set values, refer to the information in the corresponding index of "Appendix A-1 Object Dictionary" in A-1-7.

7-2-3 Mode Setting Functions for PDO Communications

Outline of Operation

- **Application**
  There are two modes for data refreshing with PDO communications. Select the mode based on the number of input data to assign for PDO communications and the refresh cycle.*
  * In this section, the refresh cycle applies to data in the Main module. This is not the refresh cycle for data between the Main module and the master.

  • Normal Mode
  In Normal Mode, the assigned inputs may not be refreshed every cycle, but you can assign a large amount of input data.
  • Detection Value Speed Priority Mode
  With this mode, you can assign less input data than with Normal Mode, but the assigned data, such as the detection values, are refreshed every cycle.

  In either mode, I/O data are refreshed every cycle.

● Details of Functions

- Normal Mode
  This mode allows you to assign up to 350 bytes of input data.
  The assigned input data (except for I/O data) are divided and refreshed in order across more than one cycle.
- Detection Value Speed Priority Mode
  This mode allows you to assign up to 108 bytes of input data.
  All assigned input data are refreshed every cycle.
  The refresh cycle depends on the number of measuring units, amount of assigned data, and whether input filters and Dummy are used.

The refresh cycle for data in the Main module for each mode is given in the following table.

- Free-Run Mode

Mode	Normal Mode	Detection Value Speed Priority Mode			
Number of measuring units	30 max.	16 max.	30 max.	30 max.	30 max.
Assigned data size [bytes]	350	16 max.	36 max.	37 to 76	77 to 108
Input filter	With or without	None	With or without	With or without	With or without
Dummy	With or without	None	With or without	With or without	With or without
Refresh cycle [μs]	200	100	125	150	175

- DC Mode
  The refresh cycle is the same as the output cycle of the Sync0 signal.

Setting Methods

The PDO communications mode is set through SDO communications.
The applicable index is 300C hex.
Refer to the applicable index in "A-1 Object Dictionary" in Page A - 2 for the set values.

7-2-4 Automatic Detection of Connected Counter Modules

Outline of Operation

- **Application**

  The Main module and the Distribution module have a feature that automatically registers the number of connected Counter modules. It is not necessary to register the number of Counter modules with the Configuration tool or through SDO communications in advance. (You can also manually register the number of Counter modules with the Configuration tool or through SDO communications.)

- **Details of Functions**

  The Main module and Distribution module detect the number of Counter modules that are connected to them when the power supply is turned ON. This number is registered as the number of Counter modules. It does not matter whether you turn ON the power supply to the Main module or to the Distribution modules first.

  If the number of Counter modules that are connected to the Main module and Distribution modules changes after the power supply is turned ON (i.e., if the registered number disagrees with the connected number), an error occurs. Refer to Chapter 8 Troubleshooting and Maintenance for details.

Precautions for Correct Use

If you need to add Counter modules to the Main module or to a Distribution module after the system begins operation, make sure to turn OFF the power supply to the Main module and all Distribution modules.

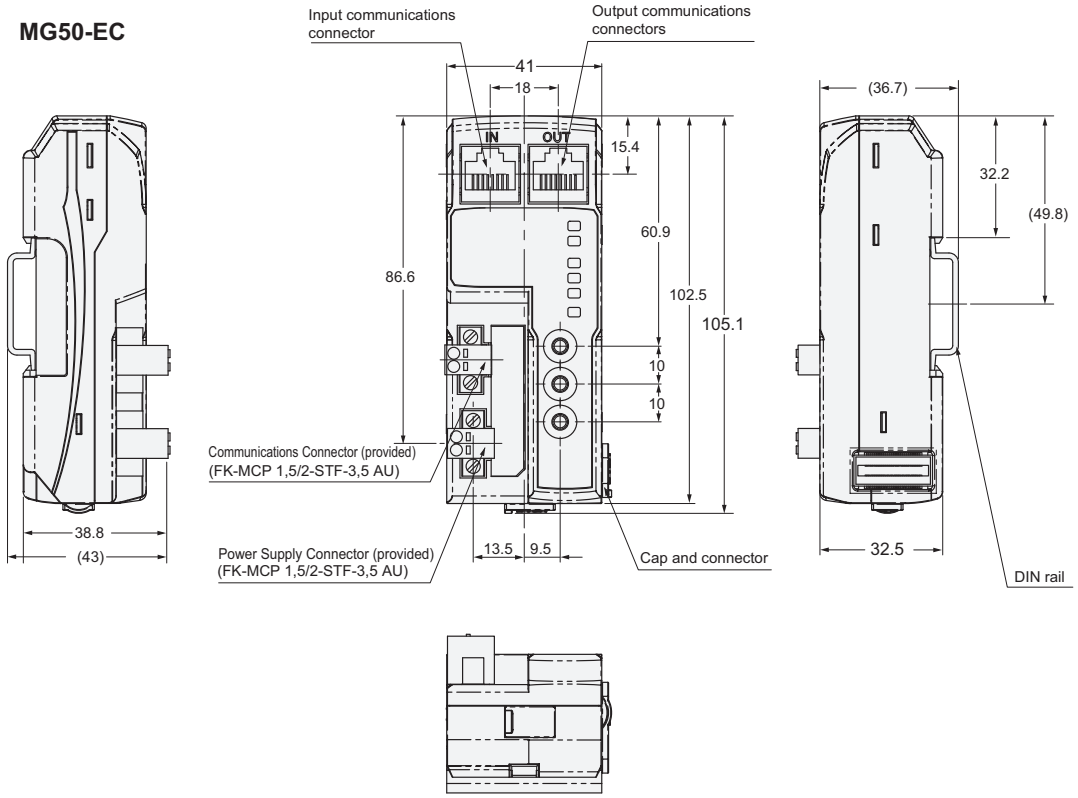
Setting Methods

To manually register the number of Counter modules, use SDO communications.
The applicable index is 3001 hex.
Refer to the applicable index in *Appendix A-1 Object Dictionary* for the set values.

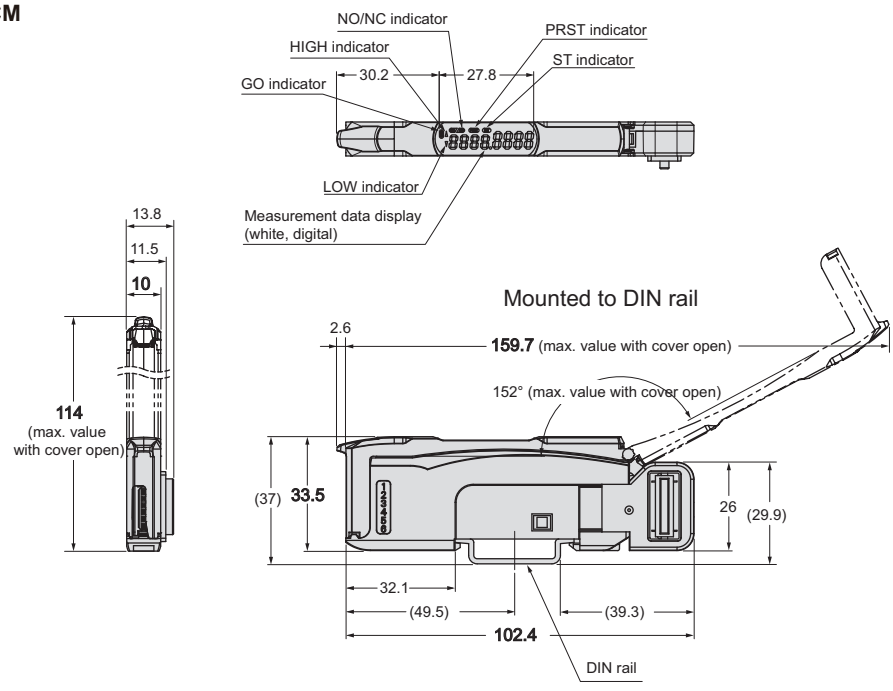
7-3 Mounting Dimensions

The mounting dimensions are shown below.

MG50-EC



MF10-CM



8

Troubleshooting and Maintenance

8-1 Troubleshooting

8-1-1 Errors that Can be Checked with Status Indicator and Actions to Take

Errors can be notified by status indicators on slave units.

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)
–	Unknown

For details on definition of each state, refer to "6-3-1 Status Indicators" in page 6 - 4.

● Errors of slave unit

[PWR] indicator	[L/A IN] [L/A OUT] LED	[RUN] indicator	[ERR] indicator	Description	Cause	Actions
On	F	On	Off	EtherCAT communication is in progress.	–	PDO communications or both PDO and SDO communications are being executed. State is normal.
Off	Off	Off	Off	Power supply error	The power is not properly supplied to the slave unit.	After removing the following factors of power supply shutdown, restart the slave unit according to the specification of connected EtherCAT master unit. • Are the power supply cables wired correctly? • Are the power supply cables disconnected? • Is the power supply voltage within the specification range? • Is the power supply capacity sufficient? • Is the power supply malfunctioning?

[PWR] indicator	[L/A IN] [L/A OUT] LED	[RUN] indicator	[ERR] indicator	Description	Cause	Actions
On	–	Off	On F	Hardware error	A hardware failure occurred.	If the error does not clear even after the power is turned ON again, the slave unit hardware is damaged. Replace the slave unit.
On	–	–	B	Illegal switch setting	A range setting switch or other switch setting is illegal.	Check the switch settings then restart the slave unit according to the specification of connected EtherCAT master unit.
				Non-volatile memory data error	A non-volatile memory data error occurred.	Use the configuration tool or SDO communications to restore the default data and restart the slave unit 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 unit hardware may be damaged. Replace the applicable slave unit.

● Errors of EtherCAT Network

[PWR] indicator	[L/A IN] [L/A OUT] LED	[RUN] indicator	[ERR] indicator	Description	Cause	Actions
On	On	–	–	Link established in physical layer	Operation standby status after establishing link in physical layer.	–
On	Off	–	–	Link not established in physical layer	A link in physical layer has not been established.	After checking the following items, restart the slave unit according to the specification of connected EtherCAT master unit. • Is the communications cable wired correctly? • Are any cables disconnected or loose in the part that connects to the connector? • Is the cable length appropriate? • Is the communications cable of the recommended specification?
					The host master has not been started.	Check that EtherCAT master unit is operating correctly.
					A hardware failure occurred.	If the problem is not resolved even after the measures described above are taken, the slave unit hardware may be damaged. Replace the applicable slave unit.
On	–	SF	–	Safe-Operational state	It is commanded from the EtherCAT master unit to shift to the Safe-Operational state.	If the trouble occurred during operating the system, check the state of the connected EtherCAT master unit.
On	–	B	–	Pre-Operational state	It is commanded from the EtherCAT master unit to shift to the Pre-Operational state.	
On	–	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 slave units that only handle input data.

● Synchronization Errors

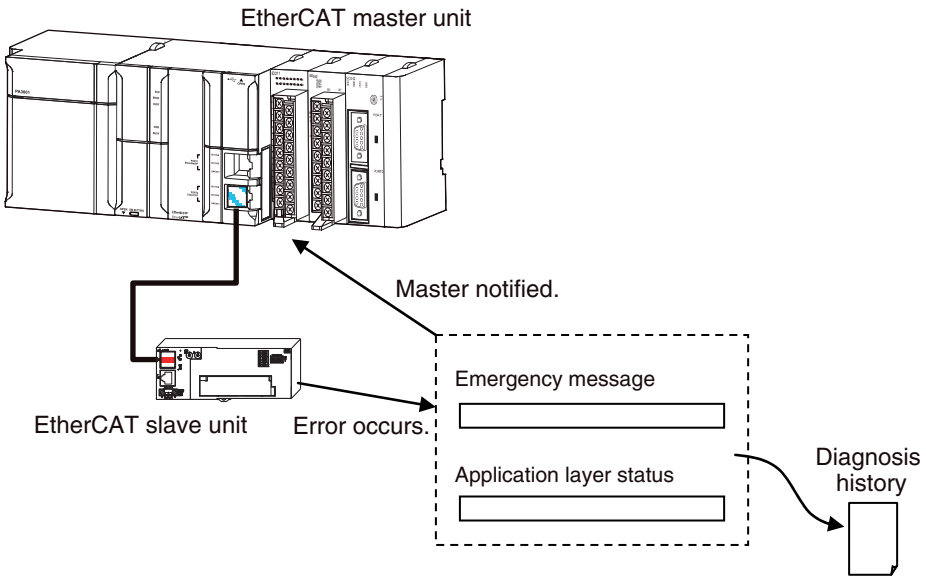
[PWR] indicator	[L/A IN] [L/A OUT] LED	[RUN] indicator	[ERR] indicator	Description	Actions
On	–	B	B	Synchronization frequency (Sync0 frequency) setting error	After checking the following items, restart the slave unit according to the specification of connected EtherCAT master unit. • Set the correct synchronization frequency.
On	–	B	SF	Synchronization error (at synchronization start)	After checking the following items, restart the slave unit according to the specification of connected EtherCAT master unit. • Is the communications cable wired correctly? • Is the communications cable exposed to excessive noise? • Review set time of Sync Not Received Timeout Setting (synchronization error setting).
On	–	SF	SF	Communications synchronization error	After checking the following items, restart the slave unit according to the specification of connected EtherCAT master unit. • Is the communications cable wired correctly? • Is the communications cable exposed to excessive noise? • Review set time of Communication Error Setting .
On	–	SF	SF	Synchronization error (in operation)	After checking the following items, restart the slave unit according to the specification of connected EtherCAT master unit. • Is the communications cable wired correctly? • Is the communications cable exposed to excessive noise? If this does not improve, the slave unit hardware may be damaged. Replace the applicable slave unit.

8-1-2 Errors Unique to MG50-EC

Symptom	Cause	Measures
Some functions are not reflected even after parameters have been set.	The functions enabled by recycling the power were changed.	Turn ON slave unit power supply again after changing the setting.
The Counter module is turned ON but there is no input.	There is a communications error.	Check for communications errors.
	The SS indicator is lit red.	See below.
SS LED lights red	Number of measuring units setting is different from Number of connecting measuring units	Set correct number of measuring units setting
		When use dummy setting, Set number of measuring units setting as include dummy.
		Counter module connecting is wrong, Check the connecting of MG50-EC and Counter modules.
		If this does not improve, the Counter module hardware may be damaged. Replace the applicable Counter module.
		There is an error in the connections to the Distribution module. Check the installation procedure for the Distribution module.

8-1-3 Error Notification Methods and Types

This section describes the notification methods for errors that occur in the slave units.



Error notification type	Description	Notification method	Page
Emergency messages	Notification is provided of application-level errors. Either CiA-defined error codes are used or error codes are added to vendor-specific areas.	The slave notifies the master when an error occurs.	8-8
Application layer status	Notification is provided of errors in EtherCAT communications. The error notification method and error codes that are defined by ETG are used.	The master is notified by writing to the application layer status register when an error occurs.	8-9

8-1-4 Emergency Error Code

The table below shows types of emergency error codes used in MG50-EC EtherCAT Main modules and corresponding error contents.

Error codes common to MG50-EC EtherCAT Main modules

Error code	Name of error	Contents	Diagnosis history	Notification to EtherCAT master unit	Measures
5530 hex	Non-volatile Memory Hardware Error	A timeout was detected when writing data to non-volatile memory during EtherCAT communications.	Not saved	Can be notified	Write the data again.
6140 hex	Slave unit Verification Error	At turning ON the power supply, a verification error occurred on the slave unit information stored in the slave unit.	Saved	Cannot be notified	If the error occurs even after restarting the power supply, the slave unit is damaged. Replace the slave unit.
6330 hex	Non-volatile Memory Checksum Error	An error occurred in non-volatile memory data in the slave unit.	Saved	Can be notified	A non-volatile memory data error occurred. Initialize non-volatile memory from a Configuration Tool or with SDO communications, and then restart the slave unit. (Target indexes: 1011 hex Restore default parameters (parameter restore))
7030 hex	Slave Hardware Error	A hardware error occurred in the EtherCAT communications area.	Saved	Cannot be notified	If the error occurs even after restarting the power supply, the slave units is damaged. Replace the slave units.

8-1-5 Application Layer Status Codes

The AL status codes that are used by the MG50-EC EtherCAT Main modules are described in the following table.

AL status codes of MG50-EC EtherCAT Main modules

AL status code	Name of error	Contents	Diagnosis history	Notification to EtherCAT master unit	Measures
0001 hex	Non-volatile Memory Control Data Error	An error was detected in non-volatile memory data in the slave unit.	Saved	Can be notified	Initialize non-volatile memory (execute restore parameter), and then restart the slave unit.
0011 hex	Illegal State Transition Request Received	An illegal state transition request was received.	Not saved	Can be notified	None
0012 hex	Error State Transition Received	A transition request to an unknown state was received.	Not saved	Can be notified	None
0014 hex	Slave unit Verification Error	A verification error occurred in the slave information stored in the slave units when the power supply was turned ON.	Saved	Can be notified	If cycling the power supply does not solve the problem, the slave unit has failed. Replace the slave unit.
0016 hex	Mailbox Setting Error	An incorrect setting was detected in the mailbox of the Sync Manager.	Not saved	Can be notified	Check the mailbox settings in the master unit.
001B hex	Process Data WDT Error	A timeout was detected for an I/O data transmission frame.	Not saved	Can be notified	Check the WDT settings in the master unit.
001D hex	RxPDO Setting Error	An error was detected in the RxPDO settings (e.g., a logic setting error in the Sync Manager).	Not saved	Can be notified	Check the Sync Manager settings in the master unit.
001E hex	TxPDO Setting Error	An error was detected in the TxPDO settings (e.g., a logic setting error in the Sync Manager).	Not saved	Can be notified	Check the Sync Manager settings in the master unit.
001F hex	PDO WDT Setting Error	An incorrect PDO WDT setting was detected.	Not saved	Can be notified	Check the WDT settings in the master unit.
0024 hex	TxPDO Assignment Error	An incorrect TxPDO setting was made (e.g., an index, subindex, or size that is out of range was registered).	Not saved	Can be notified	Check the TxPDO assignment settings in the master unit.
0025 hex	RxPDO Assignment Error	An incorrect RxPDO setting was made (e.g., an index, subindex, or size that is out of range was registered).	Not saved	Can be notified	Check the RxPDO assignment settings in the master unit.
002C hex	Synchronization Error	The SYNC0 interrupt stopped during operation in operational state.	Not saved	Can be notified	Check the synchronization settings.

AL status code	Name of error	Contents	Diagnosis history	Notification to EtherCAT master unit	Measures
002D hex	SYNC Signal Not Received	No SYNC0 signals have been received since entering DC mode.	Not saved	Can be notified	Check the synchronization settings.

8-2 Equipment Maintenance

This section describes routine equipment maintenance, in particular cleaning methods, inspection methods, and handling methods when replacing slave units.

8-2-1 Cleaning

Perform the following cleaning regularly to ensure the equipment is kept in the best condition possible.

- Wipe the equipment over with a soft, dry cloth when doing daily cleaning.
- If dirt remains even after wiping with a soft, dry cloth, wipe over with a cloth that has been wet with a sufficiently diluted detergent (2%) and wrung dry.
- Units will become stained if items such as rubber or vinyl products or adhesive tape are left on the unit for a long period. Remove such items during regular cleaning.

Precautions for Correct Use

Never use benzene, thinners, or other volatile solvents, or chemical cloths.
The unit coating may change if these products are used.

8-2-2 Inspections

Always perform periodic inspections to ensure the equipment is kept in the best possible condition.
Periodic inspections should occur every 6 months to a year.
Periodic inspections should occur more frequently, however, for units that are used in environments subject to high temperatures, high humidity, or a lot of dust.

Inspection item

Periodically inspect the following items to ensure that they do not deviate from the criteria.
If the items deviate from the criteria, adjust the environment so the criteria are met or adjust the unit itself.

Inspection item	Inspection details	Criteria	Inspection method
Environment	Are the ambient and in-panel temperatures appropriate?	0 to 55°C	Thermometer
	Is the ambient and in-panel humidity appropriate?	25% to 85% (with no condensation or icing)	Hygrometer
	Has dust collected?	No dust	Visual inspection
Installation	Has the slave unit been secured?	No looseness	Phillips screwdriver
	Are the communications cable connectors inserted properly?	No looseness	Visual inspection
	Are the external wiring screws loose?	No looseness	Phillips screwdriver
	Are the connection cables damaged?	No visible damage	Visual inspection

8-2-3 Handling when Replacing Units

Networks are constructed from an EtherCAT master unit and slave units.
If a unit is malfunctioning, the entire network will be affected. The malfunctioning unit must be replaced quickly.
To restore network functions as quickly as possible, it is recommended that spare units are kept on hand ready to replace malfunctioning units immediately.

Precautions when Replacing Units

Be aware of the following points when replacing a malfunctioning Main module.

- After replacement, check to confirm that there are no problems with the new unit.
- If you are returning a defective unit for repair, be sure to write down any details of the problem and send the information along with the defective unit to your nearest Magnescale representative.
- For poor contacts, wipe down the contacts with a clean 100% cotton cloth soaked in industrial alcohol.

Settings after Unit replacement

After replacing a unit, make the switch and other settings the same as before the unit was replaced.

A

Appendices

A-1 Object Dictionary

A-1-1 Object Dictionary Area

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

Indexes	Area	Contents
0000 hex-0FFF hex	Data Type area	Definitions of data types
1000 hex-1FFF hex	CoE Communications area	Definitions of variables that can be used by all servers for designated communications
2000 hex-2FFF hex	Manufacturer Specific area 1	—
3000 hex-5FFF hex	Manufacturer Specific area 2	Variables defined for MG50-EC EtherCAT Main modules
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-FFFF hex	Reserved area	Area reserved for future use

A-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
Unsigned64	U64	8 bytes	0 to 18446744073709551615
Integer8	INT8	1 byte	–128 to 127
Integer16	INT16	2 bytes	–32768 to 32767
Integer32	INT32	4 bytes	–2147483648 to 2147483647
Visible string	VS	---	---

A-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
  B: Not available
  C: Timing of pre-operational state → safe-operational state
  D: Timing of pre-operational state → init 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

A-1-4 Communication Objects

1000 hex	Device Type		
Range: –	Unit: –	Default: 00010191 hex	Attribute: –
Size: 4 bytes (U32)	Access: RO	PDO map: Not possible	

- Indicates the CoE device profile number.

1001 hex	Error Register		
Range: –	Unit: –	Default: 00 hex	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	

- Indicates the error type that occurs in a slave unit.

Bits	Name	Bits	Name
0	Generic error	4	Communications error
1	Current error	5	Device profile specific error
2	Voltage error	6	(Reserved)
3	Temperature error	7	Manufacturer specific error

1008 hex	Manufacturer Device Name		
Range: –	Unit: –	Default: Differ by slave unit types*	Attribute: –
Size: 20 bytes (VS)	Access: RO	PDO map: Not possible	

- Indicates the slave unit model number. “MG50-EC ” (padded with 12 spaces)

1009 hex	Manufacturer Hardware Version		
Range: –	Unit: –	Default: Differ by slave unit types*	Attribute: –
Size: 20 bytes (VS)	Access: RO	PDO map: Not possible	

- Indicates the version of the slave unit hardware.

100A hex	Manufacturer Software Version		
Range: –	Unit: –	Default: Differ by slave unit types*	Attribute: –
Size: 20 bytes (VS)	Access: RO	PDO map: Not possible	

- Indicates the version of the slave unit software.

1011 hex	Restore Default Parameters		
Sub-index 0: Number of entries			
Range: –	Unit: –	Default: 01 hex	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 1: Restore Default Parameters			
Range: –	Unit: –	Default: 00000001 hex	Attribute: A
Size: 4 bytes (U32)	Access: RW	PDO map: Not possible	

- Resets the parameters to their default values.
- The parameter is reset only when a specific value is written to Sub-index 1. This prevents parameter values from being accidentally overwritten.
- The specific value is "load".

MSB			LSB
d	a	o	l
64 hex	61 hex	6F hex	6C hex

- The ABORT code is displayed if a value other than the specific is written.
- A value 00000001 hex (command valid) is indicated when reading.

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: 000000F9 hex	Attribute: –
Size: 4 bytes (U32)	Access: RO	PDO map: Not possible	
Sub-index 3: Revision Number			
Range: –	Unit: –	Default: Differ by slave unit types*	Attribute: –
Size: 4 bytes (U32)	Access: RO	PDO map: Not possible	
Sub-index 4: Serial Number			
Range: –	Unit: –	Default: Differ by slave unit types	Attribute: –
Size: 4 bytes (U32)	Access: RO	PDO map: Not possible	

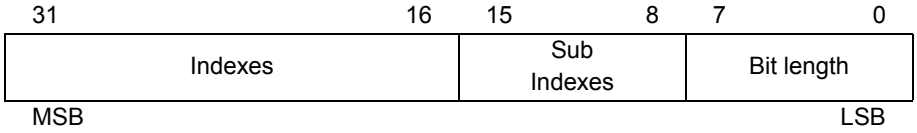
- Indicates the device information.
- Sub-index 1(Vendor ID) gives the manufacturer identifier.
- Sub-index 2 (Product Code) gives the value assigned to each slave unit type.
- Sub-index 3 (Revision Number) gives the Unit revision number.
  Bits 0 to 15: Minor revision number of the device
  Bits 16 to 31: Major revision number of the device

10F3 hex	Diagnosis History		
Sub-index 0: Number of entries			
Range: –	Unit: –	Default: 0D hex	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 1: Maximum Messages			
Range: –	Unit: –	Default: 00 hex	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 2: Newest Message			
Range: –	Unit: –	Default: –	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 5: Flags			
Range: 0000 hex- 0001 hex	Unit: –	Default: 0000 hex	Attribute: –
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	
Sub-index 6 to 13: Diagnosis Message 1-8			
Range: –	Unit: –	Default: –	Attribute: –
Size: 23 bytes (VS)	Access: RO	PDO map: Not possible	

- This object indicates up to 8 diagnosis histories. It also sets whether to notify emergency messages or not.
- Sub-index 1 (Maximum Messages) gives the number of error messages.
- Sub-index 2 (Newest Messages) gives the Sub-index number the latest message in the diagnosis history.
- Sub-index 5 (Flags) is the control flag of diagnosis history. It specifies whether or not to notify error messages via emergency messages. Setting 0001 hex means to notify. It is set to 0001 hex (Emergency notify) when power is turned ON. At startup, the setting is 0000 hex (no emergency notification).
- Sub-indexes 6 to 13 (Diagnosis messages 1 to 8) indicate the diagnosis history.
  From Sub-index 6 (Diagnosis message 1) to Sub-index 13 (Diagnosis message 8) are stored 8 errors. The 9th error and onward are stored from the Sub-index 6 (Diagnosis message 1) again.

A-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.

1B00 hex	257th transmit PDO Mapping		
Sub-index0: Number of objects			
Range: -	Unit: -	Default: 01 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO Map: Not possible	
Sub-index1: 1st Input Object to be mapped			
Range: -	Unit: -	Default: 61000110 hex	Attribute: -
Size: 4byte(U32)	Access: RO	PDO Map: Possible	

1B01 hex	258th transmit PDO Mapping		
Sub-index0: Number of objects			
Range: -	Unit: -	Default: 01 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO Map: Not possible	
Sub-index1: 1st Input Object to be mapped			
Range: -	Unit: -	Default: 61000210 hex	Attribute: -
Size: 4byte(U32)	Access: RO	PDO Map: Possible	

1B02 hex	259th transmit PDO Mapping		
Sub-index0: Number of objects			
Range: -	Unit: -	Default: 01 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO Map: Not possible	
Sub-index1: 1st Input Object to be mapped			
Range: -	Unit: -	Default: 61000310 hex	Attribute: -
Size: 4byte(U32)	Access: RO	PDO Map: Possible	

1B03 hex	260th transmit PDO Mapping		
Sub-index0: Number of objects			
Range: -	Unit: -	Default: 01 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO Map: Not possible	
Sub-index1: 1st Input Object to be mapped			
Range: -	Unit: -	Default: 61000410 hex	Attribute: -
Size: 4byte(U32)	Access: RO	PDO Map: Possible	

1B04 hex	261st transmit PDO Mapping		
Sub-index0: Number of objects			
Range: -	Unit: -	Default: 10 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO Map: Not possible	
Sub-index1 to 16: 1st to 16th Input Object to be mapped			
Range: -	Unit: -	Default: 30200101 hex 30200201 hex 30200301 hex --- 30200F01 hex 30201001 hex	Attribute: -
Size: 4byte(U32)	Access: RO	PDO Map: Possible	

1B05 hex	262nd transmit PDO Mapping		
Sub-index0: Number of objects			
Range: -	Unit: -	Default: 10 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO Map: Not possible	
Sub-index1 to 16: 1st to 16th Input Object to be mapped			
Range: -	Unit: -	Default: 30201101 hex 30201201 hex 30201301 hex --- 30201F01 hex 30202001 hex	Attribute: -
Size: 4byte(U32)	Access: RO	PDO Map: Possible	

1B06 hex	263rd transmit PDO Mapping		
Sub-index0: Number of objects			
Range: -	Unit: -	Default: 10 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO Map: Not possible	
Sub-index1 to 16: 1st to 16th Input Object to be mapped			
Range: -	Unit: -	Default: 30202101 hex 30202201 hex 30202301 hex --- 30202F01 hex 30203001 hex	Attribute: -
Size: 4 bytes (U32)	Access: RO	PDO map: Possible	

1B07 hex	264th transmit PDO Mapping		
Sub-index0: Number of objects			
Range: -	Unit: -	Default: 10 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO Map: Possible	
Sub-index1 to 16: 1st to 16th Input Object to be mapped			
Range: -	Unit: -	Default: 30203101 hex 30203201 hex 30203301 hex --- 30203F01 hex 30204001 hex	Attribute: -
Size: 4 bytes (U32)	Access: RO	PDO map: Possible	

1B08 hex	265th transmit PDO Mapping		
Sub-index0: Number of objects			
Range: -	Unit: -	Default: 01 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO Map: Not possible	
Sub-index1: 1st Input Object to be mapped			
Range: -	Unit: -	Default: 300A0108 hex	Attribute: -
Size: 4byte(U32)	Access: RO	PDO Map: Possible	

1B09 hex	266th transmit PDO Mapping		
Sub-index0: Number of objects			
Range: -	Unit: -	Default: 02 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO Map: Not possible	
Sub-index1: 1st Input Object to be mapped			
Range: -	Unit: -	Default: 30000101 hex	Attribute: -
Size: 4byte(U32)	Access: RO	PDO Map: Possible	
Sub-index2: 2nd Input Object to be mapped			
Range: -	Unit: -	Default: 30000201 hex	Attribute: -
Size: 4byte(U32)	Access: RO	PDO Map: Possible	

1B0A hex	267th transmit PDO Mapping		
Sub-index0: Number of objects			
Range: -	Unit: -	Default: 02 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO Map: Not possible	
Sub-index1: 1st Input Object to be mapped			
Range: -	Unit: -	Default: 30010108 hex	Attribute: -
Size: 4byte(U32)	Access: RO	PDO Map: Possible	
Sub-index2: 2nd Input Object to be mapped			
Range: -	Unit: -	Default: 30010208 hex	Attribute: -
Size: 4byte(U32)	Access: RO	PDO Map: Possible	

1B0B hex	268th Transmit PDO Mapping		
Subindex 0: Number of Objects			
Range: -	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: 1st Input Object to Be Mapped			
Range: -	Unit: ---	Default: 300B0120 hex	Attribute: ---
Size: 4 bytes (U32)	Access: RO	PDO map: Possible	

1B0D hex	270th Transmit PDO Mapping		
Subindex 0: Number of Objects			
Range: -	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: 1st Input Object to Be Mapped			
Range: -	Unit: ---	Default: 300D0110 hex	Attribute: ---
Size: 4 bytes (U32)	Access: RO	PDO map: Possible	

1B10 hex 1B11 hex 1B12 hex to 1B4B hex	273th to 332nd transmit PDO Mapping		
Sub-index0: Number of objects			
Range: -	Unit: -	Default: 01 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO Map: Not possible	
Sub-index1: 1st Input Object to be mapped			
Range: -	Unit: -	Default: 40010110 hex 40010210 hex 41810110 hex 41810210 hex --- 4E810110 hex 4E810210 hex	Attribute: -
Size: 4byte(U32)	Access: RO	PDO Map: Possible	

1B4C hex 1B4D hex 1B4E hex to 1BA5 hex	333rd to 422nd Transmit PDO Mappings		
Subindex 0: Number of Objects			
Range: -	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: 1st Input Object to Be Mapped			
Range: -	Unit: ---	Default: 40040120 hex 40050120 hex 40040220 hex --- 4E840220 hex	Attribute: ---
Size: 4 bytes (U32)	Access: RO	PDO map: Possible	

1BA6 hex 1BA7 hex 1BA8 hex to 1BC3 hex	423rd to 452nd Transmit PDO Mappings		
Subindex 0: Number of Objects			
Range: -	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: 1st Input Object to Be Mapped			
Range: -	Unit: ---	Default: 40090120 hex 40890120 hex 41090120 hex --- 4E890120 hex	Attribute: ---
Size: 4 bytes (U32)	Access: RO	PDO map: Possible	

1BFF hex	512nd transmit PDO Mapping		
Sub-index0: Number of objects			
Range: -	Unit: -	Default: 01 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO Map: Not possible	
Sub-index1: 1st Input Object to be mapped			
Range: -	Unit: -	Default: 20020108 hex	Attribute: -
Size: 4byte(U32)	Access: RO	PDO Map: Possible	

A-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 SM channels			
Range: –	Unit: –	Default: 04 hex	Attribute: –
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Sub-index 1: Communication Type Sync Manager 0			
Range: –	Unit: –	Default: 01 hex	Attribute: –
Size: 4 bytes (U8)	Access: RO	PDO map: Not possible	
Sub-index 2: Communication Type Sync Manager 1			
Range: –	Unit: –	Default: 02 hex	Attribute: –
Size: 4 bytes (U8)	Access: RO	PDO map: Not possible	
Sub-index 3: Communication Type Sync Manager 2			
Range: -	Unit: -	Default: 03 hex	Attribute: -
Size: 4 bytes (U8)	Access: RO	PDO map: Not possible	
Sub-index 4: Communication Type Sync Manager 3			
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 unit)
  - SM1 : Mailbox transmit (EtherCAT slave unit to master unit)
  - SM2 : Process data output (EtherCAT master unit to slave unit)
  - SM3 : Process data input (EtherCAT slave unit 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 PDOs			
Range: 00 hex to 08 hex	Unit: –	Default: Differ by slave unit types*	Attribute: –
Size: 1 byte (U8)	Access: RW*	PDO map: Not possible	
Sub-index 1 to 8: 1st-8th PDO Mapping Object Index of assigned PDO			
Range: 1600 hex to 17FF hex	Unit: –	Default: Differ by slave unit types*	Attribute: –
Size: 2 bytes (U16)	Access: RW*	PDO map: Not possible	

* "RO" is set if there is no RxPDO.

- It indicates the RxPDOs used by this sync manager.

1C13 hex	Sync Manager 3 PDO Assignment		
Sub-index 0: Number of assigned PDOs			
Range: 00 hex to 08 hex	Unit: –	Default: Differ by slave unit types*	Attribute: –
Size: 1 byte (U8)	Access: RW*	PDO map: Not possible	
Sub-index 1 to 8: 1st-8th PDO Mapping Object Index of assigned PDO			
Range: 1A00 hex to 1BFF hex	Unit: –	Default: Differ by slave unit types*	Attribute: –
Size: 2 bytes (U16)	Access: RW*	PDO map: Not possible	

* "RO" is set if there is no TxPDO.

- It indicates the TxPDOs used by this sync manager.

Default Settings

Model	PDO assignments for Sync Manager 2		PDO assignments for Sync Manager 3					
	Number of assigned RxPDOs	Assigned PDOs	Number of assigned TxPDOs	Assigned PDOs				
				1	2	3	4	5
MG50-EC	00 hex	---	0D hex	1B04 hex	1B05 hex	1B09 hex	1B0A hex	1B0B hex
				6	7	8	9	10
				1B10 hex	1B12 hex	1B14 hex	1B16 hex	1B18 hex
				11	12	13	14	
				1B1A hex	1B1C hex	1B1E hex		

Precautions for Correct Use

You can assign a maximum of 350 bytes of PDOs for the MG50-EC.
Do not assign more than 350 bytes of PDOs.

A-1-7 Manufacturer Specific Objects

This section describes the CiA401 generic I/O module device profile that is implemented in the MG50-EC Main module and the objects that are uniquely implemented in the MG50-EC Main module as an EtherCAT slave.

● Manufacturer-specific Area

3000 hex	Measuring unit Communication Status		
Sub-index0:			
Range: 08 hex	Unit: -	Default: 08 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO map: Not possible	
Sub-index1: Communication Busy			
Range: 00 hex-01 hex	Unit: -	Default: 00 hex	Attribute: A
Size: 1 bit (BOOL)	Access: RO	PDO map: possible	
Sub-index2: Communication Error			
Range: 00 hex-01 hex	Unit: -	Default: 00 hex	Attribute: A
Size: 1 bit (BOOL)	Access: RO	PDO map: possible	

- This object detect communication status with MG50-EC and Counter modules.
- When the Communication Busy bit is ON, communications are in progress between the Main module and the Counter modules. In this case, do not send new SDOs to the Counter modules.

If the Communications Error bit turns ON, the set value for the number of measuring units does not agree with the number of measuring units that are actually connected. Check the set value and the connected measuring units. If you are using Dummy, set the number of measuring units to the total of the actual number of measuring units and Dummy.

3001 hex	Number of Measuring units		
Sub-index0:			
Range: 03 hex	Unit: -	Default: 03 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO map: Not possible	
Sub-index1: Number of Measuring units Setting			
Range: 00 hex-1E hex	Unit: -	Default: 00 hex	Attribute: A
Size: 1byte(U8)	Access: RW	PDO map: possible	
Sub-index2: Number of Measuring units with Dummy			
Range: 00 hex-01 hex	Unit: -	Default: 00 hex	Attribute: A
Size: 1byte(U8)	Access: RO	PDO map: possible	
Sub-index3: Number of Connected Measuring units			
Range: 00 hex-01 hex	Unit: -	Default: 00 hex	Attribute: A
Size: 1byte(U8)	Access: RO	PDO map: Not possible	

- Sub-index1: Number of measuring units Setting
  - This object use to set measuring unit number include Dummy. Set the number of measuring units to register to the number of measuring units that are actually connected plus the number of Dummy.
- Sub-index2: Number of measuring units with Dummy
  - This object detect number of measuring units recognized by MG50-EC (with Dummy).
- Sub-index3: Number of Connected measuring units
  - This object detect number of measuring units recognized by MG50-EC (without Dummy).

3002 hex	Input Filter for Free Run Mode		
Sub-index0:			
Range: 02 hex	Unit: -	Default: 02 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO map: Not possible	
Sub-index1: Input Filter Setting			
Range: 00 hex-01 hex	Unit: -	Default: 00 hex	Attribute: R
Size: 1 bit (BOOL)	Access: RW	PDO map: Not possible	
Sub-index2: Input Filter Information			
Range: 00 hex-01 hex	Unit: -	Default: 00 hex	Attribute: A
Size: 1 bit (BOOL)	Access: RO	PDO map: Not possible	

- Sub-index1: Input Filter Setting:
  - This object set Input Filter for free run mode.
    0: disable
    1: enable
    To enable the new settings, restart the unit.
- Sub-index2: Input Filter Information:
  - This object detect Input Filter Setting for free run mode.
    0: disable
    1: enable

3004 hex	Dummy Setting		
Sub-index0:			
Range: 03 hex	Unit: -	Default: 03 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO map: Not possible	
Sub-index1: Dummy Setting			
Range: 00000000 hex-3FFFFFFF hex	Unit: -	Default: 00000000 hex	Attribute: R
Size: 4byte(U32)	Access: RW	PDO map: Not possible	
Sub-index2: Dummy Information			
Range: 00000000 hex-3FFFFFFF hex	Unit: -	Default: 00000000 hex	Attribute: A
Size: 4byte(U32)	Access: RO	PDO map: Not possible	
Sub-index3: Dummy Response Setting			
Range: 00 hex-01 hex	Unit: -	Default: 00 hex	Attribute: A
Size: 1byte(U8)	Access: RW	PDO map: Not possible	

- Sub-index1: Dummy Setting
  - Turn ON the bit that corresponds to the unit number to set as a Dummy.
    Turn ON bit 0 of the 32 bits to set unit number 1 as a Dummy, and the turn ON bit 1 to set unit number 2 as a Dummy.
    To enable the new settings, restart the unit.
- Sub-index2: Dummy Information
  - This object detect Dummy setting.
- Sub-index3: Dummy Response Setting
  - This object set the response setting when sending command to Dummy.
    0: Dummy reply normal response.
    (The read data is always “0”)
    1: Dummy reply error response.

3005 hex	Input Delay Time Status		
Subindex 0:			
Range: 01 hex	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: Input Delay Time Status			
Range: 00 to 03 hex	Unit: ---	Default: 00 hex	Attribute: A
Size: 1 byte (U8)	Access: RO	PDO map: Possible	

- Subindex 1: Input Delay Time Status
  - This object reads the input delay time status in Free-Run Mode.
    0: Undefined (Pre-Operational state)
    1: Standard (125 μs)
    2: High speed (100 μs)
    3: Low speed 1 (150 μs)
    4: Low speed 2 (175 μs)
    5: TxPDO Normal Mode Type (200 μs)
    The response time is the refresh cycle that is given in "7-2-3 Mode Setting Functions for PDO Communications" in page 7-5.

300A hex	Measuring unit Communication Status 8bit		
Sub-index0:			
Range: 01 hex	Unit: -	Default: 01 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO map: Not possible	
Sub-index1: Measuring unit Communication Status			
Range: 00 hex-02 hex	Unit: -	Default: 00 hex	Attribute: A
Size: 1byte(U8)	Access: RO	PDO map: possible	

- This object detect comunication status with MG50-EC and Counter modules.
- When bit 0 is ON, communications are in progress between the Main module and the Counter modules. In this case, do not send new SDOs to the Counter modules.
- If bit 1 turns ON, the set value for the number of measuring units does not agree with the number of measuring units that are actually connected. Check the set value and the connected measuring units. If you are using Dummy, set the number of measuring units to the total of the actual number of measuring units and Dummy.

300B hex	Measuring unit Status		
Subindex 0:			
Range: 01 hex	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: Measuring unit Warning Status			
Range: 00000000 to 3FFFFFFF hex	Unit: ---	Default: 00000000 hex	Attribute: A
Size: 4 bytes (U32)	Access: RO	PDO map: Possible	

- Subindex 1: Measuring unit Warning Status
  - This object reads the current measuring unit warning status for the measuring units.
  - The bit will be 1 when a warning exists for the corresponding unit. The unit is normal when the corresponding bit is 0.
  - A measuring unit Warning Status will exist whenever any bit of bits 08 to 15 for the units in the measuring unit status is ON.

300C hex	TxPDO Mapping Mode		
Subindex 0:			
Range: 02 hex	Unit: ---	Default: 02 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: TxPDO Mapping Mode Setting			
Range: 00 hex to 01 hex	Unit: ---	Default: 00 hex	Attribute: A
Size: 1 byte (U8)	Access: RW	PDO map: Not possible	
Subindex 2: TxPDO Mapping Mode Information			
Range: 00 to 01 hex	Unit: ---	Default: 00 hex	Attribute: A
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	

- Subindex 1
  You can change the TxPDO mapping mode setting.
  To enable the new settings, restart the unit.
  0: Normal Mode (Processing of PDO communications is divided over more than one cycle. The maximum assignable size is 350 bytes.)
  1: Detection Value Speed Priority Mode (The detection value is refreshed every cycle between the Counter modules and Main module. The maximum assignable size is 108 bytes.)
- Subindex 2
  This subindex gives the current setting.
  0: Normal Mode (Processing of PDO communications is divided over more than one cycle. The maximum assignable size is 350 bytes.)
  1: Detection Value Speed Priority Mode (The detection value is refreshed every cycle between the Counter modules and Main module. The maximum assignable size is 108 bytes.)

3020 hex	Read input bits		
Sub-index0:			
Range: 40 hex	Unit: -	Default: 40 hex	Attribute: -
Size: 1byte(U8)	Access: RO	PDO map: Not possible	
Sub-index1 to 60: Read input bits 0 to 59			
Range: 00 hex-01 hex	Unit: -	Default: 00 hex	Attribute: A
Size: 1 bit (BOOL)	Access: RO	PDO map: Possible	

- This object is measuring unit Input 1 to 60.
- The order of the assignments is given below.
  Input Bit 0: No.1 measuring unit input 1
  Input Bit 1: No.1 measuring unit input 2
  Input Bit 2: No.2 measuring unit input 1
  Input Bit 3: No.2 measuring unit input 2
  - - -
  Input Bit 56: No.29 measuring unit input 1
  Input Bit 57: No.29 measuring unit input 2
  Input Bit 58: No.30 measuring unit input 1
  Input Bit 59: No.30 measuring unit input 2
  Input Bit 60: Cannot be used.
  Input Bit 61: Cannot be used.
  Input Bit 62: Cannot be used.
  Input Bit 63: Cannot be used.

● The address connection with Counter module

These object to comunication Counter modules.
Each object exist 1 to 30 objects by number of measuring units.
The object is offset 80Hex.
Show below number of measuring units and index address relation.

Unit number	Index
1	4000 to 407F
2	4080 to 40FF
3	4100 to 417F
4	4180 to 41FF
5	4200 to 427F
6	4280 to 42FF
7	4300 to 437F
8	4380 to 43FF
9	4400 to 447F
10	4480 to 44FF
11	4500 to 457F
12	4580 to 45FF
13	4600 to 467F
14	4680 to 46FF
15	4700 to 477F
16	4780 to 47FF
17	4800 to 487F
18	4880 to 48FF
19	4900 to 497F
20	4980 to 49FF
21	4A00 to 4A7F
22	4A80 to 4AFF
23	4B00 to 4B7F
24	4B80 to 4BFF
25	4C00 to 4C7F
26	4C80 to 4CFF
27	4D00 to 4D7F
28	4D80 to 4DFF
29	4E00 to 4E7F
30	4E80 to 4EFF

Writing must be performed one object at a time. There is an object for selection of multiple Counter module numbers between 1 and 30.
The indexes for the objects are from 4F00 to 4F7F hex.

Index (for unit numbers 1 to 30)	Index (for multiple objects)	Subindex	Name	Size	Access	Applicable Counter modules
						TA0
3000 hex	No	1	Communications Busy	BOOL	RO	---
	No	2	Communications Error	BOOL	RO	---
3001 hex	No	1	Number of measuring units Setting	U8	RW	---
	No	2	Number of measuring units with Dummy	U8	RO	---
	No	3	Number of Connected measuring units	U8	RO	---
3002 hex	No	1	Input Filter Setting	BOOL	RW	---
	No	2	Input Filter Information	BOOL	RO	---
3004 hex	No	1	Dummy Setting	U32	RW	---
	No	2	Dummy Information	U32	RO	---
	No	3	Dummy Response Setting	U8	RW	---
3005 hex	No	1	Input Delay Time Status	U8	RO	---
300A hex	No	1	Measuring unit Communication Status	U8	RO	---
300B hex	No	1	Measuring unit Warning Status	U32	RO	---
300C hex	No	1	TxPDO Mapping Mode Setting	U8	RW	---
	No	2	TxPDO Mapping Mode Information	U8	RO	---
300D hex	No	1	Measuring unit Warning Status 16 bit	U16	RO	---
3020 hex	No	1 to 60	Read input bits 00 to 59	BOOL	RO	---
4000 + (N-1) × 80 hex	No	1	Type of Measuring unit	U16	RO	Yes
4004 + (N-1) × 80 hex	4F04 hex	1	Threshold 1 Settings	INT32	RW	Yes
4005 + (N-1) × 80 hex	4F05 hex	1	Threshold 2 Settings	INT32	RW	Yes
4006 + (N-1) × 80 hex	No	1	Measuring unit Status	U16	RO	Yes
4008 + (N-1) × 80 hex	4F08 hex	1	Output Mode Setting	U16	RW	Yes
4009 + (N-1) × 80 hex	No	1	Detection Value (4 bytes)	INT32	RO	Yes
400A + (N-1) × 80 hex	4F0A hex	1	Operating Mode	U16	RW	Yes
400B + (N-1) × 80 hex	4F0B hex	1	Detection Function	U16	RW	Yes
4011 + (N-1) × 80 hex	4F11 hex	1	Display Digits	U16	RW	Yes
4015 + (N-1) × 80 hex	4F15 hex	1	Eco Function Setting	U16	RW	Yes
4016 + (N-1) × 80 hex	4F16 hex	1	Key Lock Setting	U16	RW	Yes
4017 + (N-1) × 80 hex	4F17 hex	1	Display Blinking	U16	RW	Yes
4020 + (N-1) × 80 hex	4F20 hex	1	Hysteresis Width Setting	U16	RW	Yes
4022 + (N-1) × 80 hex	4F22 hex	1	Hysteresis Width 2	U32	RW	Yes
4033 + (N-1) × 80 hex	4F33 hex	1	2-point settings (1st point)	U16	RW	Yes
4034 + (N-1) × 80 hex	4F34 hex	1	2-point settings (2nd point)	U16	RW	Yes
4036 + (N-1) × 80 hex	4F36 hex	1	Full Auto Tolerance Judgement Setup	U16	RW	Yes
4038 + (N-1) × 80 hex	4F38 hex	1	Reference Point Use Setting	U16	RW	Yes
4039 + (N-1) × 80 hex	4F39 hex	1	Preset Value	INT32	RW	Yes
403B + (N-1) × 80 hex	4F3B hex	1	Tolerance Setting High	INT32	RW	Yes
403C + (N-1) × 80 hex	4F3C hex	1	Tolerance Setting Low	INT32	RW	Yes
403E + (N-1) × 80 hex	4F3E hex	1	±Tolerance Setting	U16	RW	Yes
4042 + (N-1) × 80 hex	4F42 hex	1	Measuring unit Initialization	U16	RW	Yes
4071 + (N-1) × 80 hex	4F71 hex	1	Direction	U16	RW	Yes
4072 + (N-1) × 80 hex	4F72 hex	1	Output Mode Selection	U16	RW	Yes
4075 + (N-1) × 80 hex	4F75 hex	1	Preset	U16	RW	Yes

Precautions for Correct Use

The Counter module bank cannot be changed when using the MG50-EC.
Leave the Counter module in bank 1 (default).

4000 + (N-1) × 80 hex	No_01 ... 30 Type of measuring unit		
Subindex 0: Number of Entries			
Range: 01 hex	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Type of measuring unit			
Range: 0000 to FFFF hex	Unit: ---	Default: --- hex	Attribute: ---
Size: 2 bytes (U16)	Access: RO	PDO map: Not possible	

- This object reads the model number of the measuring unit with the unit number that is specified by the index.

Data	Model
0460 hex	MF10-CM

4004 + (N-1) × 80 hex	No_01 ... 30 Threshold 1 Settings		
Subindex 0: Number of Entries			
Range: 02 hex	Unit: ---	Default: 02 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 IN1			
Range: –2147483648 to 2147483647 (80000000 to 7FFFFFFF hex)	Unit: ---	Default: --- hex	Attribute: A
Size: 4 bytes (INT32)	Access: RW	PDO map: Possible	

- This object sets the threshold 1 setting for the Counter module with the unit number that is specified by the index.
- Threshold 1 is used in Normal Detection Mode or as the low threshold in Area Detection Mode.
- The setting range is –1999999 to 9999999 (FFE17B81 hex to 0098967F hex).

4005 + (N-1) × 80 hex	No_01 ... 30 Threshold 2 Settings		
Subindex 0: Number of Entries			
Range: 01 hex	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Threshold 2 Setting			
Range: –2147483648 to 2147483647 (80000000 to 7FFFFFFF hex)	Unit: ---	Default: --- hex	Attribute: A
Size: 4 bytes (INT32)	Access: RW	PDO map: Possible	

- This object sets the threshold 2 setting for the Counter module with the unit number that is specified by the index.
- Threshold 2 is used as the high threshold in Area Detection Mode.
- The setting range is –1999999 to 9999999 (FFE17B81 hex to 0098967F hex).

4006 + (N-1) × 80 hex	No_01 ... 30 Measuring unit Status		
Subindex 0: Number of Entries			
Range: 01 hex	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Measuring unit Status			
Range: 0000 to FFFF hex	Unit: ---	Default: 0000 hex	Attribute: ---
Size: 2 bytes (U16)	Access: RO	PDO map: Not possible	

- This object reads the status of the measuring unit with the unit number that is specified by the index.

Data	Measuring unit Status
Bit 00	Normal operation (This bit is normally set to 1, and changes to 0 if the bits 08 on change to 1.)
Bit 01	DPC status (This bit is set to 1 when the DPC is ON, and 0 when the DPC is OFF.)
Bit 02	Tolerance Judgement Status (This bit is set to 1 when ST is ON, and 0 when ST is OFF.)
Bits 03 to 07	Not used.
Bit 08	—
Bit 09	EEPROM error (all models)
Bit 10	Load short-circuit error (all models)
Bit 11	Head-related error
Bits 12 to 15	Not used.

4008 + (N-1) × 80 hex	No_01 ... 30 Output Mode Setting		
Subindex 0: Number of Entries			
Range: 02 hex	Unit: ---	Default: 02 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 IN1			
Range: 0000 hex to FFFF hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- This object sets the output mode for the Counter module with the unit number that is specified by the index.

Data	Setting
	Output 1 (subindex 1)
0000 hex	Normal Detection Mode
0001 hex	Area Detection Mode
0002 hex	Not used.
0003 hex	—
0004 to FFFF hex	Not used.

- The previous value is retained if a measurement error occurs in Hold Mode.

4009 + (N-1) × 80 hex	No_01 ... 30 Detection Value (4 Bytes)		
Subindex 0: Number of Entries			
Range: 01 hex	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Detection Value (4 Bytes)			
Range: –2147483648 to 2147483647 (80000000 to 7FFFFFFF hex)	Unit: ---	Default: 00000000 hex	Attribute: ---
Size: 4 bytes (INT32)	Access: RO	PDO map: Possible	

- This object reads four bytes of the detection value for the Counter module with the unit number that is specified by the index.

400A + (N-1) × 80 hex	No_01 ... 30 Operating Mode		
Subindex 0: Number of Entries			
Range: 02 hex	Unit: ---	Default: 02 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 IN1			
Range: 0000 hex to FFFF hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- This object sets the operating mode of the measuring unit with the unit number that is specified by the index.

Data	Setting
0000 hex	NO
0001 hex	NC
0002 to FFFF hex	Not used.

400B + (N-1) × 80 hex	No_01 ... 30 Detection Function		
Subindex 0: Number of Entries			
Range: 02 hex	Unit: ---	Default: 02 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Detection Function			
Range: 0000 hex to FFFF hex	Unit: ---	Default: 0001 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- This object sets the operating mode of the measuring unit with the unit number that is specified by the index.

Data	Setting
0000 hex	SHS (super high speed)
0001 hex	HS (high speed)
0002 hex	STND (standard)
0003 hex	GIGA (high resolution)
0004 to FFFF hex	Not used.

4011 + (N-1) × 80 hex	No_01 ... 30 Display Digits		
Subindex 0: Number of Entries			
Range: 02 hex	Unit: ---	Default: 02 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 DPC Setting and Display Digits			
Range: 0000 hex to FFFF hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- This object sets the number of display digits of the measuring unit with the unit number that is specified by the index.

Display Digits Setting

Data	Setting
0000 hex	4 digits
0001 hex	3 digits
0002 hex	2 digits
0003 hex	1 digit
0004 to FFFF hex	Not used.

4015 + (N-1) × 80 hex	No_01 ... 30 Eco Function		
Subindex 0: Number of Entries			
Range: 01 hex	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Eco Function Setting			
Range: 0000 hex to FFFF hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- This object sets the eco mode of the measuring unit with the unit number that is specified by the index.

Data	Setting
0000 hex	Eco function OFF
0001 hex	Eco function ON
0002 hex	Eco function LO
0003 to FFFF hex	Not used.

4016 + (N-1) × 80 hex	No_01 ... 30 Key Lock Setting		
Subindex 0: Number of Entries			
Range: 01 hex	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Key Lock Setting			
Range: 0000 hex to FFFF hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- This object sets the key lock setting of the measuring unit with the unit number that is specified by the index.

Data	Setting
0000 hex	Key Lock OFF
0001 hex	Key Lock ON
0002 to FFFF hex	Not used.

4017 + (N-1) × 80 hex	No_01 ... 30 Display Blinking		
Subindex 0: Number of Entries			
Range: 01 hex	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Display Blinking			
Range: 0000 hex to 0001 hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- This object sets the blinking setting of the measuring unit with the unit number that is specified by the index.
- Set this object to 0001 hex to write data. It is always set to 0000 hex when reading data.

4020 + (N-1) × 80 hex	No_01 ... 30 Hysteresis Width Setting		
Subindex 0: Number of Entries			
Range: 02 hex	Unit: ---	Default: 02 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO		PDO map: Not possible
Subindex 1: No_01 ... 30 Hysteresis Width Setting			
Range: 0000 hex to FFFF hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW		PDO map: Not possible

- This object sets the hysteresis width setting of the measuring unit with the unit number that is specified by the index.

Data	Setting
0000 hex	Standard
0001 hex	User setting
0002 to FFFF hex	Not used.

4022 + (N-1) × 80 hex	No_01 ... 30 Hysteresis Width 2		
Subindex 0: Number of Entries			
Range: 01 hex	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO		PDO map: Not possible
Subindex 1: No_01 ... 30 Hysteresis Width 2			
Range: 00000000 to 05F5E0FF hex	Unit: ---	Default: - hex	Attribute: A
Size: 4 bytes (U32)	Access: RW		PDO map: Not possible

- This object sets the Hysteresis Width 2 high setting of the measuring unit with the unit number that is specified by the index.
- Subindex 1 of Hysteresis Width 2 is used for IN1 in Normal Detection Mode and for the high and low hysteresis in Area Detection Mode.
- The setting range is 00000000 hex to 05F5E0FF hex.

4033 + (N-1) × 80 hex	No_01 ... 30 2-point setting (1st point)		
Subindex 0: Number of Entries			
Range: 02 hex	Unit: ---	Default: 02 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO		PDO map: Not possible
Subindex 1: No_01 ... 30 IN1			
Range: 0000 hex to 0001 hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW		PDO map: Not possible

- This object executes the first point of two-point setting for the measuring unit with the unit number that is specified by the index.
- Set this object to 0001 hex to execute and 0000 hex to reset.
- A value of 0000 hex is always read for this object.

4034 + (N-1) × 80 hex	No_01 ... 30 2-point setting (2nd point)		
Subindex 0: Number of Entries			
Range: 02 hex	Unit: ---	Default: 02 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO		PDO map: Not possible
Subindex 1: No_01 ... 30 IN1			
Range: 0000 hex to 0001 hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW		PDO map: Not possible

- This object executes the second point of two-point setting for the measuring unit with the unit number that is specified by the index.
- Set this object to 0001 hex to write data. It is always set to 0000 hex when reading data.
- Execute the first point of 2-point setting first.

4036 + (N-1) × 80 hex	No_01 ... 30 1-point setting, ±tolerance setting setup		
Subindex 0: Number of Entries			
Range: 02 hex	Unit: ---	Default: 02 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 IN1			
Range: 0000 hex to 0001 hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- This object executes the 1-point setting, ±tolerance setting setup command for the measuring unit with the unit number that is specified by the index.
- Set this object to 0001 hex to execute and 0000 hex to reset.
- It is always set to 0000 hex when reading data.

4038 + (N-1) × 80 hex	No_01 ... 30 Reference Point Use Setting		
Subindex 0: Number of Entries			
Range: 02 hex	Unit: ---	Default: 02 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Reference Point Use Setting			
Range: 0000 hex to FFFF hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- This object sets the reference point use setting of the measuring unit with the unit number that is specified by the index.

Reference Point Use Setting

Data	Setting
0000 hex	Reference point setting used.
0001 hex	Reference point setting not used.
0002 to FFFF hex	Not used.

4039 + (N-1) × 80 hex	No_01 ... 30 Preset Value		
Subindex 0: Number of Entries			
Range: 02 hex	Unit: ---	Default: 02 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Preset Value			
Range: −19999999 to 99999999 (FECED301 hex to 05F5E0FF hex)	Unit: ---	Default: --- hex	Attribute: A
Size: 4 bytes (INT32)	Access: RW	PDO map: Not possible	

- This object sets the preset value of the measuring unit with the unit number that is specified by the index.
- The setting range for the preset value is −19999999 to 99999999 (FECED301 hex to 05F5E0FF hex).

403B + (N-1) × 80 hex	No_01 ... 30 Tolerance Setting High		
Subindex 0: Number of Entries			
Range: 02 hex	Unit: ---	Default: 02 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Tolerance Setting High			
Range: −1999999 to 9999999 (FFE17B81 hex to 0098967F hex)	Unit: ---	Defaults: Tolerance Setting High: 000003E8 hex	Attribute: A
Size: 4 bytes (INT32)	Access: RW	PDO map: Not possible	

- This object sets the tolerance setting high setting of the measuring unit with the unit number that is specified by the index.
- The setting range for the tolerance setting high setting is −1999999 to 9999999 (FFE17B81 hex to 0098967F hex).

403C + (N-1) × 80 hex	No_01 ... 30 Tolerance Setting Low		
Subindex 0: Number of Entries			
Range: 02 hex	Unit: ---	Default: 02 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Tolerance Setting Low			
Range: −1999999 to 9999999 (FFE17B81 hex to 0098967F hex)	Unit: ---	Defaults: Tolerance Setting Low: FFFFFC18 hex	Attribute: A
Size: 4 bytes (INT32)	Access: RW	PDO map: Not possible	

- This object sets the tolerance setting low setting of the measuring unit with the unit number that is specified by the index.
- The setting range for the tolerance setting low setting is −1999999 to 9999999 (FFE17B81 hex to 0098967F hex).

403E + (N-1) × 80 hex	No_01 ... 30 ±tolerance setting		
Subindex 0: Number of Entries			
Range: 02 hex	Unit: ---	Default: 02 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 ±tolerance setting			
Range: 0000 hex to 0001 hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- This object sets ±tolerance setting of the measuring unit with the unit number that is specified by the index.
- Set this object to 0001 hex to execute. It is always set to 0000 hex when reading the data.

4042 + (N-1) × 80 hex	No_01 ... 30 Measuring unit Initialization		
Subindex 0: Number of Entries			
Range: 01 hex	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Measuring unit Initialization			
Range: 0000 hex to 0001 hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- This object executes the measuring unit initialization command for the measuring unit with the unit number that is specified by the index.
- Set this object to 0001 hex to write data. It is always set to 0000 hex when reading data.
- To initialize the measuring unit during operation, use this command to initialize the measuring unit. Do not use the buttons on the measuring unit.

4071 + (N-1) × 80 hex	No_01 ... 30 Direction		
Subindex 0: Number of Entries			
Range: 01 hex	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Direction			
Range: 0000 hex to FFFF hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- This object sets the direction of the measuring unit with the unit number that is specified by the index.

Data	Setting
0000 hex	Normal
0001 hex	Reversed

4072 + (N-1) × 80 hex	No_01 ... 30 Output Mode Selection		
Subindex 0: Number of Entries			
Range: 01 hex	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Output Mode Selection			
Range: 0000 hex to FFFF hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- This object sets the output mode selection of the measuring unit with the unit number that is specified by the index.

Data	Setting
0000 hex	Normal
0001 hex	Hybrid

4075 + (N-1) × 80 hex	No_01 ... 30 Preset		
Subindex 0: Number of Entries			
Range: 01 hex	Unit: ---	Default: 01 hex	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: No_01 ... 30 Preset			
Range: 0000 hex to 0001 hex	Unit: ---	Default: 0000 hex	Attribute: A
Size: 2 bytes (U16)	Access: RW	PDO map: Not possible	

- This object sets the preset of the measuring unit with the unit number that is specified by the index.

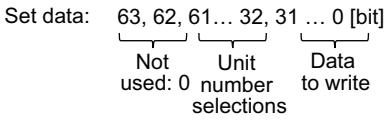
Data	Setting
0000 hex	Cleared
0001 hex	Executed

4F00 to 4F7F hex	Object for Selection of Multiple Units		
Subindex 0: Number of Entries			
Range: *1	Unit: ---	Default: *1	Attribute: ---
Size: 1 byte (U8)	Access: RO	PDO map: Not possible	
Subindex 1: Multi (*2)			
Range: 0000000000000000 to FFFFFFFFFFFFFFFF hex	Unit: ---	Default: 0000000000000000 hex	Attribute: A
Size: 8 bytes (U64)	Access: RW	PDO map: Not possible	
Subindex 2: Multi (*2)			
Range: 0000000000000000 to FFFFFFFFFFFFFFFF hex	Unit: ---	Default: 0000000000000000 hex	Attribute: A
Size: 8 bytes (U64)	Access: RW	PDO map: Not possible	

*1 The setting range and default settings are the same as the values for the objects that are used from unit numbers 1 to 30.

*2 This is the same as the name of the objects that are used from unit numbers 1 to 30.

- Bit 0 to 31 set values:
  There is a different set value for each object. Set the values to write.
- Bit 32 to 61set values:
  These bits are used to specify the unit numbers of the measuring units to which to write object data.
  Turn ON the bits that correspond to the target unit numbers.
  To write to all measuring units from unit numbers 1 to 30, you can turn OFF all bits 32 to 61.
- Bit 62 and 63 set values:
  0 (not used)



Example:

Case 1 This example sets the Threshold 1 Input 1 object for unit numbers 1, 10, and 30 to 1000 decimal.

⇒ Write the following data for an index of 0x4F04 and subindex of 0x01: 0x20000201000003E8.

Case 2 This example sets the display mode for all unit numbers from 1 to 30 to blinking.

⇒ Write the following data for an index of 0x4F17 and a subIndex of 0x01: 0x0000000000000001 or 0x3FFFFFFF00000001.

A-2 Using the Distribution Module

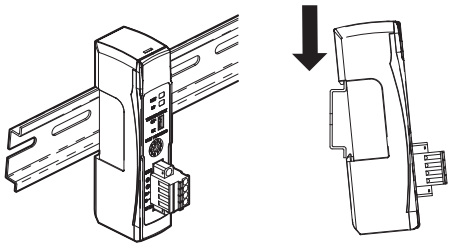
A-2-1 Mounting and Removing Distribution Modules

This section describes how to mount a MG51 Distribution module and Counter modules to a DIN rail and how to remove them.

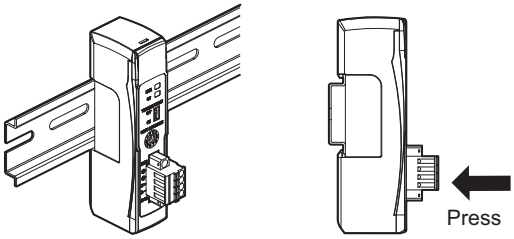
Mounting Procedure

Use the following procedure to install the modules.

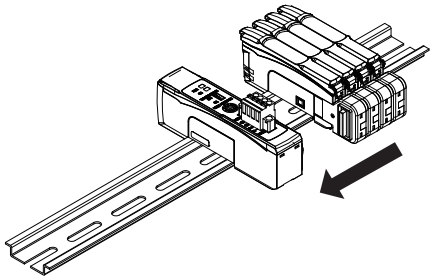
1 **Place the top part of the module onto the DIN rail.**



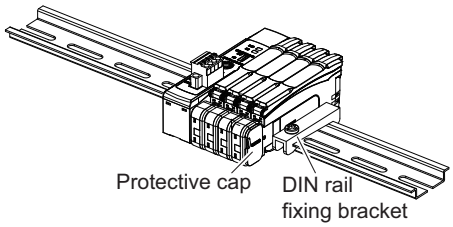
2 **Press the bottom part of the module onto the DIN rail.**



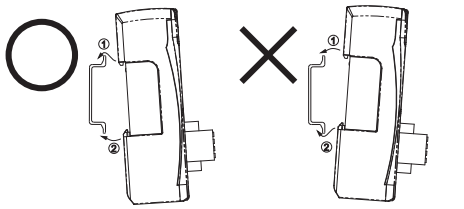
3 **Remove the protective cap from the right side of the Distribution module. Then, slide the Counter module, align the hooks on the connector with the Distribution module, and press the modules together until you hear them lock into place.**



4 **Secure the enclosed DIN rail Fixing brackets onto the ends so that there is no space between them and the modules. Finally, attach the protective cap you removed in step 3 to the Counter module on the far right end.**



CHECK! Do not reverse the order of steps 1 and 2, above. Doing so may reduce the mounting strength on the DIN rail.

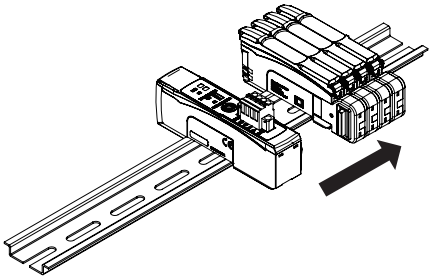


After you have completed the above procedure, check to make sure that the MG51 is mounted securely into place.

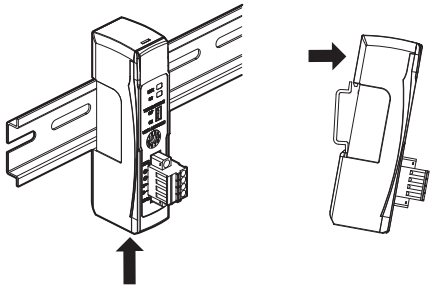
Removal Procedure

Use the following procedure to remove the Distribution module.

1 **Slide the Counter modules to separate them from the Distribution module.**



2 **Press in on the Distribution module toward the DIN rail and lift up to remove it.**



A-2-2 Installing a DS-Bus Network

This section describes how to install a DS-Bus network.

Precautions for Installing a DS-Bus Network

This section provides basic precautions for installing a DS-Bus network.

● Precautions for Installing a Network

- When installing a DS-Bus network, observe proper safety measures and follow all applicable standards.
  We recommend that you request installation from a specialist who is qualified in safety measures and standards.
- Do not place any DS-Bus network devices near any devices that generate noise.
  If no other suitable location is available, place the device or devices in a metal case or take other measures to reduce ambient noise.

● Precautions for Installing Communications Cables

- Check the following conditions for the communications cables in the network.
  - Are there any disconnections?
  - Are there any short circuits?
  - Are there any problems with connector connections?
- When connecting to the communications connector on each device, be sure to insert the wires until they lock into place in the communications cable connector.
- Separate communications cables from high-voltage power lines and install them in ducts.
- Do not wire communications cables near devices that generate noise.
- Do not wire communications cables in high-temperature, high-humidity environments.
- Use in locations free of dirt, oil mist, and other foreign matter.
- There is a limit to the bending radius of communications cables. Refer to the specifications for your communications cables for information on allowable bending radii.
- You can connect up to eight Distribution modules to one Main module.
- Keep the total length of DS-Bus communications cables (L1 + L2 + ... + Ln) to within 30 m.
- Turn ON the DS-Bus termination setting switch for the last Distribution module on the DS-Bus network. Turn this switch OFF for all other Distribution modules.

Preparing to Install the Network

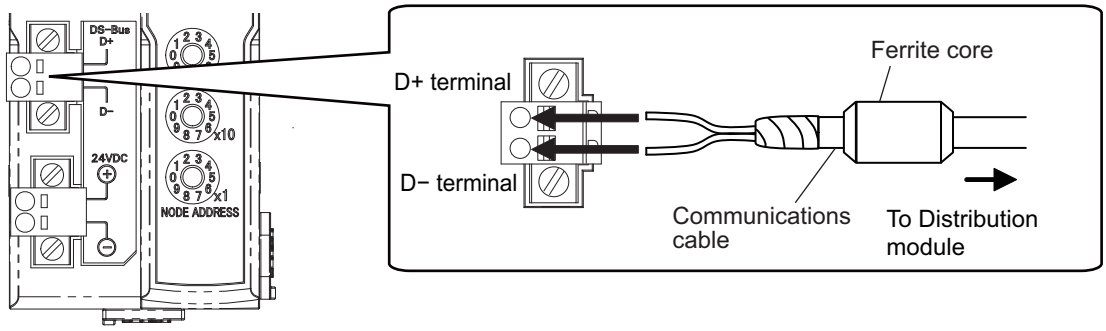
Prepare the following equipment.

Item	Remarks
DS-Bus communications cables	Please contact our company.
DS-Bus communications connector for Main module	Enclosed with the MG50 Series Main module.
DS-Bus communications connectors for Main modules	Enclosed with the MG51 Distribution module.
Ferrite cores	Two are required. Enclosed with the MG51 Distribution module.

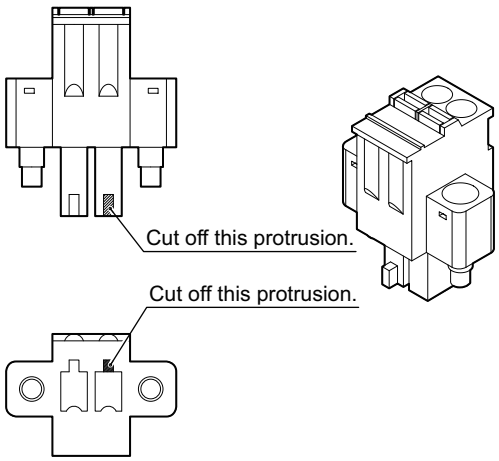
Connecting Communications Cables and Connectors

● MG50 series Main Module

Connect a communications cable to the DS-Bus communications connector on the Main module. Also, clamp on a ferrite core (enclosed) on the communications cable.



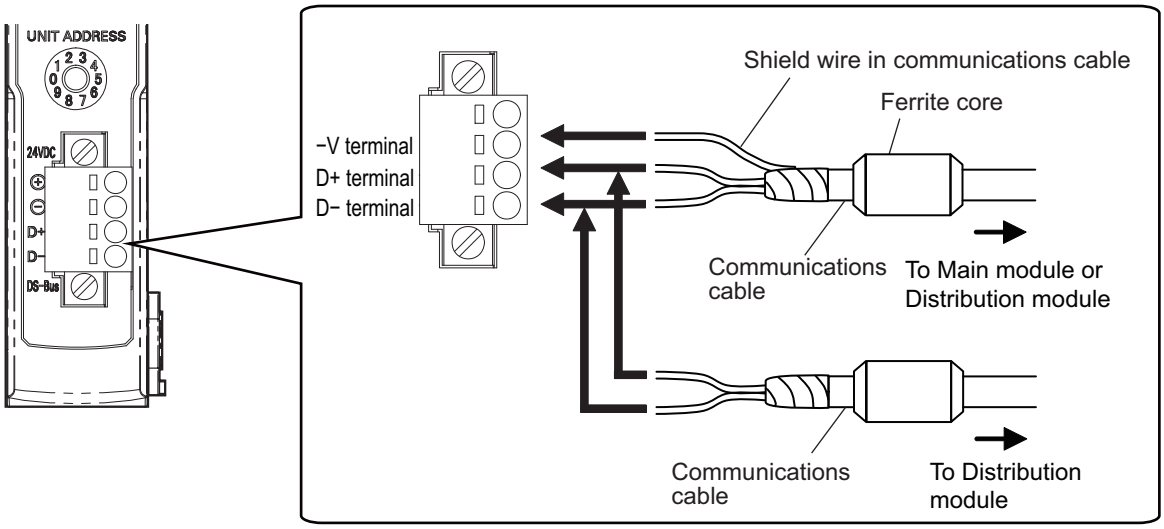
When you prepare a new DS-Bus connector, cut off the protrusion on one side of the connector as shown in the following figure. The enclosed connector already has this protrusion removed.



● MG51 Distribution Modules

Connect the D+ and D− lines and the shield wire in the communications cable to the power supply/communications connector on the Distribution module. Also, clamp on a ferrite core (enclosed) on the communications cable.

In connections between Distribution modules, connect the shield wire in the communications cable to the −V terminal on only one of the Distribution modules. Do not connect the shield wire to both units.



A-2-3 Power Supply Specifications and Connections of the Distribution Module

Precautions for Unit Power Supply

Observe the following precautions for the allowable current for cables and connectors, for voltage drop, and for power supply layout.

● Precaution for Cable Voltage Drop

Make sure that the power supply to the Distribution module that is farthest from the power source is within the allowable fluctuation range.

● Supplying Power from Multiple Power Sources

If you supply the unit power from more than one power source, you can reduce the line current, the voltage drop, and the cable size.
This can also be used to help ensure system safety against power supply problems.

● Power Supply Problems

You must determine the power supply layout and groupings according to whether the entire system is to be stopped or whether stopping the entire system is to be avoided when problems occur in the power supply.
To avoid stopping the entire system, we recommend that you supply power from more than one power source and supply power to separate groups of Distribution modules from each.
This will also reduce the voltage drop and allow you to use smaller cables.

Unit Power Supply Specifications

Use a standard power supply that meets the following specifications.

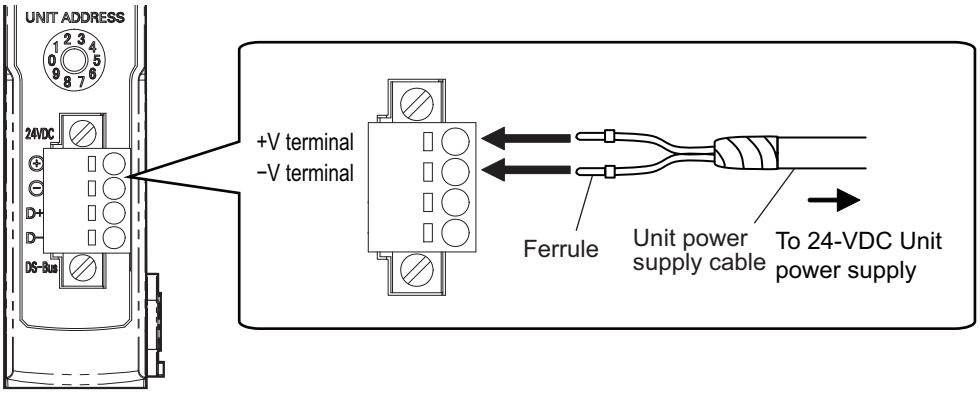
Item	Specification
Output voltage	24 VDC 10%
Output ripple	600 mVp-p
Output current	The supply capacity of the power supply must be equal to or greater than the total current consumption of all slaves.
Isolation	Between output and AC power supply and between output and frame ground

Precautions for Correct Use

- When calculating the output current for the unit power supply, always include the current consumption of the MG51 and the current consumption of all Counter modules and measuring units in the unit power supply consumption current.
- Select a power supply that has sufficient capacity, allowing for the inrush current at system startup.

Unit Power Supply Connections

Connect a cable from the unit power supply (24 VDC) to the power supply connector on each Distribution module to supply power separately to each unit.



Attach ferrules to the unit power supply cable wires and connect them securely so that they do not come loose.

● Recommended Parts

We recommend the following ferrules for the unit power supply cable.

Model number	Applicable wire size	Crimping tool	Manufacturer
AI0,5-10WH	0.5 mm^2 (AWG20)	CRIMPFOX UD6 (product number 1204436) or CRIMPFOX ZA3 Series	Phoenix Contact
H0.5/16 orange	0.5 mm^2 (AWG20)	PZ1.5 Crimper (product number 900599)	Weidmüller

A-2-4 General Specifications of the Distribution Module

The following table gives the general specifications of the MG51 Distribution modules.

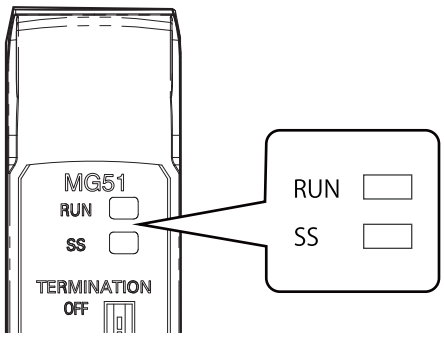
Item	Specifications and Performances
Unit power supply voltage	24 VDC (20.4 to 26.4 V)
Maximum connectable Measuring units	10
Power and current consumption	2 W max. (Not including the power supplied to measuring units.), 80 mA max. at 24 VDC (Not including the current supplied to measuring units.)
Noise immunity	Conforms to IEC 61000-4-4, 1 kV (power supply line).
Vibration resistance	10 to 60 Hz with a 0.7 mm double amplitude, 50 m/s^2 at 60 to 150 Hz, for 1.5 hours each in X, Y, and Z directions
Shock resistance	150 m/s^2 for 3 times each in X, Y, and Z directions
Dielectric strength	500 VAC at 50/60 Hz for 1 min
Insulation resistance	20 MΩ min. (at 500 VDC)
Ambient operating temperature	0 to 55°C *1
Operating ambient humidity	25% to 85% (with no condensation or icing)
Operating ambient environment	No corrosive gases.
Storage temperature	–30 to 70°C (with no condensation or icing)
Storage humidity	25% to 85% (with no condensation or icing)
Installation Procedure	35 mm DIN rail-mounting

*1 Temperature Limitations Based on Number of Connected Counter modules:
Groups of 1 or 2 Counter modules: 0 to 55°C, Groups of 3 to 10 Counter modules: 0 to 50°C

A-2-5 Hardware Specifications of the Distribution Module

Status Indicators

These indicators show the current status of the MG51.



● RUN Indicator

This indicator shows the operating status.

Color	State	Description
Green	Not lit.	Power OFF, or one of the following errors has occurred: Rotary switch setting error, watchdog timer timeout error, hardware error, RAM check error
	Flashing	No access from the Main module (for 3 seconds or longer).
	Lit	Normal status, or measuring unit not connected error

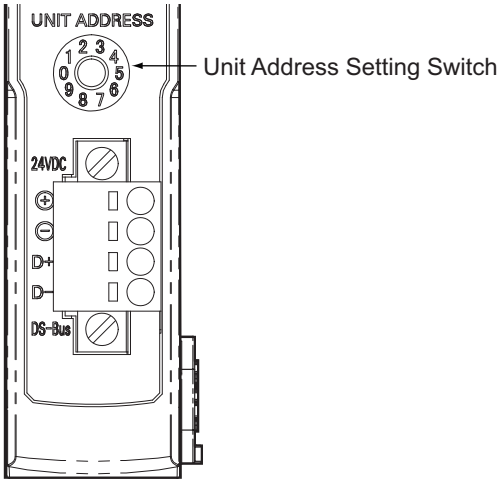
● SS Indicator

This indicator shows the measuring unit connection status and various error information.

Color	State	Description
	Not lit.	Initial checks are in progress or a hardware error or measuring unit disconnected error occurred after turning the power supply OFF and ON.
Green	Lit	The number of connected measuring units does not match the number of connected measuring units setting or there was a RAM check error.
Red	Lit	One of the following errors occurred: Number of connected measuring units verification error, too many measuring units connected error, RAM check error, or rotary switch setting error

Unit Address Setting Switch

This switch sets the unit address (as a decimal number) of the MG51 on the DS-Bus network. The setting range is 1 to 8. (Factory setting: 1)
If multiple Distribution modules are connected to the Main module, set the addresses of the Distribution modules in order starting from 1.

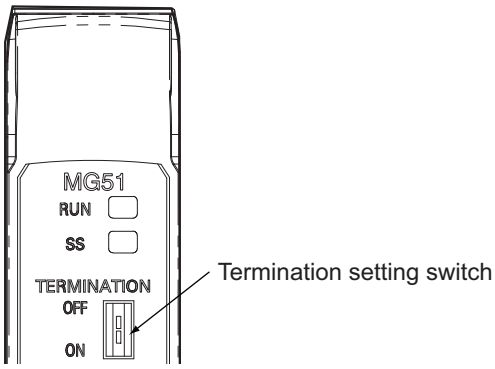


Precautions for Correct Use

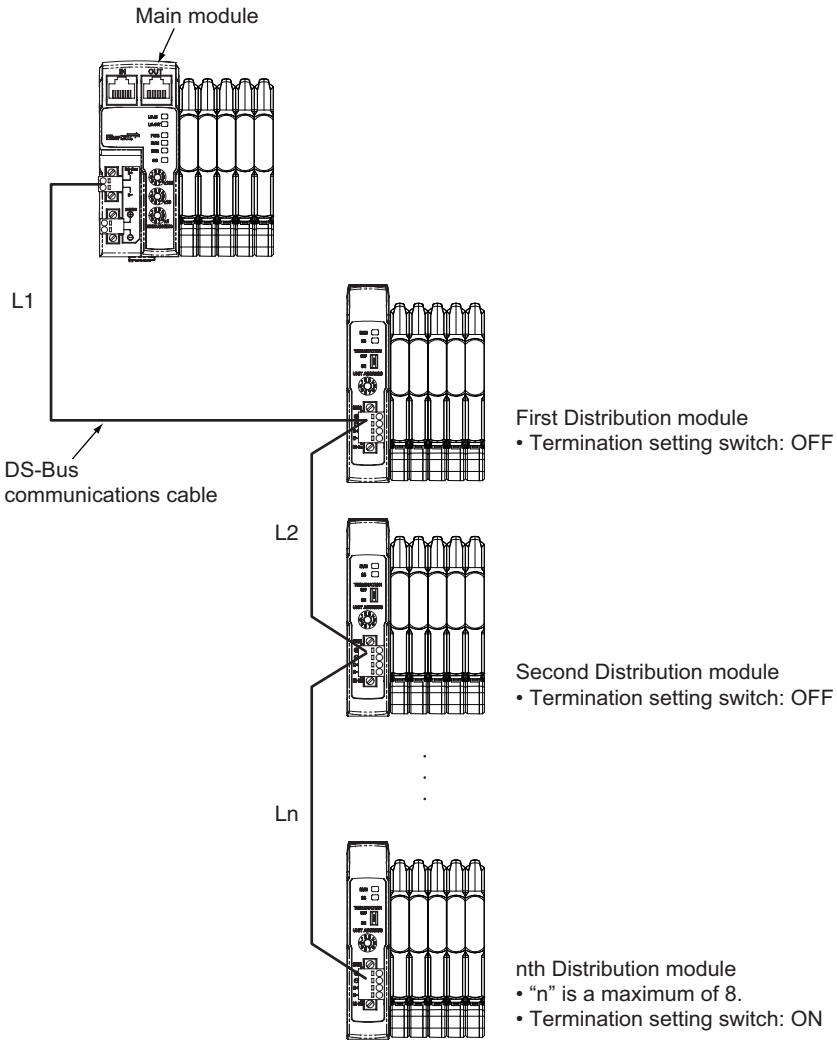
- The setting of the unit address switch is read only once when the power is turned ON. Changing this setting after the power is turned ON will have no effect until after the next time the power is turned ON.
- An error will occur and operation will not continue normally if the same unit address is assigned to more than one unit.

DS-Bus Network Termination Setting Switch

This switch turns the communications terminating resistance ON or OFF on the DS-Bus network.

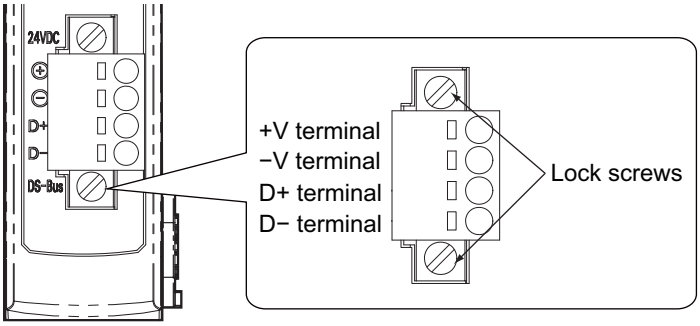


Turn ON the DS-Bus termination setting switch for the last Distribution module on the DS-Bus network. Turn this switch OFF for all other Distribution modules. This is shown in the following figure.



Communications and Power Supply Connectors

Connect the power supply cable from the unit power supply and the DS-Bus communications cable to this connector.



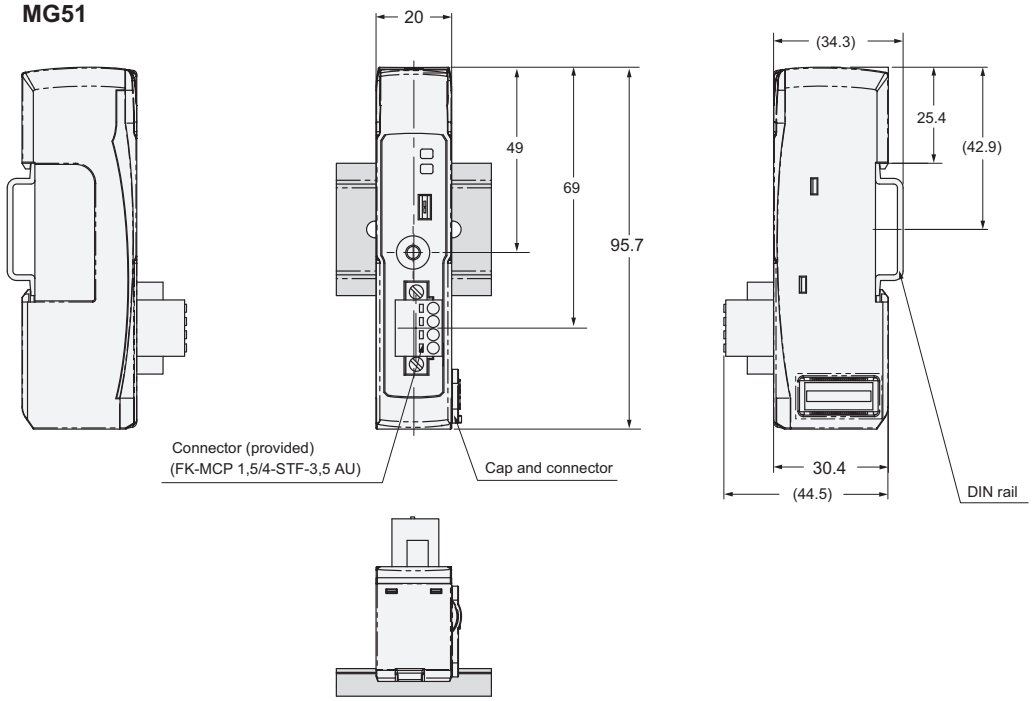
Name	Specifications
+V	24 VDC
-V	0 VDC
D+	Communications data signal +
D-	Communications data signal −

- Connector type: Four-pin spring cage connector with lock screws
- Applicable ferrule diameters: 0.25 to 0.5 mm^2 (AWG24 to AWG20)
  (Using ferrules with insulating sleeves)

Refer to " Unit Power Supply Connections" in page A-35 for the recommended ferrules.

A-2-6 External Dimensions for the Distribution Module

MG51



B-1 Terminology

Use the following list of EtherCAT terms for reference.

Term	Abbreviation	Description
AL status (application layer status)	–	Status for indicating information on errors that occur in an application on a slave.
CAN application protocol over EtherCAT	CoE	A CAN application protocol service implemented on EtherCAT.
CAN in Automation	CiA	CiA is the international users' and manufacturers' group that develops and supports higher-layer protocols.
device profile	–	Collection of device dependent information and functionality providing consistency between similar devices of the same device type.
distributed clocks	DC	Clock distribution mechanism used to synchronize EtherCAT Main modules and the EtherCAT master units.
EtherCAT slave controller	ESC	A controller for EtherCAT slave communication.
EtherCAT slave information	ESI	An XML file that contains setting information for an EtherCAT slave unit.
EtherCAT state machine	ESM	An EtherCAT communication state machine.
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.
index	–	Address of an object within an application process.
network configuration information	–	The EtherCAT network configuration information held by the EtherCAT master.
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.
operational	–	A state in EtherCAT communications where SDO communications and I/O are possible.
PDO communications	–	An acronym for process data communications.
pre-operational	–	A state in EtherCAT communications where only SDO communications are possible without being able to perform I/O.
Process data	–	Collection of application objects designated to be downloaded cyclically or acyclically for the purpose of measurement and control.
process data communications	–	One type of EtherCAT communications that uses process data objects (PDOs) to exchange information in realtime with a fixed cycle. This is also called PDO communications.
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 unit.
safe operational	–	A state in EtherCAT communications where only SDO communications and reading input data from slaves are possible. Outputs from slaves are not performed.
SDO communications	–	One type of EtherCAT communications that uses service data objects (SDOs) for communicating information when required.
service data object	SDO	CoE asynchronous mailbox communications where all objects in the object dictionary can be read and written.
slave information interface	SII	Slave information that is stored in non-volatile memory in the slave.
subindex	–	Sub-address of an object within the object dictionary.

Term	Abbreviation	Description
sync manager	SM	Collection of control elements to coordinate access to concurrently used objects.
Transmit PDO	TxPDO	A process data object sent from an EtherCAT slave unit.

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