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User's Guide

Hitachi Inverter

Communication option for the Ethernet

P1-EN

After reading this guide, keep it handy for future reference.

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When contacting us, please let us know the following reference number.

NT254X

S.1 Introduction

Thank you for purchasing the P1-EN: communication option for Hitachi SJ series P1 (afterward, "Hitachi SJ series P1" referred as SJ-P1). This user's guide describes how to handle and maintain the P1-EN. Please read this guide carefully before using the P1-EN, and keep it handy for those who operate, maintain and inspect it.

For the purpose of reducing paper consumption and provision of the latest information, we enclose the Basic Guide only, while providing the User's Guide for more detailed description through electronic data instead of CD or printed document.

■ About the User's Guide (this document)

The User's Guide provides detailed information necessary for handling the product. Please make sure to read this Guide for proper use.

If future updated descriptions differ from the Basic Guide, the description in the User's Guide will have higher priority. Always use the P1-EN strictly within the range described in the User's Guide and perform proper inspection and maintenance to prevent failures or accidents.

The latest version of the User's guide can be obtained through our website. In case it is not available or cannot be downloaded please contact the nearest sales office.

■ About the Basic Guide

The Basic Guide provides the minimum information necessary for handling the product. Please make sure to read the Basic Guide as well as the User's Guide for more detailed information.

■ Handling the inverter

For handling the inverter, please make sure to read its Basic Guide and User's Guide.

S.2 Cautions

■ For a proper use

Before using the inverter, please read carefully the inverter's Basic and User's Guide, the P1-EN Basic Guide and this guide.

In Addition any personnel who handles or performs maintenance to the product must read carefully the inverter's Basic and User's Guide, the P1-EN Basic Guide and this guide.

Before any attempt to install, operate, maintain or inspect this equipment, a complete understanding of the equipment specifications, safety instructions, precautions, handling and operation instructions is required. Additionally, periodically review the inverter's Basic and User's Guide, the P1-EN User's Guide and this guide.

■ Precautions

It is prohibited to reproduce or reform this document partially or totally in any form without the publisher's permission.

The contents of the document are subject to change without prior notice.

If a hard copy of this document is required please contact the nearest sales office. Keep in mind that you will be charged for a hard copy of this document.

Any handling, maintenance or operation method NOT described on the inverter's Basic and User's Guide, the P1-EN Basic Guide or this guide is not covered by the product warranty. Please DO NOT perform any procedure NOT described on the SJ-P1 or the P1-EN guides since it can be the cause of unexpected failures or accidents.

We are not responsible for any impact from operations regardless of unexpected failure or accident due to operation or handling of the product in a manner not specified on the inverter's Basic and User's Guide, the P1-EN Basic Guide or this guide. We appreciate your understanding.

If you find any unclear or incorrect description, missing description or misplaced or missing pages, Please inform the Hitachi inverter technical service office.

Note that, in case the inverter's Basic and User's Guide, the P1-EN Basic Guide or this guide are enclosed, they should be delivered to the end user of the inverter. Also make sure to download and keep accessible any other related guides or instructions for the end user.

S.3 Product Warranty and Inquiry

■ About product inquiry

- For an inquiry about product damage or faults or a question about the product, notify your supplier or Hitachi inverter technical service office. When contacting the technical service, please provide the following information.

- Model: P1-EN
- Manufacture Number (MFG No.):
It shows on the name plates.
(Please refer to the chapter 3, for more information.)
- Date of Purchase: Purchase date by the customer
- Inquiry contents:
 - Inform us the defective point and its condition.
 - Inform us the suspicious content and its details.

■ Product warranty

- The product P1-EN will be warranted by Hitachi Industrial Equipment Systems Co., Ltd. (afterward, referred as "Hitachi") during the warranty period from your date of purchase only under proper usage of product.
- However, the warranty expressed here is covered only for products delivered from Hitachi, and will not be responsible for others damage or loss of products like a motor or any equipment or systems damage caused by improper usage of the product. We recommend applying safety design which is able to provide a hazard notice to the user in case of malfunction or damage of the delivered product to minimize the consequences on other equipment or system. We advise that the selection of the delivered product is done with sufficient margin for performance, as well as using redundant design for other equipment or systems. Also, the compatibility of the product with the customer's intended use is not warranted, hence is the customer responsibility to perform validation tests before any operation.
- In case a defective product is delivered, or defects on quality during the manufacturing process are detected, Hitachi will repair or exchange the product free of charge, only during the product warranty period (afterward, referred as "warranty service").
- The product will be warranted for one year from the date of purchase. However, depending on the case, actual expenses for sending technical assistance will be charged to the customer. Also, Hitachi will not be responsible of any readjustment or testing on site.

- After a warranty service, the exchanged or repaired part will be warranted for 6 months from the date of the warranty service. Hitachi will be responsible for repairing or exchanging the previously exchanged or repaired part only during this warranty period.
- In order to receive warranty service, you should present the receipt issued by the product supplier or any other document that allow us to check the purchase date. However, any defects, damage, malfunction or any other failure caused by one of the following facts will not be covered by warranty service.

- (1) Cannot confirm the purchase date.
- (2) The damage or fault resulted from improper usage or inadequate handling of the product or usage that does not comply with the instructions described in the user's guide or basic guide.
- (3) Incorrect usage of the product and/or the inverter, inadequate setting of the product and/or the inverter, remodeling or inadequate repair or repair carried out by an unqualified repair center.
- (4) Deterioration and wear as result of normal operation.
- (5) Fault resulted from natural disaster, such as earthquake, fire disaster, lightning strike, pollution, salt pollution, or abnormal voltage or any others external factors.
- (6) Shock, falling, or Vibration resulted during transportation or displacement after purchase.
- (7) Damage or fault resulted from remodeling firmware by unqualified personal not belonging to Hitachi.
- (8) Damage or fault resulted from using a function program (EzSQ).
- (9) For overseas use.

■ Liability limitation

- In this product warranty, all warranties offered to the customer are stipulated, and neither Hitachi, affiliated companies or related dealers are liable to any express warranties or implied warranties including, but not limited to, product merchantability or specific application fitness.
- Also, Hitachi, affiliated companies or related dealers are not responsible of any incidental damage, special damage, direct loss, or indirect loss (even predictable or not) sustained by the customer as a result of a faulty product.

■ Using the warranty service

- The customer is able to receive a warranty service during the warranty period from the product supplier or service station, if the product does not meet the specifications described in this guide or the basic guide. However, this guide will have priority in case of content mismatch between this and the basic guide.
- A fare-paying service can also be obtained by contacting your supplier, local Hitachi distributor or service station.

■ Change on product specifications

- Please be aware that the information described in Brochure, Basic Guide, User's Guide or Technical Document might be modified without notice.

■ Precautions for product operation

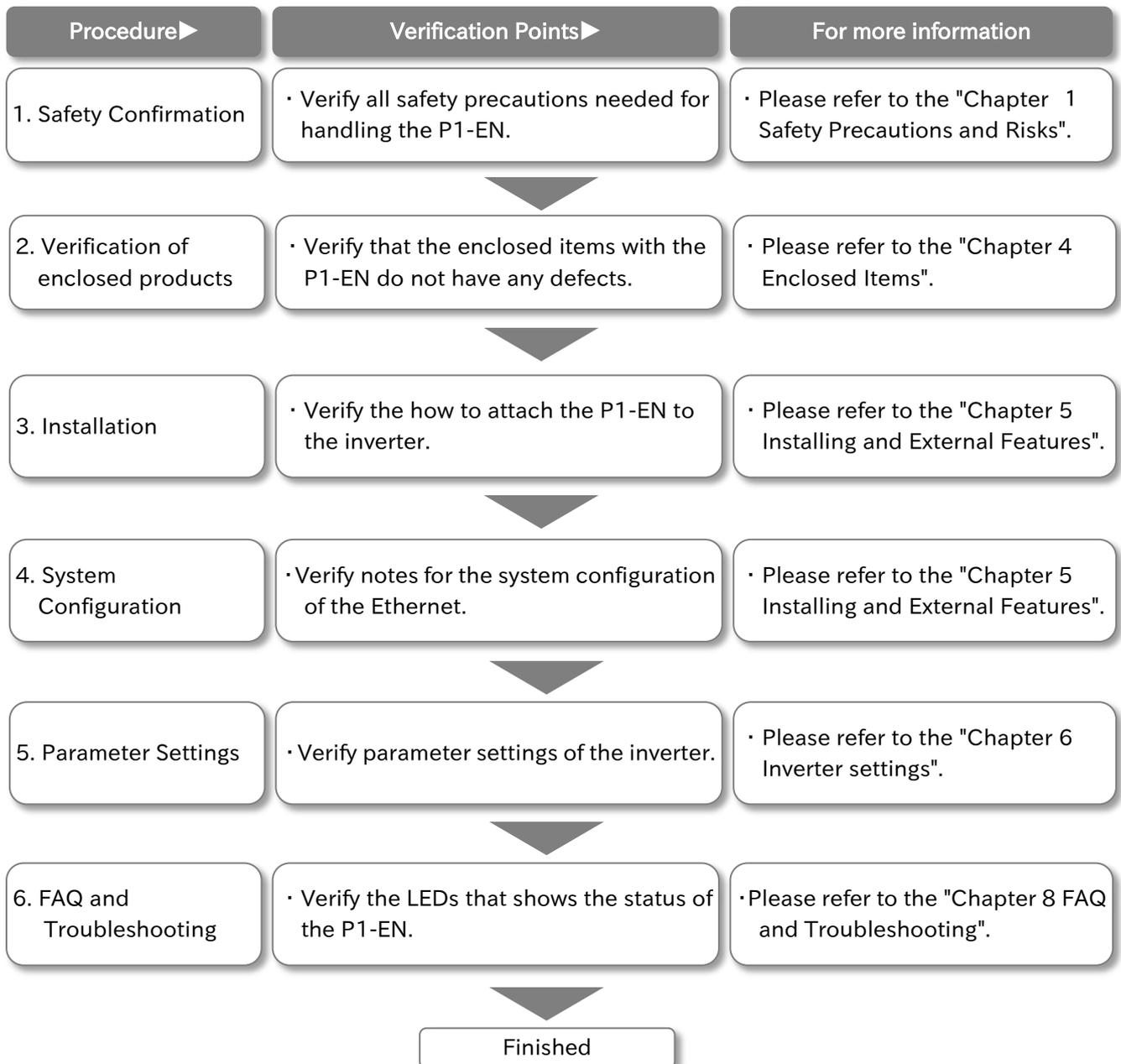
- The product should be operated following the working conditions, handling methods and precautions described in User's Guide.
- Please verify that the inverter settings are adequate for operation, before operating it remotely through the network.
- Please verify that the Hitachi inverter is correctly configured and installed for the intended purpose in the designed system.
- When using the Hitachi inverter please implement the following actions.
 - (1) Select an inverter with sufficient capacity for the rated current and performance.
 - (2) Implement safety design such as redundant system design.
 - (3) Implement safety design which minimizes risks in case of an inverter failure.
 - (4) Design the system in a way it can warn the operator about any danger.
 - (5) Carry out periodic maintenance to the customer's equipment as well as the inverter.
- For applications that involve human life, or have risk of an important loss, make sure to avoid a critical accident by installing a fail-safe device, protecting device, detecting device, alarm device, and/or spare device, etc.

■ Supplement

- This warranty term will not restrict the legal right of customer who has purchased the product.
- This warranty is valid only in Japan(excluding special types of contracts).
- Contact your sales agent for warranty of products purchased overseas.

S.4 Getting Started

- Please follow the steps written below for start using the P1-EN.
- Before operating the device, please read and fully understand the safety precautions written below and on the Chapter 1.



S.5 Related Documents

Document Name	Document Code
P1-EN(Ethernet) User's Guide (this document)	NT254X
P1-EN(Ethernet) Basic Guide	NT2541X

Document Name (Inverter)	Document Code
SJ series P1 User's Guide	NT251*1)
SJ series P1 Basic Guide	NT2511*1)

*1) It represents the version of each guide.

S.6 Registered Trademark

Ethernet is a registered trademark of Xerox Corporation in the United States.

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Chapter 1 Safety Precautions

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1.1 About this chapter

This chapter contains the information about Safety precautions during the installation, wiring, operation and inspection.

Before installation, wiring, operation, inspection, or usage please read completely and fully understand this guide and other references.

1.2 Types of warnings

In this guide, the safety precautions as well as residual risks are categorized by degree of risk as "Danger", "Warning" and "Caution".

The definition of each category is described below.

Danger

This category warns the user that in case of an incorrect or improper handling, it leads to a dangerous situation that have a high risk of causing death, serious injuries and/or major property damage.

Warning

This category warns the user that in case of an incorrect or improper handling, it leads to a dangerous situation that may cause death, serious injuries and/or major property damage.

Caution

This category warns the user that in case of an incorrect or improper handling, it leads to a dangerous situation that may cause physical injuries and/or property damage.

However, any content labeled with " Caution" and depending on the case, might have a possibility of leading to a highly dangerous situation. It is extremely important that you follow the instructions and warnings

Furthermore, content labeled with "" must be followed and paid special attention.

1.3 Symbol explanation

In this guide, there are some explanatory notes using different symbols. Please pay attention to this content and keep in mind its information.

Symbol definition

	<p>When handling this product, this symbol indicates danger, warning, caution about ignition, electric shock, high temperature and others.</p> <p>Inside or near the  symbol, the specific content will be shown.</p>
	<p>This symbol indicates "General hazard not specified, be cautious".</p>
	<p>This symbol indicates "Electric shock hazard".</p>
	<p>This symbol indicates prohibited actions "Actions that should not be done" when handling this device.</p>
	<p>This symbol indicates actions that must be done based on the instructions.</p>

1.4 Precautions

1.4.1 Please be careful!

Danger



Caution

· If handled incorrectly or improperly, it might cause death, serious physical injuries, or damage to the inverter, motor or even the entire system.



Do

· Before installation, wiring, operation, inspection, or usage please read and fully understand this guide and other references.



Caution

· In order to explain this device details the illustrations in this guide might show this device without covers.



Do

· Before operating this device please return all the covers to the original position, and follow all the necessary regulations and instructions written in this guide.



Caution

· There will be additional warnings about hazards and failure causes in other chapters.



Do

· Before installation, wiring, operation, inspection, or usage please read and fully understand this guide.

1.4.2 Precautions during the installation!

Danger



Fire hazard

● Risk of fire!

· DO NOT place inflammable objects nearby.



Prohibited

· DO NOT let scraps of wire, welding sputtering, irons scraps or other objects get inside the device.



Do

· Avoid installing this device in places with high temperature, high humidity, Condensation-prone conditions, dusty conditions, corrosive gas, explosive gas, flammable gas, grinding fluid mist, hydrogen sulfide or salt damage prone conditions. Additionally, it is recommended to install this device in ventilated room not exposed to direct sunlight.



Failure

● Risk of an inverter failure!

· This device is a precision equipment, DO NOT drop it, or give it a strong shock.

· DO NOT get on (step on) or place heavy objects on this device.

· When handling the object, avoid places prone to static electricity(like carpets).



Do

· Since the human body can get charged with static electricity, as a safety measure please touch a safe metallic surface before handling this device.



Injury

● Risk of injury!

· DO NOT install or operate products with damage or missing parts.



Prohibited

1.4.3 Precautions during the wiring!

**Danger****Electric shock and fire hazard****Do**

- **Risk of an electric shock and/or fire!**
- Be sure to ground the inverter.
- Entrust the wiring work only to a qualified electrician.
- Before the wiring work make sure to turn off the power supply and wait for more than 10 *1) or 15 *2) minutes depending on the inverter model. (Confirm that the charge lamp is OFF and the DC voltage between terminals P and N is 45 V or less).

**Failure****Prohibited**

- **Risk of inverter failure!**
- Do not pull any wire after wiring.

**Electric shock and injury****Do**

- **Risk of an electric shock and/or injury!**
- Perform the wiring only after installing the inverter.

- *1) For P1-00044-L to P1-01240-L (P1-004L to P1-220L), P1-00041-H to P1-00620-H (P1-007H to P1-220H) models the wait time is 10 minutes.
- *2) For P1-01530-L to P1-02950-L (P1-300L to P1-550L), P1-00770-H to P1-03160-H (P1-300H to P1-1320H) models the wait time is 15 minutes.

**Warning****Electric shock and injury****Do**

- **Risk of an electric shock and/or injury!**
- DO NOT operate/switch any of the switches from the 4 pole DIP switch on this device. When this device is shipped all switches are turned off.
- If any of the switches from the 4 pole DIP switch is operated/switched, this device will not work as intended and it might be the cause of failure.
- Please handle the cables properly and DO NOT let them get damaged. Using damaged cables will not only interfere with the correct operation of this device but also might be the cause of a system failure.

**Fire hazard****Do**

- **Risk of fire!**
- Please tighten the screws and bolts with the specified torque. (Please refer to the inverter user's guide).
- Verify that none of the screws and bolts are loose.
- Make sure that the inverter and this device are fixed together with the securing screw.
- Make sure that the connectors are properly fixed.

1.4.4 Precautions during operation!


Danger

● Risk of an electric shock or fire!

Electric shock and fire hazard

- DO NOT touch the inside of this device, check the signal, do any wiring or plug/unplug the connectors while it energized.



Prohibited

- DO NOT insert any sick or rod like objects inside this device while it is energized.


● Risk of an injury and/or fire!

Injury and fire hazard

- DO NOT touch the inside of this device or the inverter while they are energized.



Prohibited


● Risk of an electric shock!

Electric shock

- Make sure to fasten all the screws of this device before turning it on. DO NOT detach this device while it is energized or the inverter capacitors are still charged.
- Additionally DO NOT touch the inside of the inverter while the inverter capacitors are still charged.
- DO NOT touch this device with wet hands.



Prohibited


Warning

● Risk of injury and/or device damage!

Injury or device damage

- By using this device it becomes easier to change the settings and the output frequency of the inverter. When changing the settings or the output frequency of the inverter please make sure that it is within the supported range by the motor and/or the equipment.



Do

- In case this device is being used to make the inverter produce high frequency outputs for a motor or other equipment, make sure with the respective manufacturer that the motor or the equipment can tolerate the high frequency output given by the inverter.
- During operation verify the motor rotation direction, and that there are no irregular sounds or vibrations.

1.4.5 Precautions during maintenance/inspection!

 **Danger**


● Risk of an electric shock!

Electric shock

· Before the wiring work make sure to turn off the power supply and wait for more than 10 *1) or 15 *2) minutes depending on the inverter model. (Confirm that the charge lamp is OFF and the DC voltage between terminals P and N is 45 V or less).



Do



Prohibited

· Entrust the maintenance, inspection and/or part replacement only to a specialized personnel. (Be sure to remove wristwatches and metal accessories, e.g., bracelets, before maintenance and inspection work and use insulated tools for the work).

*1) For P1-00044-L to P1-01240-L (P1-004L to P1-220L), P1-00041-H to P1-00620-H (P1-007H to P1-220H) models the wait time is 10 minutes.

*2) For P1-01530-L to P1-02950-L (P1-300L to P1-550L), P1-00770-H to P1-03160-H (P1-300H to P1-1320H) models the wait time is 15 minutes.

1.4.6 Precautions for disposal!

 **Danger**

● Risk of injury and/or an explosion!

 Injury and explosion hazard

· For disposal of this device, outsource to a qualified industrial waste disposal contractor. Disposing this device on your own may result in the production of poisonous gas.



Do

· Contact Hitachi technical service or your sales agent if you need to get this device fixed.

· A qualified waste disposer includes industrial waste collector/transporter and industrial waste disposal operator. Follow all laws and decrees related to procedures of waste management and public cleansing when disposing of this device.

1.4.7 Other precautions

**Danger**

Electric shock injury and fire hazard

● Risk of an injury, an electric shock and/or fire!

· Do NOT modify this device.



Prohibited

※In addition to the precautions described above, there are other precautions described in the chapter 8 of the inverter user's guide. Please read and follow those precautions as well.

1.5 Caution labels examples

- We include the caution label templates so motor, inverter or system related accidents or dangerous situations may be prevented. Please use these labels for your system or equipment.
- When the inverter is configured for remote operation, automatic operation or the retry function is active, there are cases when the operation will be resumed automatically after a shut down. In order to warn about this cases please use the label example on the right side as a reference.

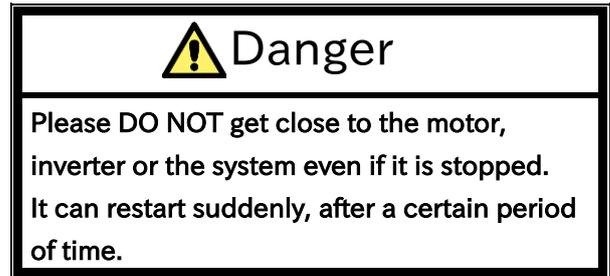
(Label template)

- Please fill in the label and use it for preventing accidents.



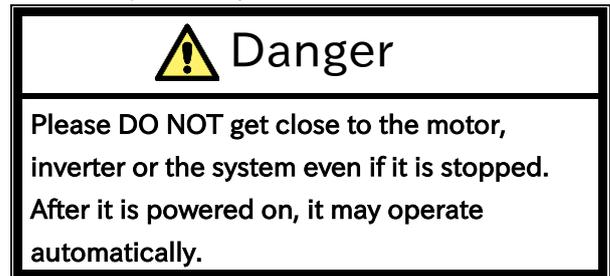
(Label example)

- For warning about automatically resumed operation after an error as a result of the retry function.



(Label example)

- For warning about remote or automatic operation after the system is powered on.



(Memo)

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Chapter 2 Overview

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2.1 About this chapter

This chapter specifies the devices that this guide will describe. Additionally, it contains information necessary to clearly understand this guide, the objectives of this guide and its terminology.

2.2 Applicable devices

The contents of this guide will apply to the P1-EN device. For information about the inverter please refer to the inverter's user's guide or the basic guide.

2.3 Before reading this guide

This guide is aimed for people who purchase, handle, install or connect control equipment, design systems or manage factories.

This guide units are based on the SI system.

2.4 Guide objectives

The objectives of this guide are:

- explain how to wire and connect the device.
- explain how to configure the device.

2.5 Guide outline

This guide has the following structure.

- **The chapter 1: Safety Precautions**
"Safety Precautions" contains the safety instructions for installing, wiring, operating, maintaining and inspecting this device.
- **The chapter 2: Overview**
"Overview" contains information necessary to clearly understand this guide.
- **The chapter 3: About the P1-EN**
"About the P1-EN" contains the explanation about this device appearance and general features.
- **The chapter 4: Enclosed Items**
"Enclosed Items" contains information about the items included with this device.
- **The chapter 5:
Installing and Configuration**
"Installing and Configuration" contains information for installing and system configuring this device on the inverter.
- **The chapter 6: Inverter Settings**
"Inverter Settings" contains the explanation of the inverter parameters that relate with this device.
- **Chapter 7: About the Modbus TCP**
"About the Modbus TCP" contains the explanation of the Modbus TCP, protocol and capability.
- **Chapter 8: FAQ and Troubleshooting**
"FAQ and Troubleshooting" contains the explanation of the P1-EN LEDs lighting patterns, the explanation of inverter error (trip) status and its trouble shooting.
- **Chapter 9: Specifications**
"Specifications" contains the specifications of the P1-EN.

2.6 Symbol definition

In this guide, there are some explanatory notes using the symbols shown in the table below. This table also contains the explanation of each symbol.

Symbol and its definition	Description
Questions about a particular situation 	Simply describes some problematic or recurring situations. Hence, in cases when an occurring situation is similar to a situation described in this guide, it may be solved by using this guide information and the P1-EN functions.
Solution/Answer 	Describes the settings and operations required in order to solve a particular problem or situation.
Precautions 	Describes the points of caution when using an indicated function. This descriptions contain information such as, data overwrite risk, indispensable settings, non-operation risk and other probable dangers.

(Memo)

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Chapter 3 About the P1-EN

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3.1 About this chapter

This chapter contains the explanation about this device external features and information on the name plate.

Symbol	Definition
	Questions about a particular situation
	Solution/Answer
	Precautions

3.2 P1-EN appearance and nomenclature



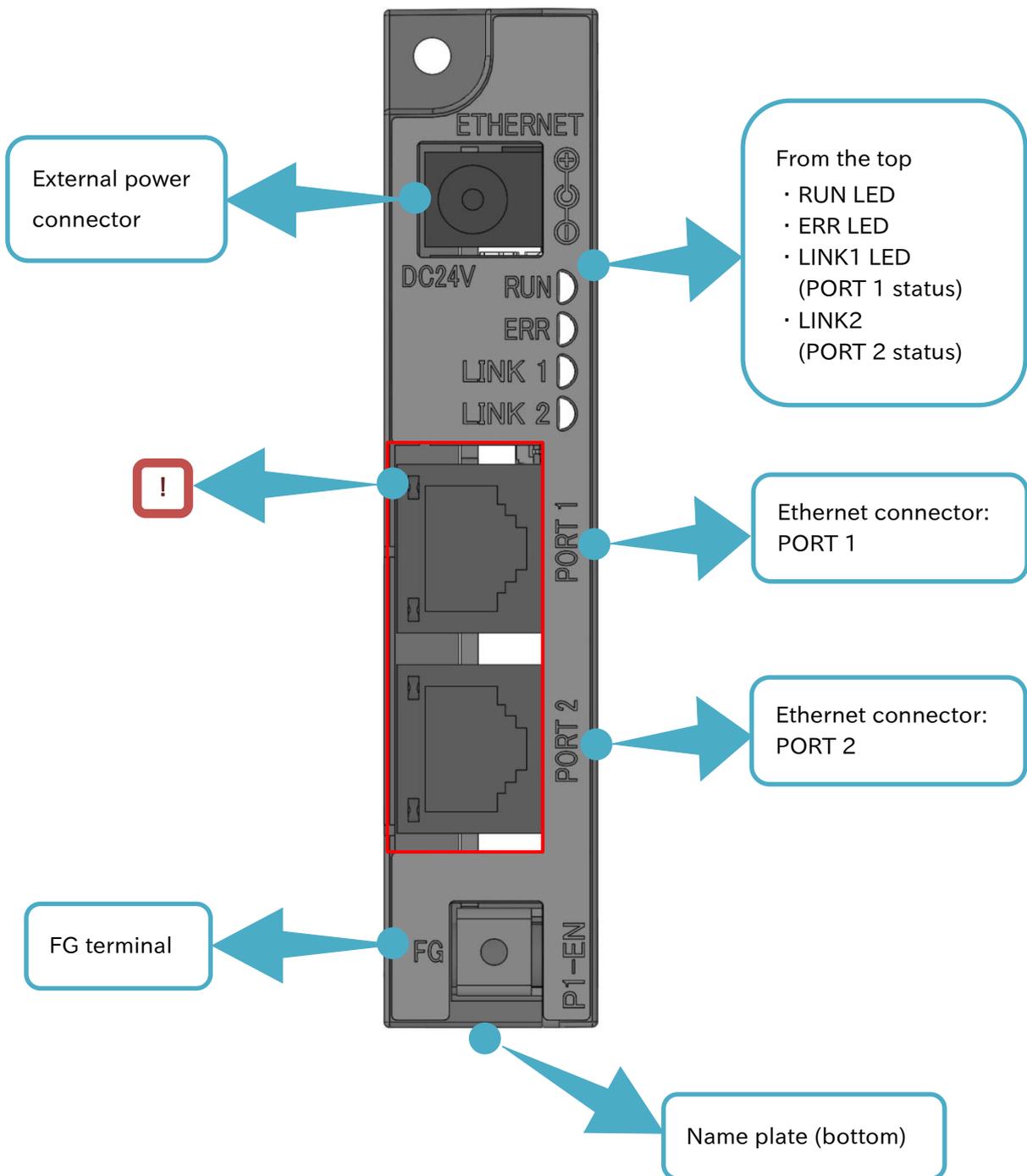
· I need to know the appearance and nomenclature of this device.



· The four LEDs over the RJ-45 connection don't turn on or blink.



· An external view of this device is shown below. For installing this device or details of LEDs, connectors and other parts refer to the chapter 5 "Installation and Configuration".



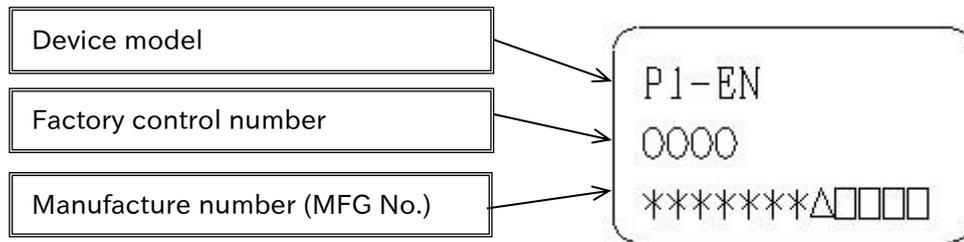
3.3 Name plate



· What is the information written on the plate?



· The P1-EN name plate gives the following information.



3.4 Dimensions after installed



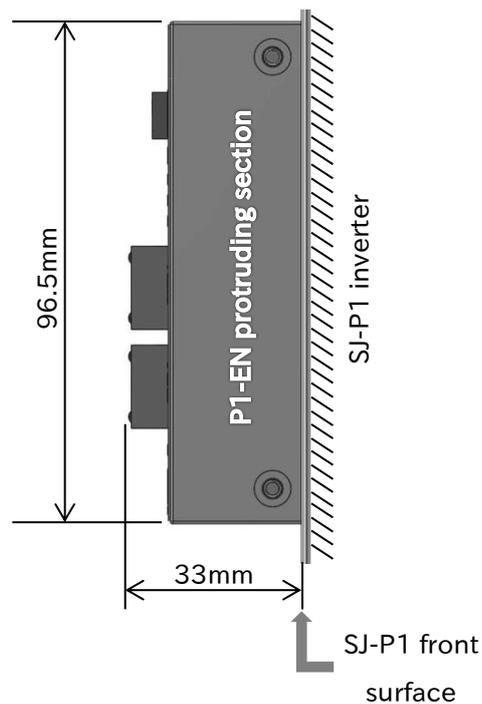
· What are the P1-EN dimensions after being installed?



· As shown on the image a part of this device will stand out from the SJ-P1. Please be cautious when installing the P1-EN.



· The dimensions of this device after it is installed on the SJ-P1 are shown in the image below.



View from the right side of the SJ-P1.

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4.1 About this chapter

This chapter contains information about the items enclosed with the P1-EN. Additionally, it is explained how to inspect and verify this product after its purchase.

Symbol	Definition
	Questions about a particular situation
	Solution/Answer
	Precautions

4.2 About the enclosed items

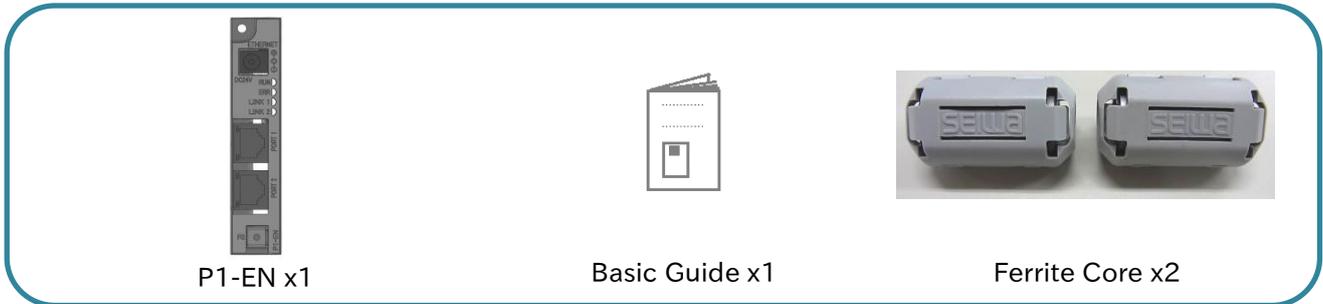


· What items are enclosed?



· The enclosed items are shown on the images below.

· Enclosed items



■ Ferrite core specification

Item Name	Manufacturer	Model	Inner Diameter
Ferrite Core	SEIWA ELECTRIC MFG Co., Ltd.	E04SR200935A	9mm



Contact your sales agent immediately in case there are defects or imperfections.

4.3 Verification after the purchase



- What should I verify after the purchase?

4.3.1 Verification when unpacking



- Please verify the items written on the right when unpacking.
- In case there is any doubt or trouble with the product please contact your sales agent as soon as possible.

✓ Check that the items were not smashed or damaged during the delivery.

Check that
there is a P1-EN,
✓ there is a Basic Guide,
there are 2 ferrite cores,
when unpacking.

✓ Please check again that your order match with the name plate of this device.

4.3.2 Read this guide

- This guide contains the information necessary to handle the P1-EN correctly. Read it carefully and keep it safe.
- Also, use the inverter user's guide and basic guide as a reference.
- Please make sure that the P1-EN basic guide and the inverter basic guide reach the end user. Additionally, advice the end user to download and read the latest version of this guide.

(Memo)

Chapter 5 Installation and Configuration

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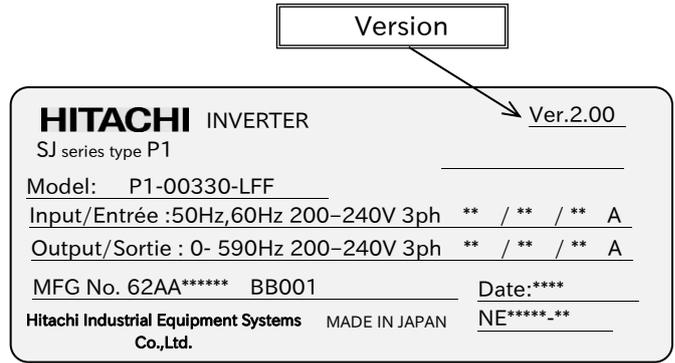
5.1 About this chapter

This chapter contains information for installing and system configuring this device on the inverter. For information about the inverter installation please refer to the inverter user's guide. Additionally, when doing any work or operation, always follow the safety instructions and cautions given in the chapter 1.

Symbol	Definition
	Precautions

5.2 Supported inverters

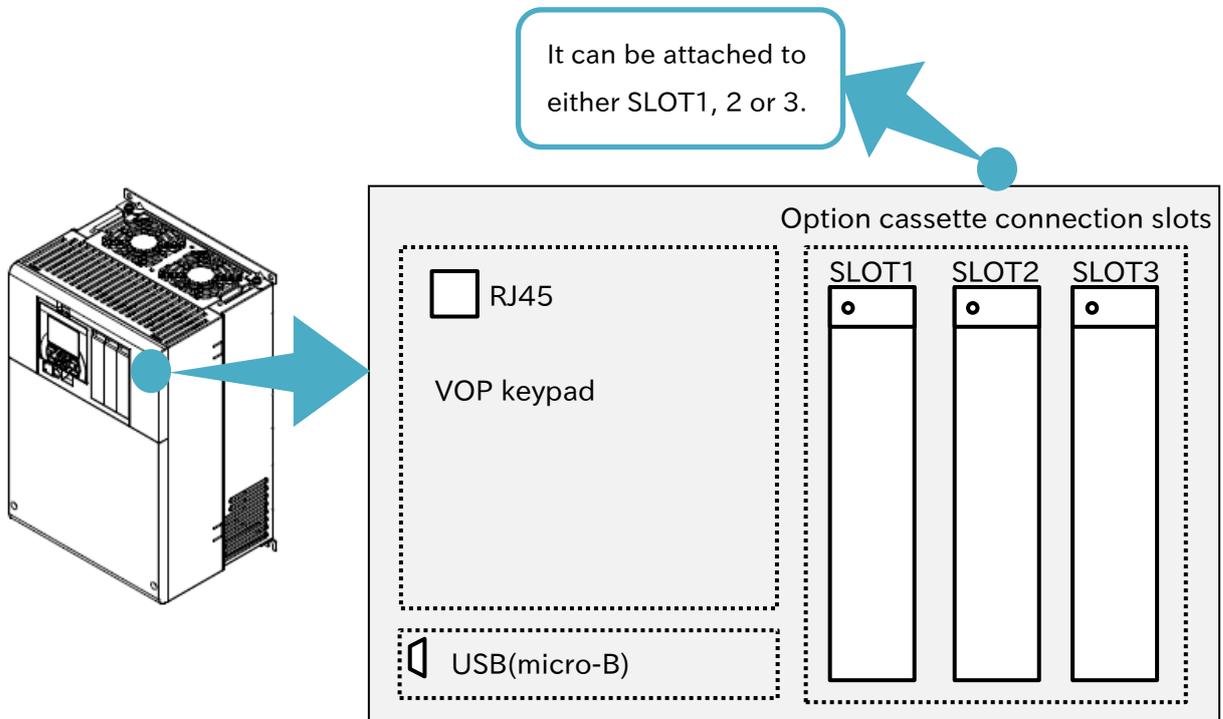
The P1-EN can be attached to all types of SJ-P1. However, depending on the SJ-P1 manufacture date, it might not support the P1-EN. Please check the version of the inverter which is written on the name plate of it (the name plate example is shown on the image to the right.) If the version is 2.00 or higher it can support the P1-EN.



5.3 Installation

5.3.1 About the installation

The P1-EN can be attached to any of the 3 option slots of the SJ-P1.

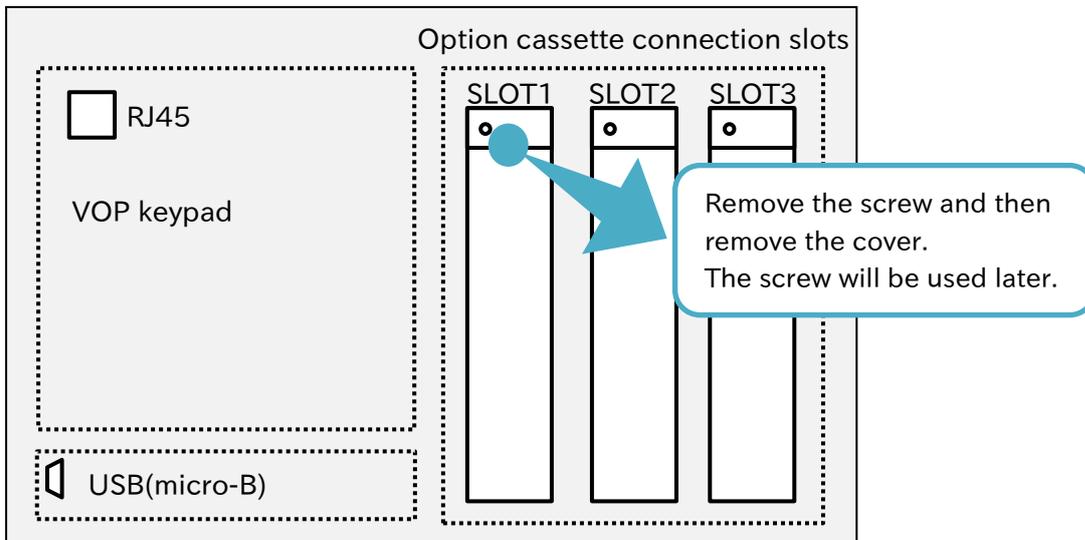


5.3.2 How to install

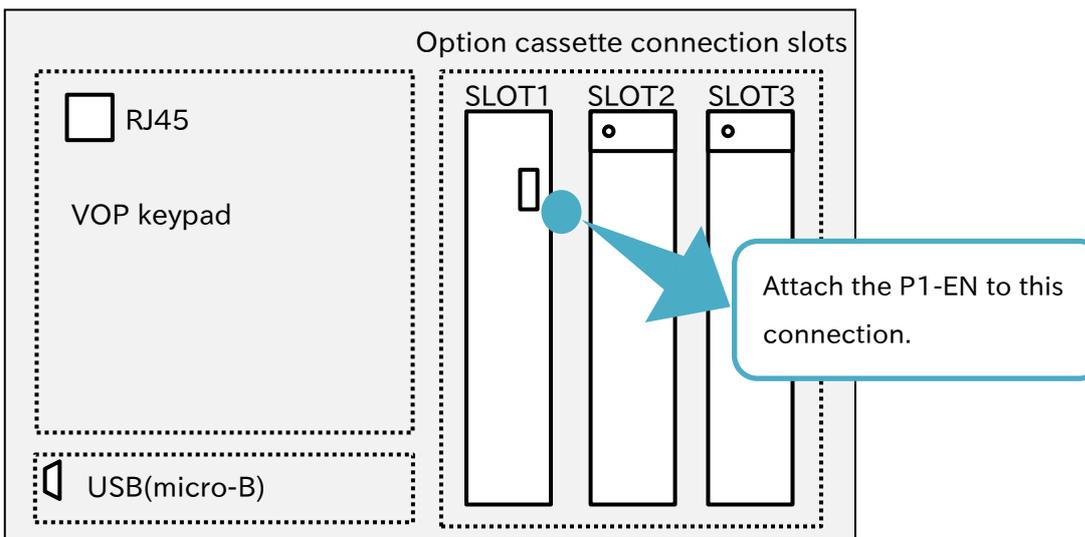
Before installing the P1-EN please refer to the chapter 6 "Inverter Settings" and configure the inverter.

For explanation purposes, it will be assumed that the P1-EN is going to be installed in the SLOT1.

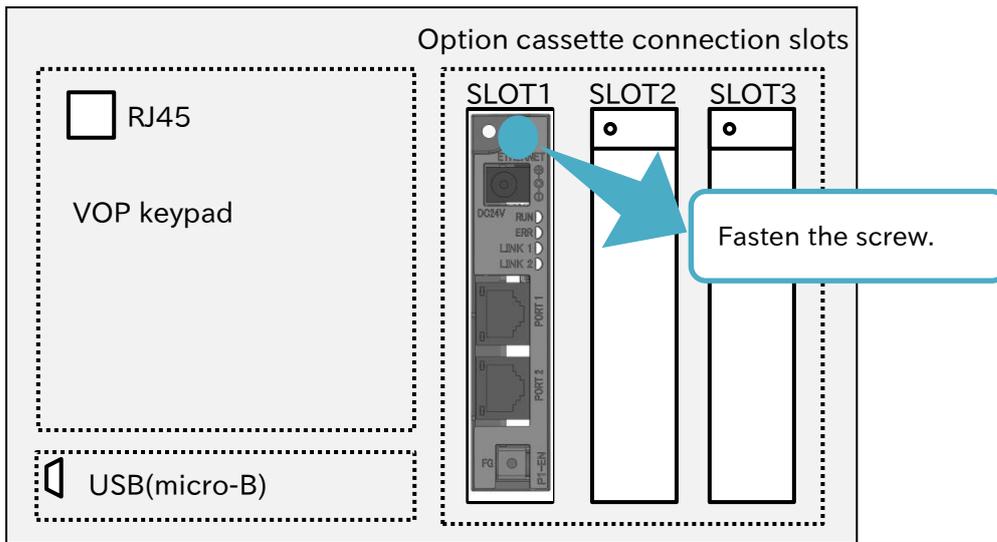
- (1) Remove the cover of the option cassette connection slot. Despite the removed cover will no longer be needed, it is recommended to keep it in a safe place. However the screw that secured the cover will be used to secure the P1-EN.



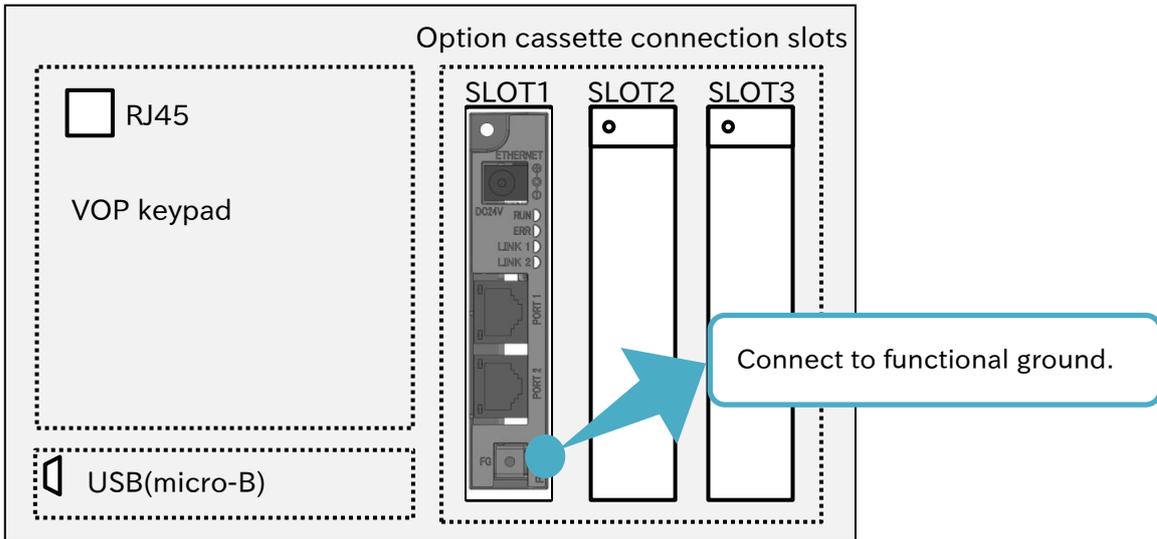
- (2) Attach this device. The slots 2 and 3 have one more connection in the lower side. However, the P1-EN will not need that connection.



- (3) Secure the P1-EN with the screw removed in procedure (1).



- (4) Connect the FG terminal to functional ground.



5.4 Attach the ferrite cores

Attach the included ferrite cores to the Ethernet cable. These cores should be attached as close as possible to the P1-EN RJ-45 connection.



Depending on the Ethernet cable the ferrite core cannot be correctly fixed to the cable and it may slip along the cable, despite having an anti-slip claw. In these cases the ferrite core can be fixed by attaching something like a clamping band or a wire to the Ethernet cable on one or both sides of the ferrite core. Keep in mind that the cores should be attached as close as possible to the P1-EN RJ-45 connection.

5.5 About the connection

- Make sure that the communication line and the power line are placed as far as possible from each other. If the power line and the communication line are placed close to each other, the communication line will pick up noise from the power line that can interfere with the transmission.
- Make sure to set up the system, so that in an event of a network failure, the inverter output stops immediately.
 - (1) In case the master detects an abnormality in the connection, shut down the inverter primary power supply.
 - (2) Allocate function "like free run" or "reset" to the inverter input terminals, accordingly, when the master detects a connection abnormality it turns on these terminals.
 - (3) Configure the inverter so in case of a connection abnormality, it stops, free run stops or trip. (When the operation command is received through Ethernet, the inverter shipment settings are configured so that if there is any abnormality in the connection the inverter will immediately stop.)

For other information concerning the installation, please refer to the inverter user's guide.



Connect the communication cable (Ethernet cable), so it minimizes the tension and stress over the connector. Furthermore, take the same precautions when connecting the power cable (for supplying the external power 24 VDC).

5.6 External features

5.6.1 Ethernet connector specifications

The P1-EN connector (PORT1 and PORT2) specifications are shown below.

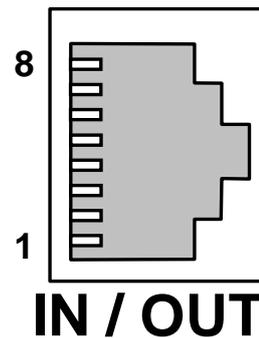
The connection is available Ethernet connectors conformed with 10BASE-T/100BASE-TX.

■ Connector specifications

Connector Type	Notes
RJ-45	The electric characteristics conform with the IEEE802.3 standard, category 5e or higher, with shield.

■ Pin assignment

Pin No.	Notation	Signal type
1	TD+	Data transmission+
2	TD-	Data transmission-
3	RD+	Data reception+
4	-	-
5	-	-
6	RD-	Data reception-
7	-	-
8	-	-



5.6.2 Ethernet cable specifications

An Ethernet twist pair cable (category 5e or higher) is used for the connection. It is recommended to use a cable with the following specifications.



The distance between the nodes (the devices) should be within 100 meters.

■ Cable recommended specifications

Item Name	Description
Twist pair cable	100BX-TX support (category 5e or higher) STP(Shield twist pair) cable (Straight or Crossed) When the configuring communication speed setting to auto negotiation, the function of Auto MDI-X is enabled. Therefore it can be used any the cable types.



- The function Auto MDI-X is valid or invalid by the inverter parameter setting. For information about the parameter, please refer to "6.2 Parameter settings" in this guide.
- When the function Auto MDI-X is invalid, require the suitable cable for the connecting devices. Namely, it is necessary for proper communication between the devices to use distinguished the cable of straight type or cross type.

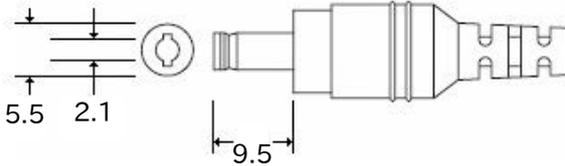
5.6.3 External power supply (optional)

Control circuits both the inverter and this device can be powered up by using external input DC24V. However, this function is not indispensable for operating this device.



It can always be supplied by the external power source. When using the external power, connect the cable, so it minimizes the tension and stress over the connector.

The input plug external view is shown below.



External power source specification:
DC24V±10% and 2A or more are required.

Plug type: PL03B

Polar characteristic: inner side (center) has positive.

For preventing electric shock, use a power source insulated from primary voltage which conform with the IEC/EN 61800-5-1 SELV.

5.6.4 LED

The P1-EN LEDs show the status of this device, details in the table below.

■ LED definition

LED	Color	Description
RUN	Green	Light off: P1-EN initializing Blinking: Link in preparation Light on: Link established the Ethernet communication
ERR	Red	Light off: No problem detected Blinking: Setting error in the inverter configuration related with the Ethernet Light on: There is a problem with the Ethernet connection
LINK1	Green	Light off: Link not established the PORT1 Light on: Link established the PORT1 Blinking: In preparation, link the PORT1 to the network
LINK2	Green	Light off: Link not established the PORT2 Light on: Link established the PORT2 Blinking: In preparation, link the PORT2 to the network



- When powered on this device, the RUN LED blinks first. After link established, the RUN LED turns on.
- It takes about 1 minute for the link established after the inverter powered on. In the meantime, all LEDs turn off.

5.7 System Configuration

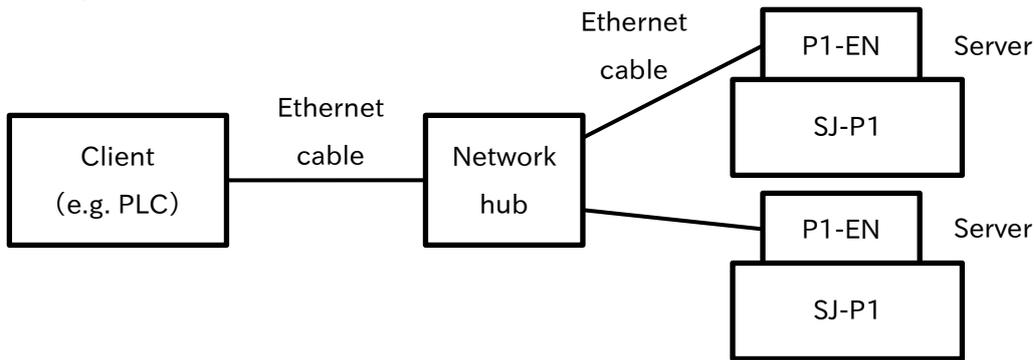
Examples of the Ethernet system configuration are shown below.



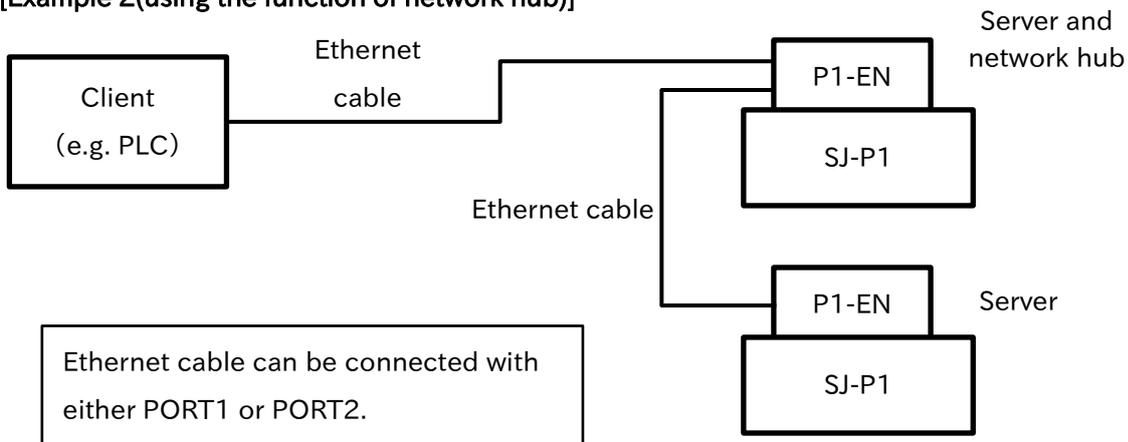
- When configuring a system or confirming the startup, read this guide and the instruction manual about the client. The client means higher-level device (master).

- In case of configuring a system that the inverter operates immediately at powered on, please consider to take about 1 minute for the link established.

[Example 1]



[Example 2(using the function of network hub)]



- Make sure that the communication line and the power line are placed as far as possible from each other. If the power line and the communication line are placed close to each other, the communication line will pick up noise from the power line that can interfere with the transmission.
- Make sure to set up the system, so that in an event of a network failure, the inverter output stops immediately. Instruct an example of procedure as shown in "5.5 About the connection".

[Function the network hub]
PORT1 and PORT2 are available as network hub (shown in above example 2), if the inverter is powered.



The only problem that the inverter can detect related to the Ethernet connection is a disconnection between this device and the inverter. If a communication timeout occurs by disconnection between this device and the client, there is no function to accommodate in such a trouble.

6

Chapter 6 Inverter Settings

Contents

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6.1 About this chapter

This chapter contains the information about the inverter settings that must be done when using the P1-EN.

Symbol	Definition
	Precautions

6.2 Parameter Settings

Before starting the communication, configure the following inverter settings as necessary.

6.2.1 Initialization

Configure the parameter [Ub-01] (Initialize mode selection) to 04 (Error history clear & Data initialize & EzSQ clear), and the parameter [Ub-05] (Initialize enable) to 01 (Initialize start), then the inverter settings will be initialized.



When configuring the inverter setting parameters, not only read this guide but also the inverter's guide and the client (higher-level device) instruction manual.

6.2.2 This device and the client (higher-level device) correlating parameters

The following table shows the inverter setting parameters and their contents related to this product and the client (higher-level device). This device reads and implements the following setting parameters from the inverter when it is powered on.



The following settings are implemented in this device when the inverter is powered on. Make sure to restart the inverter after configuring the parameters.

Parameter

Code	Parameter name	Selection	Initial value
oH-01	IP address selection	00(Gr.1)/01 (Gr.2)	00
oH-02	Communication speed (PORT1)	00(Auto Negotiation)/ 01(100M: Full-duplex)/ 02(100M: Half-duplex)/ 03(10M: Full-duplex)/ 04(10M: Half-duplex)	00
oH-03	Communication speed (PORT2)	00(Auto Negotiation)/ 01(100M: Full-duplex)/ 02(100M: Half-duplex)/ 03(10M: Full-duplex)/ 04(10M: Half-duplex)	00
oH-04	Ethernet communication timeout	1~65535(×10ms)	3000
oH-05	Modbus TCP port No. (IPv4)	502, 1024~65535	502
oH-06	Modbus TCP port No. (IPv6)	502, 1024~65535	502
oL-01	IPv4 IP address (1), Gr. 1	0~255	192
oL-02	IPv4 IP address (2), Gr. 1	0~255	168
oL-03	IPv4 IP address (3), Gr. 1	0~255	0
oL-04	IPv4 IP address (4), Gr. 1	0~255	2
oL-05	IPv4 sub-net mask (1), Gr. 1	0~255	255
oL-06	IPv4 sub-net mask (2), Gr. 1	0~255	255
oL-07	IPv4 sub-net mask (3), Gr. 1	0~255	255
oL-08	IPv4 sub-net mask (4), Gr. 1	0~255	0
oL-09	IPv4 default gateway (1), Gr. 1	0~255	192
oL-10	IPv4 default gateway (2), Gr. 1	0~255	168
oL-11	IPv4 default gateway (3), Gr. 1	0~255	0
oL-12	IPv4 default gateway (4), Gr. 1	0~255	1

Code	Parameter name	Selection	Initial value
oL-20	IPv6 IP address (1), Gr. 1	0000~FFFF	0000
oL-21	IPv6 IP address (2), Gr. 1	0000~FFFF	0000
oL-22	IPv6 IP address (3), Gr. 1	0000~FFFF	0000
oL-23	IPv6 IP address (4), Gr. 1	0000~FFFF	0000
oL-24	IPv6 IP address (5), Gr. 1	0000~FFFF	0000
oL-25	IPv6 IP address (6), Gr. 1	0000~FFFF	0000
oL-26	IPv6 IP address (7), Gr. 1	0000~FFFF	0000
oL-27	IPv6 IP address (8), Gr. 1	0000~FFFF	0000
oL-28	IPv6 prefix of sub-net, Gr. 1	0~127	64
oL-29	IPv6 default gateway (1), Gr. 1	0000~FFFF	0000
oL-30	IPv6 default gateway (2), Gr. 1	0000~FFFF	0000
oL-31	IPv6 default gateway (3), Gr. 1	0000~FFFF	0000
oL-32	IPv6 default gateway (4), Gr. 1	0000~FFFF	0000
oL-33	IPv6 default gateway (5), Gr. 1	0000~FFFF	0000
oL-34	IPv6 default gateway (6), Gr. 1	0000~FFFF	0000
oL-35	IPv6 default gateway (7), Gr. 1	0000~FFFF	0000
oL-36	IPv6 default gateway (8), Gr. 1	0000~FFFF	0000
oL-40	IPv4 IP address (1), Gr. 2	0~255	192
oL-41	IPv4 IP address (2), Gr. 2	0~255	168
oL-42	IPv4 IP address (3), Gr. 2	0~255	0
oL-43	IPv4 IP address (4), Gr. 2	0~255	2
oL-44	IPv4 sub-net mask (1), Gr. 2	0~255	255
oL-45	IPv4 sub-net mask (2), Gr. 2	0~255	255
oL-46	IPv4 sub-net mask (3), Gr. 2	0~255	255
oL-47	IPv4 sub-net mask (4), Gr. 2	0~255	0
oL-48	IPv4 default gateway (1), Gr. 2	0~255	192
oL-49	IPv4 default gateway (2), Gr. 2	0~255	168
oL-50	IPv4 default gateway (3), Gr. 2	0~255	0
oL-51	IPv4 default gateway (4), Gr. 2	0~255	1
oL-60	IPv6 IP address (1), Gr. 2	0000~FFFF	0000
oL-61	IPv6 IP address (2), Gr. 2	0000~FFFF	0000
oL-62	IPv6 IP address (3), Gr. 2	0000~FFFF	0000
oL-63	IPv6 IP address (4), Gr. 2	0000~FFFF	0000
oL-64	IPv6 IP address (5), Gr. 2	0000~FFFF	0000
oL-65	IPv6 IP address (6), Gr. 2	0000~FFFF	0000
oL-66	IPv6 IP address (7), Gr. 2	0000~FFFF	0000
oL-67	IPv6 IP address (8), Gr. 2	0000~FFFF	0000
oL-68	IPv6 prefix of sub-net, Gr. 2	0~127	64
oL-69	IPv6 default gateway (1), Gr. 2	0000~FFFF	0000
oL-70	IPv6 default gateway (2), Gr. 2	0000~FFFF	0000
oL-71	IPv6 default gateway (3), Gr. 2	0000~FFFF	0000
oL-72	IPv6 default gateway (4), Gr. 2	0000~FFFF	0000
oL-73	IPv6 default gateway (5), Gr. 2	0000~FFFF	0000
oL-74	IPv6 default gateway (6), Gr. 2	0000~FFFF	0000
oL-75	IPv6 default gateway (7), Gr. 2	0000~FFFF	0000
oL-76	IPv6 default gateway (8), Gr. 2	0000~FFFF	0000

- [oH-01]: IP address selection
There are 2 possible ways of configuring the IP address, and they are classified in two groups. The parameter [oH-01] can communicate using either the group 1 or group 2.
Group 1(Gr.1): 00
Group 2(Gr.2): 01
 - [oH-02]: Communication speed (PORT-1)
 - [oH-03]: Communication speed (PORT-2)
These parameters can select the speed of the Ethernet communication port.
oH-02: select communication speed of the PORT1
oH-03: select communication speed of the PORT2
Although the parameter setting in 00(auto negotiation) is recommended. For the other settings the function Auto MDI-X is unavailable.
 - [oH-04]: Ethernet communication timeout
After the link established, if there is no reception within the time set in the parameter [oH-04] this device will disconnect the communication with the client (higher-level device).
- 

Even if a timeout occurs, the inverter has no function to implement a trip error or other operations against the timeout.
- [oH-05]: Modbus TCP port No. (IPv4)
 - [oH-06]: Modbus TCP port No. (IPv6)
These parameters can select the port number of Modbus TCP that is able to be configured from 1024 to 65535. Although as standard specification the Modbus TCP port number generally sets in 502.
[oH-05]: in the case of using the IPv4
[oH-06]: in the case of using the IPv6
 - [oL-01]~[oL-04]:
IPv4 IP address (1)~(4), Gr. 1
 - [oL-20]~[oL-27]:
IPv6 IP address (1)~(8), Gr. 1
 - [oL-40]~[oL-43]:
IPv4 IP address (1)~(4), Gr. 2
 - [oL-60]~[oL-67]:
IPv6 IP address (1)~(8), Gr. 2
These parameters can configure the IP address of the Ethernet communication.
[oL-01] to [oL-04]:
in case of using the group 1 and the IPv4
[oL-20] to [oL-27]:
in case of using the group 1 and the IPv6
[oL-40] to [oL-43]:
in case of using the group 2 and the IPv4
[oL-60] to [oL-67]:
in case of using the group 2 and the IPv6
- 

Do not configure an IP address that may overlap, when configuring a system. The system may not work properly.
- [oL-05]~[oL-08]:
Pv4 sub-net mask (1)~(4), Gr. 1
 - [oL-44]~[oL-47]:
Pv4 sub-net mask (1)~(4), Gr. 2
These parameters can configure the sub-net mask of the Ethernet communication when using the IPv4.
[oL-01] to [oL-04]:
in case of using the group 1 and the IPv4
[oL-20] to [oL-27]:
in case of using the group 1 and the IPv6
 - [oL-28]: IPv6 prefix of sub-net, Gr. 1
 - [oL-68]: IPv6 prefix of sub-net, Gr. 2
These parameters can configure the prefix of sub-net of the Ethernet communication when using the IPv6.
[oL-28]:
in case of using the group 1
[oL-68]:
in case of using the group 2

- [oL-09]~[oL-12]:
IPv4 default gateway (1)~(4), Gr. 1
 - [oL-29]~[oL-36]:
IPv6 default gateway (1)~(8), Gr. 1
 - [oL-48]~[oL-51]:
IPv4 default gateway (1)~(4), Gr. 2
 - [oL-69]~[oL-76]:
IPv6 default gateway (1)~(8), Gr. 2
- These parameters can configure the default gateway of the Ethernet communication.
- [oL-09] to [oL-12]:
in case of using the group 1 and the IPv4
- [oL-29] to [oL-36]:
in case of using the group 1 and the IPv6
- [oL-48] to [oL-51]:
in case of using the group 2 and the IPv4
- [oL-69] to [oL-76]:
in case of using the group 2 and the IPv6

6.2.3 Inverter and P1-EN correlating parameters

The parameters described in the following table control the action taken by the inverter when there is a problem with this device or when this device is connected.

Parameter

Code	Parameter name	Selection	Initial value
oA-10	Operation mode on option card error (SLOT-1)	00(Error)/ 01(Ignore error (keep running))	00
oA-13	Run command selection at start up (SLOT-1)	00(run command disabled)/ 01(run command enabled)	00
oA-20	Operation mode on option card error (SLOT-2)	00(Error)/ 01(Ignore error (keep running))	00
oA-23	Run command selection at start up (SLOT-2)	00(run command disabled)/ 01(run command enabled)	00
oA-30	Operation mode on option card error (SLOT-3)	00(Error)/ 01(Ignore error (keep running))	00
oA-33	Run command selection at start up (SLOT-3)	00(run command disabled)/ 01(run command enabled)	00

- [oA-10]: Operation mode on option card error (SLOT-1)
- [oA-20]: Operation mode on option card error (SLOT-2)
- [oA-30]: Operation mode on option card error (SLOT-3)

These parameters can select whether to ignore the option error trip or not in cases where there are connection failures between this device and the inverter

Let the inverter trip: 00 (error)

Ignore the error and continue with the operation: 01(Ignore error (keep running))

Please make sure to configure the parameter corresponding to the slot in which this device is attached.



In the event there is a communication failure between the inverter and this device, and the option 01 (Ignore error (keep running)) is selected, the inverter operation will not stop.

Additionally, in case there is a communication failure between this device and the inverter, the client (master) stop command will not be received. Thus, safety measures and precautions are recommended.

- [oA-13]: Run command selection at start up (SLOT-1)
- [oA-23]: Run command selection at start up (SLOT-2)
- [oA-33]: Run command selection at start up (SLOT-3)

These parameters can select whether to execute run commands or not while this device and the inverter communication is being established

Do not execute: 00(run command disabled)

Execute: 01(run command enabled)

Please make sure to configure the parameter corresponding to the slot in which this device is attached.



This function can be used in cases when it is required to operate the inverter as soon as it is turned on. However, since the inverter will operate before the communication is established, we recommend taking precautions accordingly, when designing the system.

6.2.4 Other parameters

In addition to the configurations explained in sections 6.2.2 and 6.2.3, please verify the configuration of the following parameters when using this device.

- [CF-11]: Function for transforming the register data from A, V to %
When using this device please select the 00(A, V) setting.
- [oA-11]: Communication Watch Dog Timer (SLOT-1)
- [oA-21]: Communication Watch Dog Timer (SLOT-2)
- [oA-31]: Communication Watch Dog Timer (SLOT-3)
This setting is unavailable for this device. Please do not change the setting.
- [oA-12]: Action selection at communication error (SLOT-1)
- [oA-22]: Action selection at communication error (SLOT-2)
- [oA-32]: Action selection at communication error (SLOT-3)
This setting is unavailable for this device. Please do not change the setting.

7

Chapter 7 About the Modbus TCP

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7.1 About this chapter

This chapter contains information for the Modbus TCP communication.

The P1-EN is a server device that uses Modbus TCP communication via the network conformed with IEEE 802.3 (10BASE-T or 100BASE-TX).

Additionally, when doing any work or operation, always follow the safety instructions and cautions given in the chapter 1.

7.2 About the Modbus TCP

7.2.1 Communication specification

The protocol of this device is Modbus TCP.

Communication specification

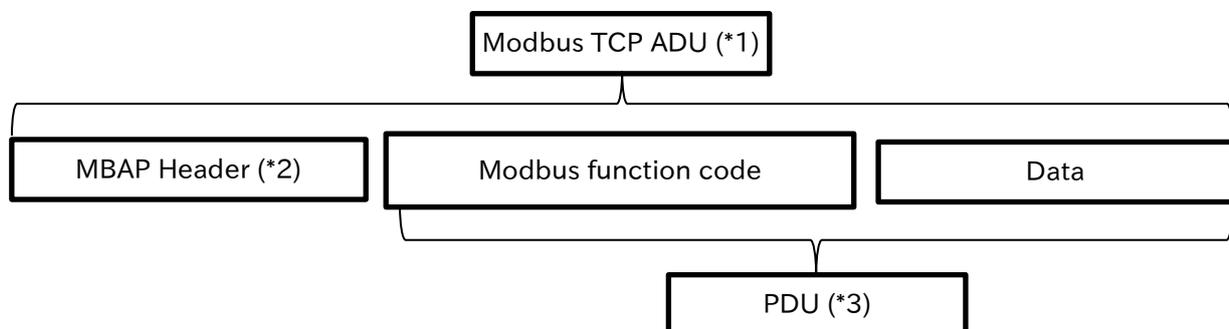
Items	Description
Communication method (transmission speed)	Fixed transmission speed: 10Mbps Full/Half-duplex or 100Mbps Full/Half-duplex *1) Auto detection transmission speed: Auto negotiation *1)
Auto MDI-X	According to selection of communication method (transmission speed), it is to be configured as follows. Selecting the auto negotiation: the function Auto MDI-X is available. Selecting others: the function Auto MDI-X is unavailable.
Communication protocol	TCP/IP
Communication protocol (application layer)	Modbus TCP
Maximum number of sessions	4 *2)
Port number	502 (it can be configured by the inverter parameter setting), [oH-05] (Modbus TCP port No. (IPv4)) or [oH-06] (Modbus TCP port No. (IPv6))
Communication distance	Distance between nodes: 100[m]max

*1) Refer to the configuration of the parameter [oH-02] (Communication speed (PORT1)) or [oH-03] (Communication speed (PORT2)).

*2) Do not connect this device to more than one of the PC software (ProDriveNext: our product) the same time. There is a possibility that data conflict occurs and the operation will not be performed properly when being access from multiple ProDriveNext at the same time.

7.2.2 Modbus TCP frame

The frame structure of the Modbus TCP is shown below.



(*1) Modbus TCP ADU (Application Data Unit)

(*2) MBAP Header (Modbus Application Protocol Header)

(*3) PDU (Protocol Data Unit)

7.2.3 Data format

The data formats of MBAP Header and PDU are shown below

The transfer from client (higher-level device) to the server (P1-EN) and server (P1-EN) to client (higher-level device) have the same format.

■ Data format of MBAP Header

Address	Items	Description
0,1	Transaction Identifier	The client (higher-level device) to the server (P1-EN): Configure an arbitrary ID to identify the transaction. The server (P1-EN) to the client (higher-level device): It returns the received data as it is.
2,3	Protocol Identifier	The client (higher-level device) to the server (P1-EN): Configure "0000h". The server (P1-EN) to the client (higher-level device): It returns "0000h".
4,5	Length	Configure the size of datas united Unit ID (address 6) and PDU (address 7 to N). (unit: the number of bytes) *1)
6	Unit Identifier	The client (higher-level device) to the server (P1-EN): Configure "FFh". The server (P1-EN) to the client (higher-level device): It returns "FFh".

*1) In case configuring a length setting which differs from the specification, it will be determined as the error and there will be no response.

■ Data format of PDU

Address	Items	Description
7	Modbus function code	The client (higher-level device) to the server (P1-EN): Configure an arbitrary Modbus function code. The server (P1-EN) to the client (higher-level device): In the case of normal response, it returns the Modbus function code. Or in the case of exception response, it returns the code the Modbus function code concatenated with "80h".
8~N	Data	The client (higher-level device) to the server (P1-EN): Configure the inquiry data. The server (P1-EN) to the client (higher-level device): It returns the response data. Or in the case of exception response, it returns the exception code.

7.2.4 Modbus function code

The Modbus function codes available with the inverter are shown the followings.

Function code definition

Code	Function	Maximum data bytes that can be handled by 1 message	Maximum number of datas that can be handled by 1 message
01h	Read Coils	4	32 coils (bit unit)
03h	Read holding registers	32	16 registers (2 byte length unit)
05h	Write single coil	2	Single coil (bit unit)
06h	Write single register	2	Single register (2 byte length unit)
08h	Diagnostics	—	—
0Fh	Write multiple coils	4	32coils (bit unit)
10h	Write multiple registers	32	16 registers (2 byte length unit)
17h	Read/Write multiple registers	32	16 registers (2 byte length unit)

The data format available with the Modbus is shown below.

Data format

Items	Description
Coil	Binary data (1 bit length) that can be read or written.
Holding register	16-bit word data that can be read or written.

For information about the code number of coil and holding register, refer to the inverter user's guide. Also, the data scale of each holding register is determined by the data resolution.

(Examples)

- In the case of the parameter "[Ab110]: Multispeed-0 setting, 1st-motor" (register number: 2F4Eh) its data resolution is 0.01[Hz], hence the data scale is 100 times. That is, if the data is 50.00[Hz], it is expressed as 5000d.
- In the case of the parameter "[bC110]: Electronic thermal level setting, 1st-motor" (register number: 339Ah) (register number: 2F4Eh) its data resolution is 0.1[A], hence the data scale is 10 times. That is, if the data is 25.0[A], it is expressed as 250d.
- In the case of the parameter "[Hb110]: Async. Motor constant R1, 1st-motor" (register number: 3B06h to 3B07h) its data resolution is 0.000001[ohm], hence the data scale is 1000000 times. That is, if the data is 0.149378[ohm] it is expressed as 149378d.

7.2.5 Read coils [01h]

This function code is used to read status of coils.

[Request]

The Request specifies the starting address, i.e. the address of the first coil specified, and the number of coils.

(Example)

Reading 15 coils with the coil number of "0001h" through "000Fh".

Address	Blocks	Items	Code
0	Modbus TCP header part	Transaction ID (Hi)	15h
1		Transaction ID (Lo)	01h
2		Protocol ID (Hi)	00h
3		Protocol ID (Lo)	00h
4		Data size (Hi)	00h
5		Data size (Lo)	06h
6		Unit ID	FFh
7	Modbus data part	Function code	01h
8		Starting address (Hi)	00h
9		Starting address (Lo)	00h
10		Quantity of coils (Hi)	00h
11		Quantity of coils (Lo)	0Fh

} In the case, 6 byte lengths (address 6 through 11).

} In the case, "0000h" ("0001h" minus 1).

} In the case, the quantity of coils is 15.

Hi: high order

Lo: low order

[Response]

The coils in the response message are packed as one coil per bit of the data field.

When reading 15 coils with the coil number of 0001h through 000Fh (in the above request), it returns the codes the following.

Address	Blocks	Items	Code
0	Modbus TCP header part	Transaction ID (Hi)	15h
1		Transaction ID (Lo)	01h
2		Protocol ID (Hi)	00h
3		Protocol ID (Lo)	00h
4		Data size (Hi)	00h
5		Data size (Lo)	05h
6		Unit ID	FFh
7	Modbus data part	Function code	01h
8		Byte conut	02h
9		Output status 1	40h
10		Output status 2	12h

} In the case, 5 byte lengths (address 6 through 10).

← Coil number: "0008h" through "0001h"

← Coil number: "000Fh" through "0009h"

Hi: high order

Lo: low order

The status of outputs 8 through 1 is shown as the byte value "40h", or binary "0100 0000b". Output 8 is the MSB of this byte, and output 1 is the LSB. Likewise, the status of outputs F through 9 is shown as the byte value "12h", or binary "0001 0010b". Output F is in the seventh bit position from the right, and output F is the MSB of this byte. The one remaining high order bit is zero filled.

By convention, bits within a byte are shown with the MSB to the left, and the LSB to the right.

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Coil status 1	0008h	0007h	0006h	0005h	0004h	0003h	0002h	0001h
	OFF(0)	ON(1)	OFF(0)	OFF(0)	OFF(0)	OFF(0)	OFF(0)	OFF(0)
Coil status 2	Remain	000Fh	000Eh	000Dh	000Ch	000Bh	000Ah	0009h
	OFF(0)	OFF(0)	OFF(0)	ON(1)	OFF(0)	OFF(0)	ON(1)	OFF(0)

↑

If the returned output quantity is not a multiple of eight, the remaining bits in the final data byte will be padded with zeros (toward the high order end of the byte).

7.2.6 Read holding registers [03h]

This function code is used to read the contents of a contiguous block of holding registers.

[Request]

The request specifies the starting register address and the number of registers. In the registers are addressed starting at zero.

(Example)

Reading information about trips ("03E9h" through "03EDh") from the inverter.

Address	Blocks	Items	Code
0	Modbus TCP header part	Transaction ID (Hi)	15h
1		Transaction ID (Lo)	01h
2		Protocol ID (Hi)	00h
3		Protocol ID (Lo)	00h
4		Data size (Hi)	00h
5		Data size (Lo)	06h
6		Unit ID	FFh
7	Modbus data part	Function code	03h
8		Starting address (Hi)	03h
9		Starting address (Lo)	E8h
10		Number of registers (Hi)	00h
11		Number of registers (Lo)	05h

} In the case, 6 byte lengths (address 6 through 11).

} In the case, "03E8h" ("03E9h" minus 1).

} In the case, the number of registers is 5.

Hi: high order

Lo: low order

[Response]

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte.

Address	Blocks	Items	Code	
0	Modbus TCP header part	Transaction ID (Hi)	15h	} In the case, 13 byte lengths (address 6 through 18).
1		Transaction ID (Lo)	01h	
2		Protocol ID (Hi)	00h	
3		Protocol ID (Lo)	00h	
4		Data size (Hi)	00h	
5		Data size (Lo)	0Dh	
6		Unit ID	FFh	
7	Modbus data part	Function code	03h	} 0003h→03d →E03(factor: over current)
8		Byte count *1)	0Ah	
9		Redister value 1 (Hi)	00h	
10		Redister value 1 (Lo)	03h	
11		Redister value 2 (Hi)	00h	
12		Redister value 2 (Lo)	00h	
13		Redister value 3 (Hi)	04h	
14		Redister value 3 (Lo)	D2h	
15		Redister value 4 (Hi)	00h	
16		Redister value 4 (Lo)	1Eh	
17		Redister value 5 (Hi)	01h	
18	Redister value 5 (Lo)	1Ch		

Hi: high order

Lo: low order

*1) Data for the number of data bytes is transferred.
 In the above example, it returns 10 ("0Ah") bytes for five holding register data.

7.2.7 Write single coil [05h]

This function code is used to write a single output to either ON or OFF.

Data	Coil status	
	To be ON	To be OFF
Output value (Hi)	FFh	00h
Output value (Lo)	00h	00h

[Request]

The request specifies the address of the coil to be forced.

(Example)

Configure the code number "0001h (operation command)" to "ON (driving)".

Address	Blocks	Items	Code	
0	Modbus TCP header part	Transaction ID (Hi)	15h	} In the case, 6 byte lengths (address 6 through 11).
1		Transaction ID (Lo)	01h	
2		Protocol ID (Hi)	00h	
3		Protocol ID (Lo)	00h	
4		Data size (Hi)	00h	
5		Data size (Lo)	06h	
6	Modbus data part	Unit ID	FFh	} In the case, "0000h" ("0001h" minus 1). } "FF00h" (to be ON)
7		Function code	05h	
8		Starting address (Hi)	00h	
9		Starting address (Lo)	00h	
10		Output value (Hi)	FFh	
11		Output value (Lo)	00h	

[Response]

The normal response is an echo of the request, returned after the coil state has been written.

Configure the inverter parameter [AA111] to "03 (RS485)" in order to drive actually.

Address	Blocks	Items	Code	
0	Modbus TCP header part	Transaction ID (Hi)	15h	} In the case, 6 byte lengths (address 6 through 11).
1		Transaction ID (Lo)	01h	
2		Protocol ID (Hi)	00h	
3		Protocol ID (Lo)	00h	
4		Data size (Hi)	00h	
5		Data size (Lo)	06h	
6	Modbus data part	Unit ID	FFh	} In the case, "0000h" ("0001h" minus 1). } "FF00h" (to be ON)
7		Function code	05h	
8		Starting address (Hi)	00h	
9		Starting address (Lo)	00h	
10		Output value (Hi)	FFh	
11		Output value (Lo)	00h	

Hi: high order

Lo: low order

7.2.8 Write single register [06h]

This function code is used to write a single holding register.

[Request]

The request specifies the address of the register to be written. Registers are addressed starting at zero.

(Example)

Configure the register number "2F4Eh (Multispeed-0 setting, 1st-motor)" to "50.00[Hz]".

Address	Blocks	Items	Code
0	Modbus TCP header part	Transaction ID (Hi)	15h
1		Transaction ID (Lo)	01h
2		Protocol ID (Hi)	00h
3		Protocol ID (Lo)	00h
4		Data size (Hi)	00h
5		Data size (Lo)	06h
6		Unit ID	FFh
7	Modbus data part	Function code	06h
8		Starting address (Hi)	2Fh
9		Starting address (Lo)	4Dh
10		Register vaule (Hi)	13h
11		Register value (Lo)	88h

} In the case, 6 byte lengths (address 6 through 11).
 } In the case, "2F4Dh" ("2F4Eh" minus 1).
 } 1388h→5000d
 } →50.00[Hz] (frequency)

[Response]

The normal response is an echo of the request, returned after the register contents have been written.

Configure the inveter parameter [AA101] to "07 (parameter setting)" in order to drive actually.

Address	Blocks	Items	Code
0	Modbus TCP header part	Transaction ID (Hi)	15h
1		Transaction ID (Lo)	01h
2		Protocol ID (Hi)	00h
3		Protocol ID (Lo)	00h
4		Data size (Hi)	00h
5		Data size (Lo)	06h
6		Unit ID	FFh
7	Modbus data part	Function code	06h
8		Starting address (Hi)	2Fh
9		Starting address (Lo)	4Dh
10		Register vaule (Hi)	13h
11		Register value (Lo)	88h

} In the case, 6 byte lengths (address 6 through 11).
 } In the case, "2F4Dh" ("2F4Eh" minus 1).
 } 1388h→5000d
 } →50.00[Hz] (frequency)

Hi: high order

Lo: low order

7.2.9 Diagnostics [08h]

Function code 08 provides a test (only 00: Return Query Data) for checking the communication system between the server and the client.

The normal response to the Return Query Data request is to loopback the same data. The function code and sub-function codes are also echoed.

[Request]

Address	Blocks	Items	Code
0	Modbus TCP header part	Transaction ID (Hi)	15h
1		Transaction ID (Lo)	01h
2		Protocol ID (Hi)	00h
3		Protocol ID (Lo)	00h
4		Data size (Hi)	00h
5		Data size (Lo)	06h
6		Unit ID	FFh
7	Modbus data part	Function code	08h
8		Sub-function (Hi)	00h
9		Sub-function (Lo)	00h
10		Data (Hi)	XXh
11		Data (Lo)	XXh

} In the case, 6 byte lengths (address 6 through 11).

← freely-selected

[Response]

Address	Blocks	Items	Code
0	Modbus TCP header part	Transaction ID (Hi)	15h
1		Transaction ID (Lo)	01h
2		Protocol ID (Hi)	00h
3		Protocol ID (Lo)	00h
4		Data size (Hi)	00h
5		Data size (Lo)	06h
6		Unit ID	FFh
7	Modbus data part	Function code	08h
8		Sub-function (Hi)	00h
9		Sub-function (Lo)	00h
10		Data (Hi)	XXh
11		Data (Lo)	XXh

} In the case, 6 byte lengths (address 6 through 11).

← freely-selected

Hi: high order

Lo: low order

7.2.10 Write multiple coils [0Fh]

This function code is used to force each coil in a sequence of coils to either ON or OFF.

[Request]

The request specifies the coil references to be forced.

(Example)

Configure 15 coils with coil number "0001h" through "000Fh" especially "0007h", "000Ah" and "000Dh" (input terminal: 3, 6 and 9) to ON.

By convention, bits within a byte are shown with the MSB to the left, and the LSB to the right.

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Output value (Hi)	0008h	0007h	0006h	0005h	0004h	0003h	0002h	0001h
	OFF(0)	ON(1)	OFF(0)	OFF(0)	OFF(0)	OFF(0)	OFF(0)	OFF(0)
Output value (Lo)	Remine	000Fh	000Eh	000Dh	000Ch	000Bh	000Ah	0009h
	OFF(0)	OFF(0)	OFF(0)	ON(1)	OFF(0)	OFF(0)	ON(1)	OFF(0)



If the returned output quantity is not a multiple of eight, the remaining bits in the final data byte will be padded with zeros (toward the high order end of the byte).

Output value (Hi) = 01000000b = 40h
 (coil number: 0008h through 0001h)
 Output value (Lo) = 00010010b = 12h
 (coil number: 000Fh through 0009h)

Address	Blocks	Items	Code
0	Modbus TCP header part	Transaction ID (Hi)	15h
1		Transaction ID (Lo)	01h
2		Protocol ID (Hi)	00h
3		Protocol ID (Lo)	00h
4		Data size (Hi)	00h
5		Data size (Lo)	09h
6		Unit ID	FFh
7	Modbus data part	Function code	0Fh
8		Starting address (Hi)	00h
9		Starting address (Lo)	00h
10		Quantity (Hi)	00h
11		Quantity (Lo)	0Fh
12		Byte Count *1)	02h
13		Outputs value (Hi) *2)	40h
14		Outputs value (Lo) *2)	12h

} In the case, 10 byte lengths (address 6 through 15).

Hi: high order
 Lo: low order

*1) Even if the number of bytes that actually need to be changed is odd, add 1 to the number of bytes. As a result, "Byte Count" is configured to the even number at all times.

*2) In the case of note *1), the added "Outputs value" should be configured to 00h.

[Response]

The normal response returns the function code, starting address, and quantity of coils forced.

Address	Blocks	Items	Code
0	Modbus TCP header part	Transaction ID (Hi)	15h
1		Transaction ID (Lo)	01h
2		Protocol ID (Hi)	00h
3		Protocol ID (Lo)	00h
4		Data size (Hi)	00h
5		Data size (Lo)	06h
6		Unit ID	FFh
7	Modbus data part	Function code	0Fh
8		Starting address (Hi)	00h
9		Starting address (Lo)	00h
10		Quantity of coils (Hi)	00h
11		Quantity of coils (Lo)	0Fh

} In the case, 6 byte lengths (address 6 through 11).

Hi: high order

Lo: low order

7.2.11 Write multiple registers [10h]

This function code is used to write a block of contiguous registers.

[Request]

The requested written values are specified in the request data field.

(Example)

Configure the register number "2B02h (FA-10: acceleration time monitor)" to 10.00[s].

Address	Blocks	Items	Code
0	Modbus TCP header part	Transaction ID (Hi)	15h
1		Transaction ID (Lo)	01h
2		Protocol ID (Hi)	00h
3		Protocol ID (Lo)	00h
4		Data size (Hi)	00h
5		Data size (Lo)	0Bh
6		Unit ID	FFh
7	Modbus data part	Function code	10h
8		Starting address (Hi)	2Bh
9		Starting address (Lo)	01h
10		Quantity register (Hi)	00h
11		Quantity register (Lo)	02h
12		Byte count *1)	04h
13		Register value 1 (Hi)	00h
14		Register value 1 (Lo)	00h
15	Register value 2 (Hi)	03h	
16	Register value 2 (Lo)	E8h	

In the case, 6 byte lengths (address 6 through 11).

In the case, "2B01h" ("2B02h" minus 1).

0000 03E8h → 1000d → 10.00[s]

*1) Configure the number of bytes to actually change, not the number of hold registers.

[Response]

The normal response returns the function code, starting address, and quantity of registers written.

Address	Blocks	Items	Code
0	Modbus TCP header part	Transaction ID (Hi)	15h
1		Transaction ID (Lo)	01h
2		Protocol ID (Hi)	00h
3		Protocol ID (Lo)	00h
4		Data size (Hi)	00h
5		Data size (Lo)	06h
6		Unit ID	FFh
7	Modbus data part	Function code	10h
8		Starting address (Hi)	2Bh
9		Starting address (Lo)	01h
10		Quantity register (Hi)	00h
11	Quantity register (Lo)	02h	

In the case, 6 byte lengths (address 6 through 11).

Hi: high order

Lo: low order

7.2.12 Read/Write multiple registers [17h]

This function code performs a combination of one read operation and one write operation. The write operation is performed before the read.

[Request]

The request specifies the starting address and number of holding registers to be read as well as the starting address, number of holding registers, and the data to be written.

(Example)

Configure the register number "2B02h (FA-10: acceleration time monitor)" to 10.00[s].
Then, read the register number "2B04h (FA-12: deceleration time monitor)".

Address	Blocks	Items	Code
0	Modbus TCP header part	Transaction ID (Hi)	15h
1		Transaction ID (Lo)	01h
2		Protocol ID (Hi)	00h
3		Protocol ID (Lo)	00h
4		Data size (Hi)	00h
5		Data size (Lo)	0Fh
6		Unit ID	FFh
7	Modbus data part	Function code	17h
8		Read starting address (Hi)	2Bh
9		Read starting address (Lo)	03h
10		Quantity to read (Hi)	00h
11		Quantity to read (Lo)	02h
12		Write starting address (Hi)	2Bh
13		Write starting address (Lo)	01h
14		Quantity to write (Hi)	00h
15		Quantity to write (Lo)	02h
16		Byte count *1)	04h
17		Write register value 1 (Hi)	00h
18		Write register value 1 (Lo)	00h
19		Write register value 2 (Hi)	03h
20	Write register value 2 (Lo)	E8h	

} In the case, 15 byte lengths (address 6 through 20).
 } In the case, "2B03h" ("2B04h" minus 1).
 } In the case, "2B01h" ("2B02h" minus 1).
 } 0000 03E8h
 →1000d→10.00[s]

Hi: high order

Lo: low order

*1) Configure the number of bytes to actually change, not the number of hold registers.

[Response]

The normal response contains the data from the group of registers that were read.

Address	Blocks	Items	Code
0	Modbus TCP header part	Transaction ID (Hi)	15h
1		Transaction ID (Lo)	01h
2		Protocol ID (Hi)	00h
3		Protocol ID (Lo)	00h
4		Data size (Hi)	00h
5		Data size (Lo)	07h
6		Unit ID	FFh
7	Modbus data part	Function code	17h
8		Byte count	04h
9		Read register value 1 (Hi)	00h
10		Read register value 1 (Lo)	00h
11		Read register value 2 (Hi)	0Bh
12	Read register value 2 (Lo)	B8h	

In the case, 7 byte lengths (address 6 through 12).

0000 0BB8h
→3000d→30.00[s]

Hi: high order

Lo: low order

7.2.13 Exception response

The inverter returns a response to the request, but if an error occurs in the request, it is to return an exception response.

[Exception response]

(Example)

In case configuring nonexistent address to holding registers using the Modbus function code "03h (Read holding registers)", it is to return the exception response shown below.

Address	Blocks	Items	Code
0	Modbus TCP header part	Transaction ID (Hi)	15h
1		Transaction ID (Lo)	01h
2		Protocol ID (Hi)	00h
3		Protocol ID (Lo)	00h
4		Data size (Hi)	00h
5		Data size (Lo)	03h
6		Unit ID	FFh
7	Modbus data part	Function code *1)	83h
8		Exception codes *2)	02h

} In the case, 3 byte lengths (address 6 through 8).
 ← The function code in the request: 03h plus 80h

Hi: high order
 Lo: low order

*1) When returning the exception response, being configured adding "80h" to the function code of the request.

■ Function codes of exception response

Request	Exception Response
01h	81h
03h	83h
05h	85h
06h	86h
0Fh	8Fh
10h	90h
17h	97h

*2) The exception code indicates the factor of the exception response.

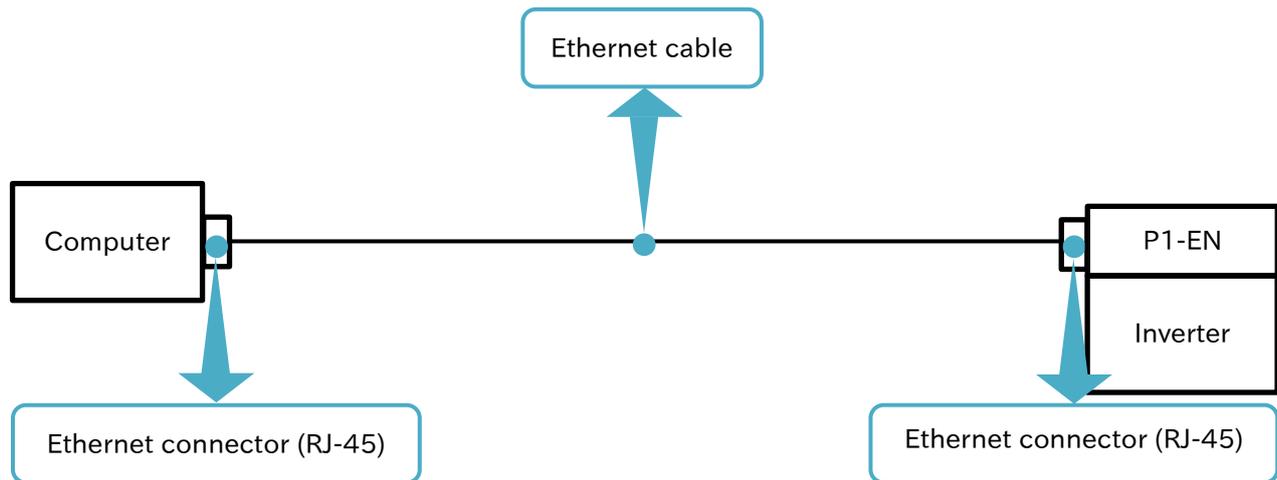
■ Exception codes

Code	Description
01h	The function code received is not an allowable action for this device.
02h	The data address received is not an allowable address for this device.
03h	A value contained is not an allowable value for this device.
21h	When writing the data to the holding register, it is out of the range in the inverter.
22h	It is the situation that the function is not allowed by the inverter: <ul style="list-style-type: none"> ● To be configuring the register that is prohibited to change while driving. ● To be writing to the register which is soft locked. ● To be executing the enter command while driving. ● To be executing the enter command in under-voltage. ● To be writing to the register while operating auto-tuning. etc.
23h	Configuring the function of writing to read-only parameter.
26h	Writing when a prior data writing or data initialization execution.
27h	Accessing only the high order parameter of 2 register length.

7.3 Connection with the ProDriveNext

When using the Modbus TCP for the connection between the ProDriveNext and the inverter, this device and a LAN cable are required. Additionally the necessary connection arrangement is shown in the figure below. Please refer to the chapter 5 to verify the specifications needed for the connection.

Functions such as the wizard function, parameter file read/write function, inverter program create/download function and trace function become available when using the ProDriveNext.



Attach the the P1-EN to any of the option slots of the inverter, then connect the P1-EN and the computer using the Ethernet cable.

For detailed information regarding the ProDriveNext, please refer to the ProDriveNext guide.

(Memo)

8

Chapter 8 FAQ and Troubleshooting

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8.1 About this chapter

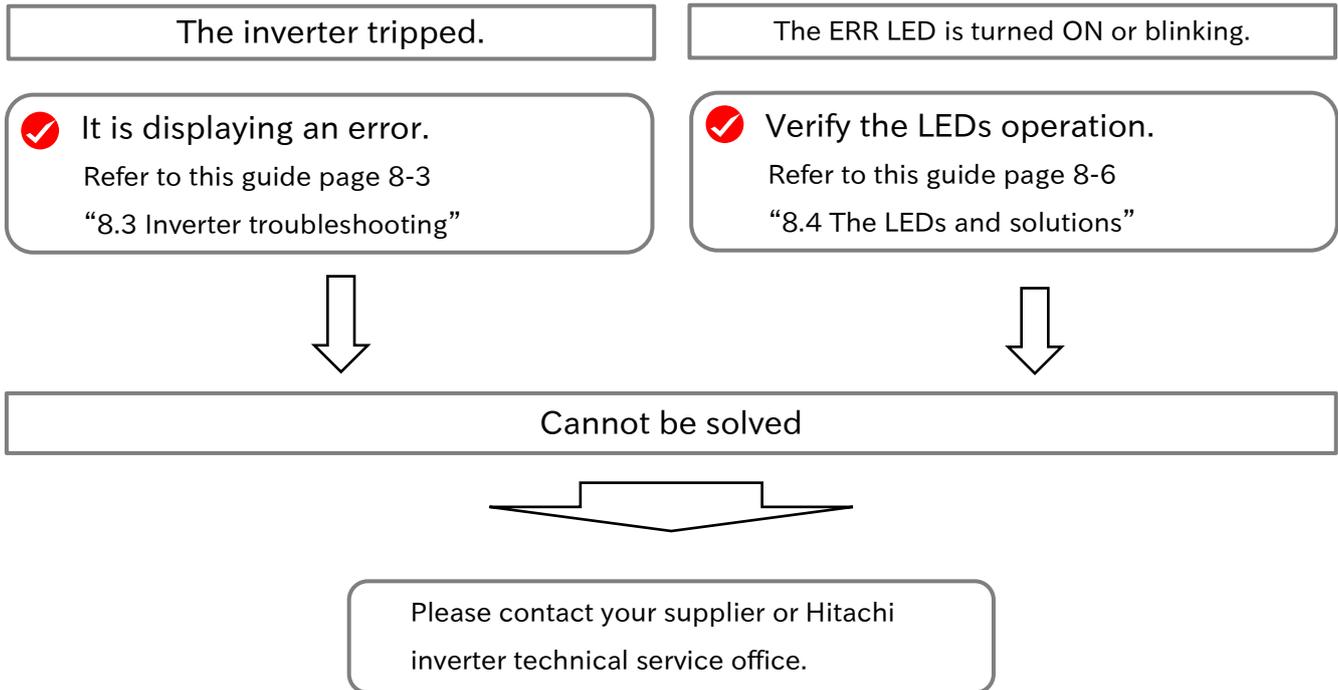
This chapter contains the troubleshooting of cases such as errors detected by the protection function, warnings given by the warning function, or some cases in which the device is not working properly.

Symbol	Definition
	Precautions



- When the device is not working properly or there is any trouble, read this chapter before trying to solve the problem. Use the following sections as a reference when dealing with these situations.

8.2 Self-diagnosis

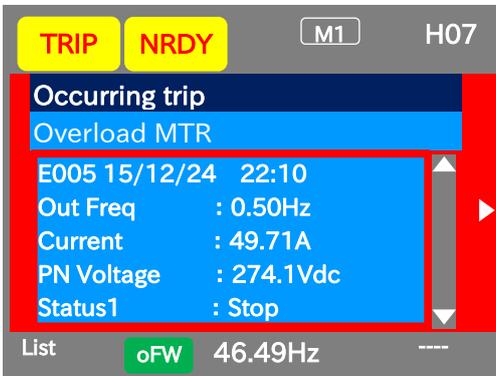


Before contacting the technical service, confirm the items on the right.
For information about how to check the (1) and (2) refer to the inverter user's guide.
For information about how to check the (3) and (4) refer to the chapter 3 in this guide.

- (1) Inverter model
- (2) Inverter manufacture number (MFG No.)
- (3) Option device model (P1-EN)
- (4) Option manufacture number (MFG No.)
- (5) Date of purchase
- (6) Inquiry contents

8.3 Inverter troubleshooting

In case the some error was detected by the inverter, it shuts the motor output down (trip). When the trip occurs, the inverter display (VOP) shows below.



The number of E005 in the above is an error code. Abnormality related to this device and its solutions are shown the following table.

■ Abnormality and its solutions.

Error display	Possible cause	Solutions
Abnormality without error code	The inverter cannot be powered on.	Troubleshoot according to the instructions described in the inverter user's guide.
	It may have been damaged that the connector connecting this device to the inverter.	Please exchange the device.
	Allocated the function "Reset" to the inverter input terminal, so when the terminal may be turned on.	Verify the inverter parameters configuring.
[SLOT 1] E060.* E069.*	Fatal abnormality occurred in this device when powered on or operating.	Turn off the inverter, then detach and attach again this device. After this, turn on the inverter again. In case the trouble cannot be solved, please exchange the device.
[SLOT 2] E070.* E079.*	It may have been damaged that the connector connecting this device to the inverter.	Please exchange the device.
[SLOT 3] E080.* E089.*	This device is disconnected or not connecting properly.	Make sure that this product and the inverter are properly attached.

For the list of errors issued by the inverter, that is shown the following table. For more information about those errors, refer to the inverter user's guide.

■ List of errors

Error code	Error name
E001	Over-current error
E005	Overload motor error
E006	Overload braking resistor error
E007	Over-voltage error
E008	Memory error
E009	Under-voltage error
E010	Current sensor error
E011	CPU error
E012	External trip error
E013	USP error
E014	Ground fault error
E015	Supplied over-voltage error
E016	Instant power failure error
E019	Temperature sensor error
E020	Overheat fan error
E021	Overheat fin error
E024	Input phase loss error
E030	IGBT error
E034	Output phase loss error

Error code	Error name
E035	External thermistor error
E036	Brake error
E038	Overload low speed error
E039	Overload controller
E040	Keypad communication error
E041	RS485 communication error
E042	Real time clock error
E043	EzSQ command error
E044	EzSQ overflow error
E045	EzSQ syntax error
E050	EzSQ user error 0
E051	EzSQ user error 1
E052	EzSQ user error 2
E053	EzSQ user error 3
E054	EzSQ user error 4
E055	EzSQ user error 5
E056	EzSQ user error 6
E057	EzSQ user error 7
E058	EzSQ user error 8
E059	EzSQ user error 9

Error code	Error name
E060	Option1 error 0
E061	Option1 error 1
E062	Option1 error 2
E063	Option1 error 3
E064	Option1 error 4
E065	Option1 error 5
E066	Option1 error 6
E067	Option1 error 7
E068	Option1 error 8
E069	Option1 error 9
E070	Option2 error 0
E071	Option2 error 1
E072	Option2 error 2
E073	Option2 error 3
E074	Option2 error 4
E075	Option2 error 5
E076	Option2 error 6
E077	Option2 error 7
E078	Option2 error 8
E079	Option2 error 9
E080	Option3 error 0
E081	Option3 error 1
E082	Option3 error 2
E083	Option3 error 3
E084	Option3 error 4
E085	Option3 error 5
E086	Option3 error 6
E087	Option3 error 7
E088	Option3 error 8
E089	Option3 error 9

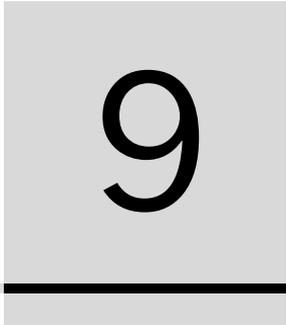
Error code	Error name
E090	STO active error
E091	STO-D error
E092	STO-1 error
E093	STO-2 error
E094	FS option-D error
E095	FS option-1 error
E096	FS option-2 error
E097	FS option disconnection error
E100	Encoder disconnection error
E104	Position control range error
E105	Speed deflection error
E106	Position deflection error
E107	Over-speed error
E110	Contact error
E112	Feedback option disconnection error

8.4 The LEDs and solutions

LED status when abnormality occurred is followings.

■ LED status with abnormality

RUN(green)	ERR(red)	Description	Solutions
Light off	Light off	The inverter power is not turned ON or P1-EN is initializing.	—
Light off	Light on	P1-EN might have been damaged.	<ul style="list-style-type: none"> • Make sure that this product and the inverter are properly attached. • Detach and attach again this device. After this, turn on the inverter again. Or exchange the device.
Light off	Blinking	Setting error in the inverter configuring.	<p>It may be unmatched between the inverter setting parameters and system configuration. (e.g. IP address configuring etc.)</p> <p>Please verify the Ethernet related parameters. For information about these parameters, refer to the chapter 6 in this guide.</p>



Chapter 9 Specifications

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9.1 About this chapter

This chapter contains information about the P1-EN specifications.

9.2 Device Specifications

■ Specifications

Item		Specification	
Model		P1-EN	
Dimensions (width×height×depth)		20.5×98.0×54.5mm	
Weight		170g	
Environment	Ambient operating temperature	-10~50°C	No icing or condensation conditions.
	Ambient operating humidity	20~90%RH	
	Storage temperature	-20~65°C	
	Vibration resistance	5.9m/s ² (0.6G), 10~55Hz	
	Conformance to EMC and electrical safety standards	IEC/EN61800-3 Second environment, Category C3 IEC/EN61800-5-1 SELV	
	Enclosure rating	IP00	
Ethernet Interface	Applicable standards	IEEE 802.3	
	Communication protocol	TCP/IP	
	Communication protocol (application layer)	Modbus TCP	
	Physical layer	10BASE-T, 100BASE-TX (IEEE802.3)	
	Connector	RJ45 (PORT1/PORT2)	
	Communication distance	Distance between nodes: 100[m]max	
External power supply		DC24V±10%, Current consumption: 1A~1.5A (Current consumption fluctuates with inverter and/or other options operating and so on.)	