Hybrid Hydraulic System

High-accuracy SUPER UNIT Communication/ Remote Control Function

[Modbus-RTU Protocol]

[RS232C/RS485]

Instruction Manual

DAIKIN INDUSTRIES, LTD.
Oil Hydraulic Division
Oil Hydraulic Equipment

PIM00559 △A

<<SAFETY PRECATIONS>>

■ Before using this product

- Give consideration to make users thoroughly understand the contents of this instruction manual.
- Incorporate the contents of this instruction manual in instruction manuals for your machine using this product.
- To ensure proper operation of this unit, be sure to read this instruction manual and all other attached documents carefully, to have a thorough understanding of the equipment, safety information and all user precautions before installation, operation and maintenance/inspection of this unit.
- Be sure to keep this manual in place where could be read whenever required.
- For detailed explanation of the unit, all figures and photographs included in this manual show the unit without covers or safety shields. To operate this unit, be sure to mount the covers and shields in the specified manner, and observe the operating procedures described in this manual.
- As for the contents of the manual, it may be changed due to product improvement, specification change or improving of use to be easy.
- This instruction manual should be used as a reference that provides safety instructions for DAIKIN Hydraulic Unit. In addition to this manual, prepare safety references for your machine to ensure safe operations and maintenance in accordance with various standards and norms.

■ Conventions of safety instructions in this manual

- In this manual, safety instructions are classified into three categories: "⚠ DANGER", "⚠ WARNING", "⚠ CAUTION".

  ⚠ DANGER: Improper handling regardless of this indication causes an urgently hazardous condition that may result in death or serious injury.

  ⚠ WARNING: Improper handling regardless of this indication causes a potentially hazardous condition that may result in death or serious injury.

  ⚠ CAUTION: Improper handling regardless of this indication causes a potentially hazardous condition that may result in medium or slight injury or property damage.

Even an item indicated as "⚠ CAUTION" may still result in a serious accident depending on the situation. All instructions given in this manual include important information. Be sure to observe all of them.

■ Safety precations

◆ General Precautions

⚠ DANGER
・ Ensure that wiring, maintenance and inspection work is carried out by people with the required expertise. Otherwise, there is a risk of electric shock, injury and fire. ・ During the above work, wear protective gear required for safe work (work clothes, gloves and so on). ・ Do not use this unit under conditions other than those specified in the catalog or delivery specifications.

⚠ CAUTION
・ Be sure to conduct daily inspections (described in this manual).

<<Exemption Clause>>

- DAIKIN shall not be responsible for any damage attributable to a fire, earthquake, third party's action and other accidents, as well as customer's intention, misuse or use under abnormal conditions.

- DAIKIN shall not be responsible for any damage incidental to use of this product or impossibility to use this product (loss of business profit, discontinuation of business).

- DAIKIN shall not be responsible for any accidents or damage attributable to negligence in observing the instructions given in the instruction manual or delivery specifications.

- DAIKIN shall not be responsible for any damage attributable to malfunction caused by combinations of this unit and external equipment.

<<Limitations on Applications>>

- If a failure or malfunction of this unit may directly threaten human life, or this product is used for equipment that may cause injury to human body, such an application must be considered depending on the case.

- This product has been manufactured under strict quality control. However, when it is used for important equipment, the equipment must be provided with a safety device to prevent malfunction of this unit from resulting in serious accident or damage.

Table of Contents

<Memo>

1 Introduction

1.1 Introduction

Thank you for choosing a high-accuracy SUPER UNIT hybrid hydraulic system (hereafter abbreviated to “hydraulic unit”).
This manual explains the Modbus protocol for the hydraulic unit’s communication and remote control function. (For details on how to operate the hydraulic unit, refer to its instruction manual.)
This function enables serial communication with a host device through the RS232C or RS485 interface.
To maintain good performance over a long period of time when using the <Modbus Protocol for Communication and Remote Control Function>, carefully read this manual and handle and maintain the related equipment appropriately.

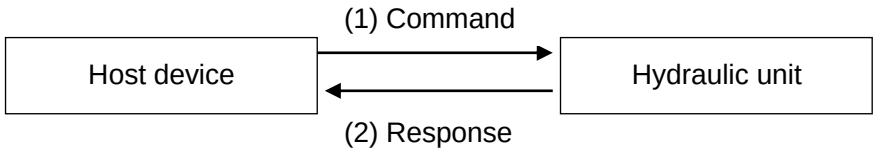
1.2 Overview

1.2.1 Features

- The hydraulic unit and main machine can be remotely controlled with the same operation panel. This eliminates complicated individual operations and restrictions on installation positions.
- The parameter settings can be changed easily. The optimum parameter settings for each type of workpiece can be achieved.
- Various data, such as the current pressure and alarm history, can be acquired, enabling centralized control at the main machine.

1.2.2 Overview

The communication and remote control function enables the main machine to read and write data in the hydraulic unit. (The hydraulic unit does not autonomously transmit data.)



■ Data communication using the Modbus protocol

- With the communication and remote control function, data in the hydraulic unit can be read and written using the main machine’s PLC or personal computer. (The hydraulic unit does not autonomously transmit data.)
- The communication network comprises one master and one slave device, and the hydraulic unit functions as a slave device.
- Only one slave device can respond to a command transmitted from the master. Each slave device is assigned a “slave address” and the master specifies the communication target using this “slave address”.

1.2.3 Applicable models

This function is optional. It is applicable to the following hydraulic unit models.

■ Applicable models (high-accuracy type)

Product series	Product model
SUT Series	SUT********-*****-C****(-*)

* "*" represents an alphanumeric character.

Memo
• There are different hardware specifications for RS232C and RS485 interfaces, so it is not possible to change the interface during use. Please consider which interface you will use in advance.

1.2.4 Specifications

■ Communication specifications

Protocol	Item	Settings	
Common	Interface	Either RS232C or RS485 compliant	
	Transmission speed	9600, 19200 [bps]	
	Communication method	Half-duplex communication	
	Synchronization method	Asynchronous mode	
	Transmission data format	Start bit	1 bit
		Date bit length	7 or 8 bits
		Parity bit	None or 1 bit
		Stop bit	1 or 2 bits
	Transmission distance Note 1	RS232C	Within 15 m (19200 [bps])
		RS485	1200 m
	Flow control	None	
Daikin	Number of transmission targets	1:1	
	Transmission code	ASCII code	
	Header	STX	
	Delimiter	ETX	
	Error detection	Sum check: 2 bytes	
		Parity check: Yes (Even/odd number) / No	
Modbus-RTU	Number of transmission targets	RS232C	1:1
		RS485	1:n (n: 32 maximum)
	Transmission code	Binary	
	Error detection	CRC check: 2 bytes	
		Parity check: Yes (Even/odd number) / No	

Note 1: The transmission distance is the theoretical value, not the guaranteed value.

Memo	• The hardware specifications are different, so it is not possible to change the interface during use. Please consider which interface you will use in advance. • When using the Modbus protocol (RTU mode), be sure to select 8 bits as the data bit length.

■ Usage conditions

(1) Use the hydraulic unit under the conditions written in the instruction manual.

(2) Consider to take countermeasures for noise if used under the following conditions.

- Places where noise exists due to static electricity
- Places where strong magnetic field or electric field occurs
- Places where power supply passes nearby

■ Precautions on use

(1) Implement failsafe measures on your side against broken signal wires etc., depending on the conditions of use.

(2) Carry out the wiring work correctly by referring to the instruction manual for the hydraulic unit.

(3) Before connecting a communication cable, touch grounded metal to discharge the static electricity from your body.

(4) Before changing set values, check that there will be no unexpected effect on the equipment due to the changes.

(5) Before changing set values, check that the register numbers and values being set are correct.

(6) In order to save parameters safely, do not turn the power off while they are being saved (for details,see 4.5 Saving to EEPROM).

2 Preparation

2.1 Sequence for Preparations for Communication

Firstly, check that the power is shut off, then make the preparations for communication by following the sequence below.

◆ Preparation of hydraulic unit

- Make preparation for the hydraulic unit (wire connecting, etc.).

  Refer to the instruction manual of hydraulic unit for more details.

⇩

◆ Connection of communication wire

- Connect the communication wire. Refer to [2.2 Wiring Guide] for more details.

⇩

◆ Power on

- Turn power on, and energize the hydraulic unit.

⇩

◆ Communication setting

- Set communication items (transmission speed, parity, etc.).
  Refer to [2.3 Panel Operations] for more details.

⇩

◆ Reset the unit

- In order to confirm the change of communication setting, turn off the power. Then turn on power after the 3 digit LED is off.
  (After turning on again, the change of setting is effective.)

⇩

◆ Preparation finished

- This completes the preparation.
  For details of the procedures relating to communications, refer to “3 Data Communication Using the Modbus Protocol”.

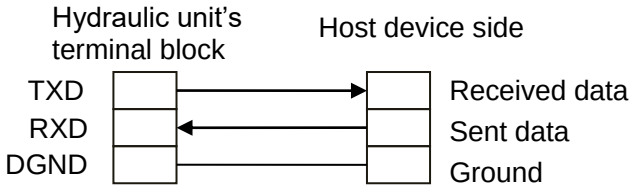
2.2 Wiring Guide

2.2.1 RS232C specifications

For serial communications, connect to the terminal numbers indicated below.
The I/O signal terminal block differs depending on the hydraulic unit. Check the connection points on the model of hydraulic unit concerned.
For details on how to perform the wiring work, refer to the instruction manual for the hydraulic unit.

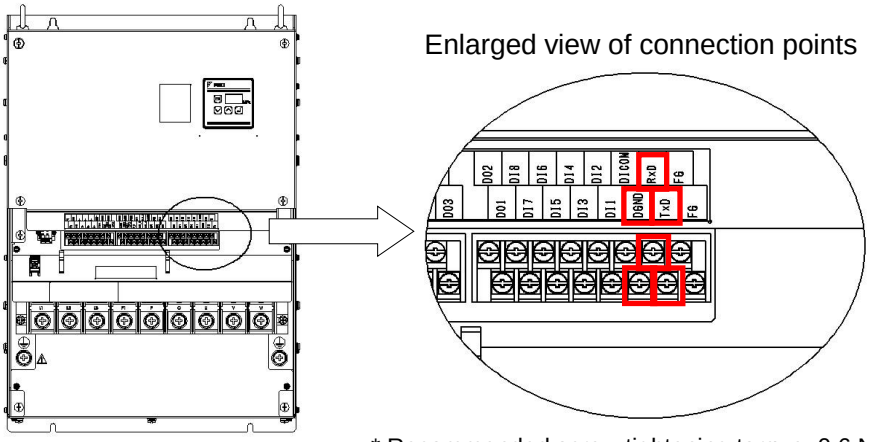
■ User I/O terminal block

Terminal indications		Type	Terminal function	Remarks
I/O signal terminal block	TXD	Serial communication terminals (RS-232C)	Sent data	Connect the sent data line from the host device to the RXD terminal, and its received data line to the TXD terminal.
	RXD		Received data	
	DGND		Ground	



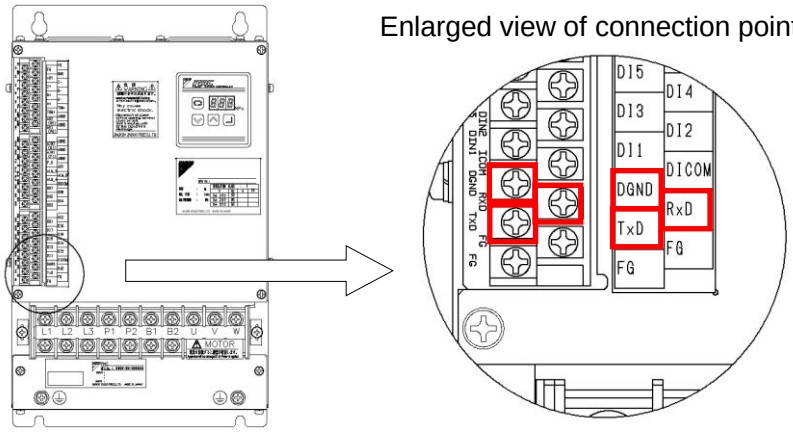
■ Connection points on I/O signal terminal blocks for each model

(1) Applicable model (motor capacity: equivalent to 37 kW, 200/400 V specification)



* Recommended screw tightening torque: 0.6 N・m

(2) Models other than that at (1) (motor capacity: equivalent to 7/11/15/22 kW, 200/400 V specification)



* Recommended screw tightening torque: 0.6 N・m

■ Recommended electric wire

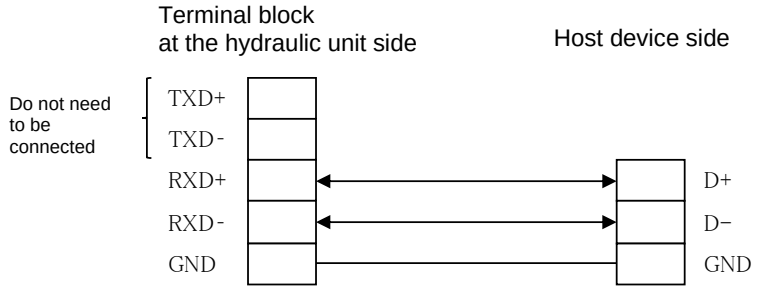
Recommended electric wire	Cable size	Remarks
KVC36SB (by Kuramo Electric)	0.3 mm^2 (AWG22)	Shielded

⚠ DANGER
・ Shut off the main power supply before making connections to the hydraulic unit. ・ Wait sufficient time* after shutting off the main power supply before starting the work. Immediately after the power is shut off, voltage remains inside the hydraulic unit controller, which may cause an electric shock. (* The time varies depending on the model and is indicated on the warning label near the controller's operation panel.)

2.2.1 RS485 specifications

For serial communications, connect to the terminal numbers indicated below.
The I/O signal terminal block differs depending on the hydraulic unit. Check the connection points on the model of hydraulic unit concerned.
For details on how to perform the wiring work, refer to the instruction manual for the hydraulic unit.

Terminal Indications		Type	Terminal Function
I/O signal terminal block	RXD+	Serial communication terminals (RS-485)	Data (plus side)
	RXD-		Data (minus side)
	GND		Ground

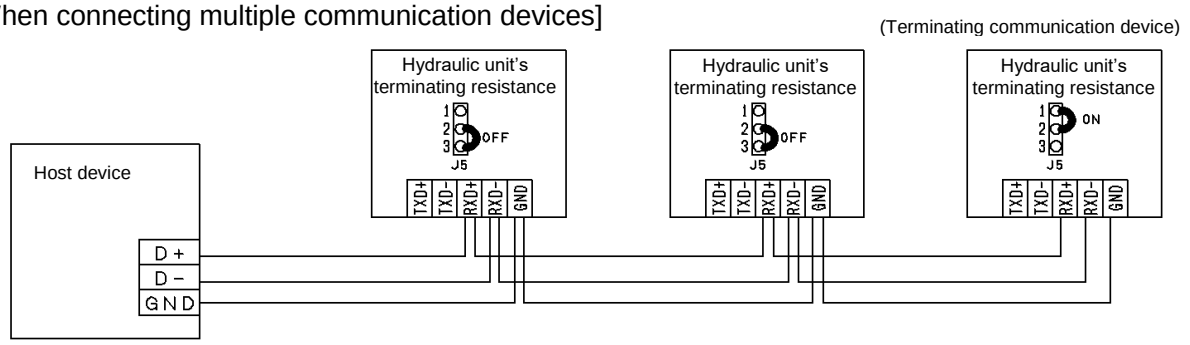


■ Selecting whether a terminating resistance is used or not by jumper setting
The J5 jumper socket can be used to select whether a terminating resistance is used or not. The default status is that a terminating resistance (120 Ω) is used.

Terminating resistance used/ not used Note 1	J5	Remarks
Terminating resistance used	1-2	Default status
Terminating resistance not used	2-3	

Note 1: When connecting multiple communication devices, use a terminating resistance only at the communication device that terminates the communication bus as shown in the figure below.

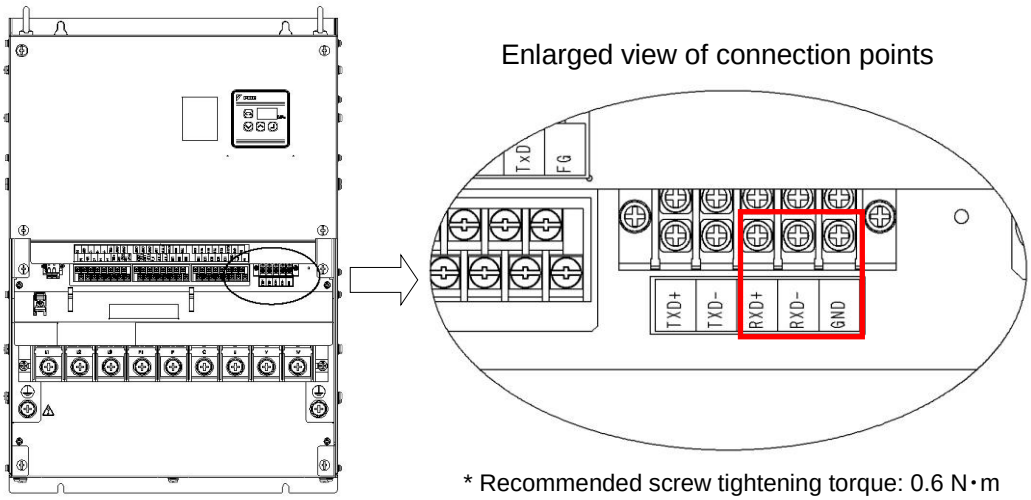
[When connecting multiple communication devices]



■ Connection points on I/O signal terminal blocks for each model, and how to select whether a terminating resistance is used or not

(1) Applicable model (motor capacity: equivalent to 37 kW, 200/400 V specification)

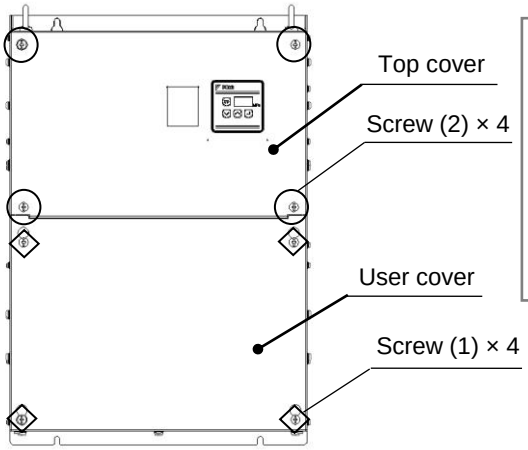
◇ Connection points



* Recommended screw tightening torque: 0.6 N・m

◇ Selecting whether a terminating resistance is used or not

In order to select whether a terminating resistance is used or not by jumper setting, the user cover and top cover need to be removed.

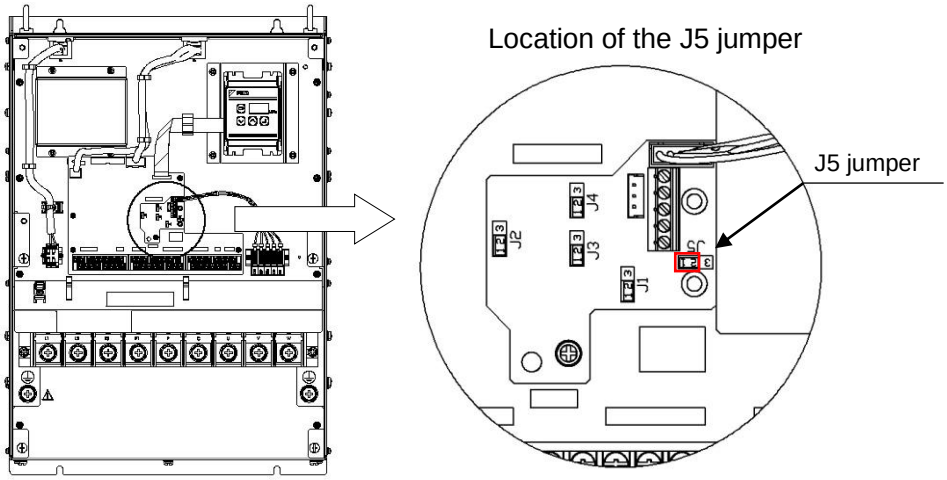


- Procedure for removing the user cover and top cover

1. Loosen four screws (1) and remove the user cover.
2. Remove four screws (2) and remove the top cover.

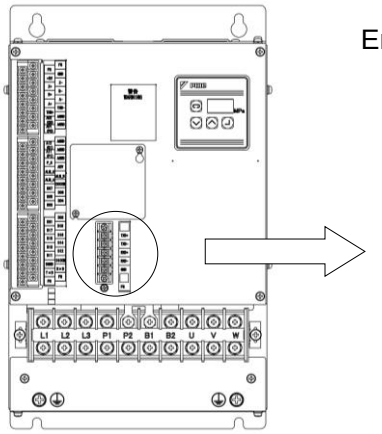
* Mount the covers by following the removal procedure in reverse.
* Recommended screw (1) and (2) tightening torque: 2.4 N・m

Removing these covers reveals the J5 jumper as shown in the figure below. Change the jumper setting as necessary.

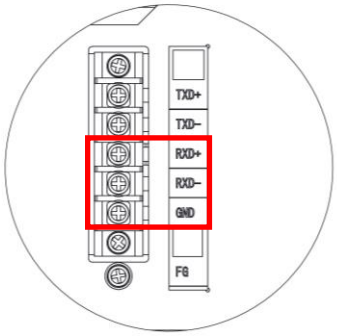


(2) Models other than that at (1) (motor capacity: equivalent to 7/11/15/22 kW, 200/400 V specification)

◇ Connection points



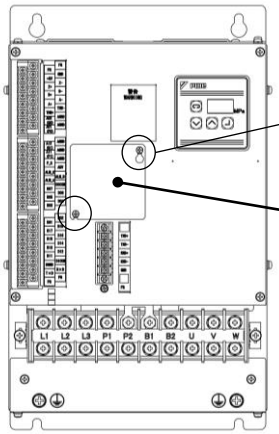
Enlarged view of connection points



* Recommended screw tightening torque: 0.6 N・m

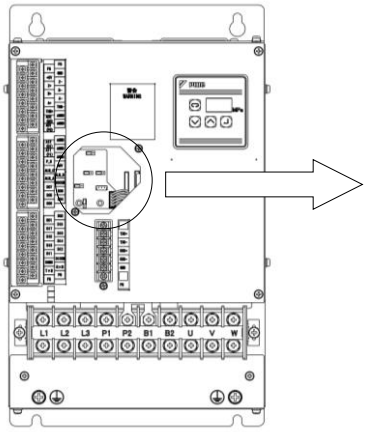
◇ Selecting whether a terminating resistance is used or not

In order to select whether a terminating resistance is used or not by jumper setting, the cover needs to be removed.

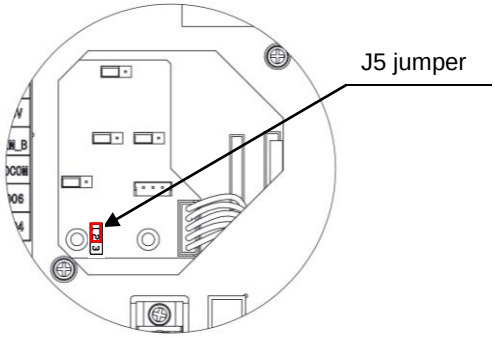


* The cover can be removed by loosening the screws.
* Recommended screw tightening torque: 0.6 N・m

Removing these covers reveals the J5 jumper as shown in the figure below. Change the jumper setting as necessary.



Location of the J5 jumper



■ Recommended electric wire

Recommended electric wire	Cable size	Remarks
KVC36SB (by Kuramo Electric)	0.3 mm^2 (AWG22)	Shielded

⚠ DANGER
・ Shut off the main power supply before making connections to the hydraulic unit. ・ Wait sufficient time* after shutting off the main power supply before starting the work. Immediately after the power is shut off, voltage remains inside the hydraulic unit controller, which may cause an electric shock. (* The time varies depending on the model and is indicated on the warning label near the controller's operation panel.)

2.2.2 Countermeasures against noise

■ Mounting a ferrite core

When using the equipment in a location where there are significant effects due to noise, such as those indicated below, take appropriate countermeasures against noise, such as fitting a ferrite core.

- Locations where noise due to static electricity is generated
- Locations where strong electric or magnetic fields are generated
- Locations where electric fields pass nearby

When fitting a ferrite core, mount it in the following way:

- Fit it at the root of the communication cable at the host device side.
- Wind the communication cable two turns around the ferrite core.

Recommended ferrite core
RFC-13 (by KITAGAWA INDUSTRIES, CO., LTD.)

■ Shield cable terminal connection

To prevent communication errors due to noise, use a shielded cable for the communication cable and connect the shield to the FG (frame ground) terminal.

2.3 Panel Operations

Communication settings can be made on the operation panel of the hydraulic unit. Communication settings cannot be changed by communication.
After making settings, shut off the power supply and check that the 3-digit LEDs have gone off before turning the power back on.
The settings made come into effect upon turning the power back on.

2.3.1 Communication parameter List

Item No.	Description	Setting range (Panel indication: setting)	Initial setting	Unit
C00	Transmission speed	0: 19200 1: 9600	0	bps
C01	Date bit length	0: 8 1: 7	0	bit
C02	Stop bit	0: 1 1: 2	0	bit
C03	Parity bit	0: None 1: Even 2: Odd	0	–
C04 Note 1	RS485 transmission/reception switching time	0.01 to 0.10	0.01	sec
C05	(Reserve)	–	–	–
C06 Note 2	Slave address setting	0 to 32	0	–
C07	Protocol selection	0: Daikin 1: Modbus-RTU	0	–

Note 1: Set the transmission/reception switching time for RS485 communication.
The transmission/reception switching time is the time from the completion of command reception to the start of response transmission. However, there will be some delay with respect to the set value due to the internal processing time.

Note 2: This parameter takes effect when “1: Modbus-RTU” is set for parameter C07. Setting “0” disables the Modbus communication function, meaning that no communication takes place.

IMPORTANT	The settings made come into effect upon turning the power off and back on.

2.3.2 Setting method

The operation panel consists of 3 digit LED 8.8.8., mode key, setting key, and enter key .

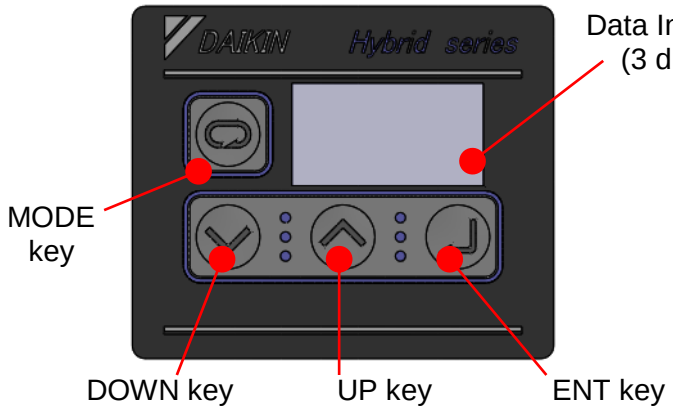
The panel displays the actual pressure normally, and can be switched to each mode by key operation.

As for the communication setting mode, refer to the following procedures.

(1) Display the actual pressure. (When in other mode, press the key and display the actual pressure.)

(2) Press keys at the same time for more than 2 sec.

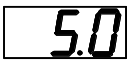
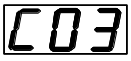
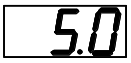
The next page shows the example of parity setting.



There are 3 digits data Indicator and 4 switching keys as shown in left.
The indicator normally displays the actual pressure (MPa).

■ Example of communication setting (procedures of parity bit change)

<Example> Change the parity bit setting from None to Even.

Operation method	Key operation	3 digit LED	Remarks
・ Power ON			
↓			
・ Display actual pressure			
・ Setting mode	Press ▽ ↵ keys at the same time for 2 sec or more		
↓			2 sec later
・ Select item number	▽ or △		
↓			
・ Setting value display	↵		
↓			Parity bit n: none
・ Change setting value	▽ △		
↓			E: Even
・ Write in setting value	↵		
↓			The item number display after writing in.
・ Return to actual pressure display	ESC		
			

2.3.3 Monitor data list

No.	Display name	Unit	Display details
n30	Previous communication error number	–	Displays the communication error code that occurred last time. Under normal conditions, "–1" is displayed.
n31	Received data 1	HEX	The 14 bytes from the head of the data received last time is displayed, each in hexadecimal notation. When data reception has completed and reception of the next packet of data starts, all of the received data is cleared and it is updated to the data of the next packet. * When there is a discrepancy in communication settings, such as the transmission speed, between this product and the main machine, data is not received normally and the data display is uncertain.
n32	Received data 2	HEX	
n33	Received data 3	HEX	
n34	Received data 4	HEX	
n35	Received data 5	HEX	
n36	Received data 6	HEX	
n37	Received data 7	HEX	
n38	Received data 8	HEX	
n39	Received data 9	HEX	
n40	Received data 10	HEX	
n41	Received data 11	HEX	
n42	Received data 12	HEX	
n43	Received data 13	HEX	
n44	Received data 14	HEX	

<Memo>

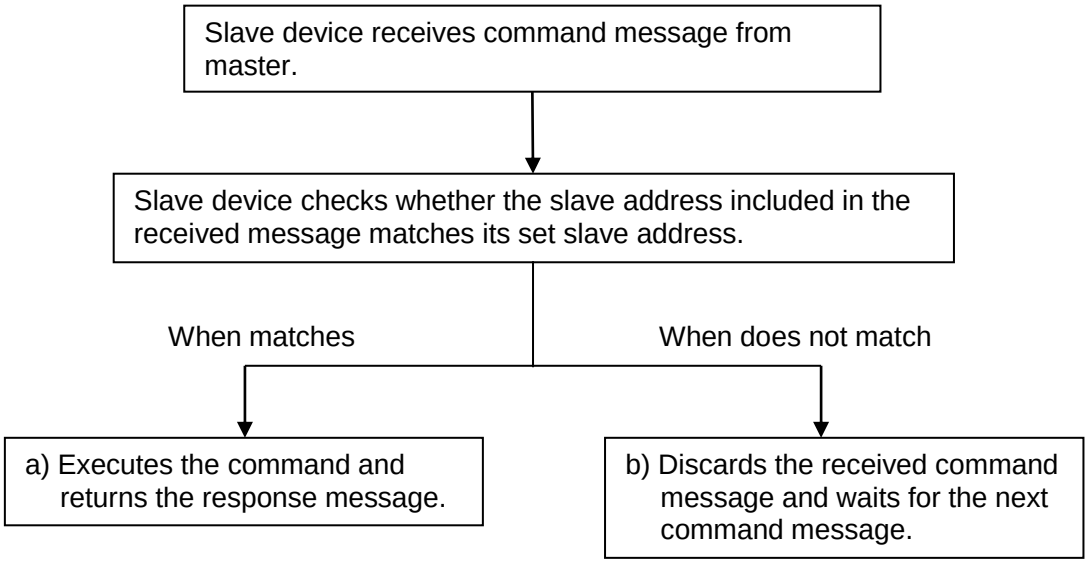
3 Data Communication Using the Modbus Protocol

3.1 Communication Procedure

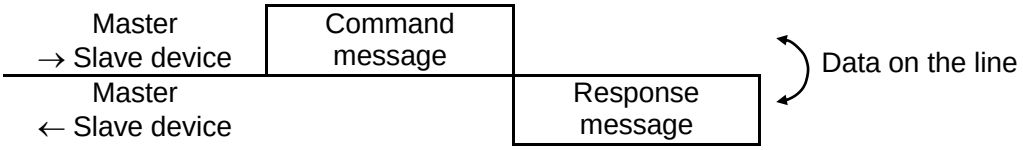
3.1.1 Modbus communication protocol

Communications using the Modbus protocol are carried out according to a procedure where communication is initiated from the master and only the slave device specified by the slave address responds.

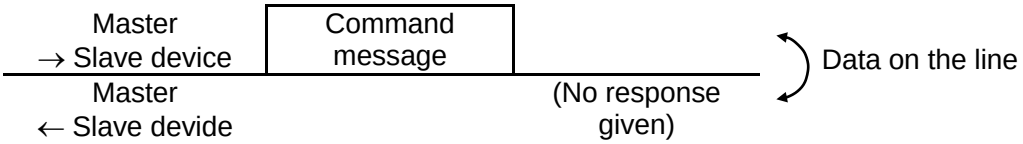
The operation at the slave device (this product) is as follows.



a) When the slave address in the command message has matched the setting

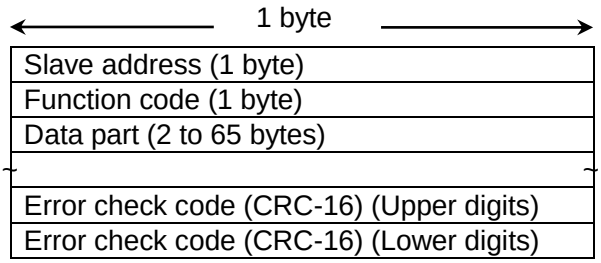


b) When the slave address in the command message has not matched the setting



3.1.2 Format of command messages

Command messages and response messages are composed of four parts: a slave address, a function code, a data part and an error check code (CRC-16).



Format of messages

Each part is explained below.

(1) Slave address

This specifies the address for the destination slave device. This product compares this value with the parameter-set value and only processes the command if they match.

(2) Function code

This specifies the code for the function to be executed.

(3) Data part

This is the data necessary for executing the function code. The composition of the data part differs depending on the function code. The data in the controller are assigned a coil address or a register address, and this address is specified for data reading/writing.

(4) Error check code

This code is used to detect errors in the message in the process of signal transmission. In the Modbus protocol (RTU mode), CRC-16 (CRC = cyclic redundancy check) is used.
For the CRC calculation procedure, refer to “3.1.5 Calculating error check codes (CRC-16)”.

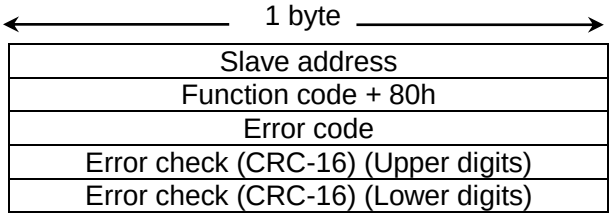
3.1.3 Responses from slaves

(1) Response in normal communications

The slave device responds to command messages by creating a response message corresponding to each command message. The format of the response messages created in this case is identical to that described in “3.1.2 Format of command messages”. The detail of the data part differs depending on the function code. For details, refer to “3.2 Message Details”.

(2) Response in the event of an error

If an error other than a transmission error, such as specification of a non-existent function code, is found in a command message, the slave device responds to the message by creating an error response message without executing the command. The format for error response messages is shown below. The function code used for the error response message is the function code of the command message with 80H added to it.



Error response message

Error code	Details	Descriptions
01h	Function code error	A function code that this product does not support was specified. Check the function code.
02h	Data address error	A register address that cannot be used for the specified function code has been specified. (No parameter, unable to read parameter, unable to write parameter)
03h	Data range error	Data cannot be written because the write data is out of range.
04h	Write protect error	Writing to currently write-protected data has been specified.

Memo	• When the function code 03h or 10h is specified, the slave device responds with the error code 02h only if no data exists. If the message contains even a single piece of valid data, the slave device returns a normal response or a different error code. • Even if the specified register does not contain data, writing a value exceeding 9999 results in a response with the error code 03h.

(3) No response

The slave device ignores the command message and returns no response in the following cases.

- When the slave address specified in a command message does not match the slave address set for the slave device
- When the error check code does not match, or a transmission error such as a parity error is detected
- When data that comprise a message are received with a time interval equivalent to 3.5 bytes (9600 bps: approx. 4 ms, 19200 bps: approx. 2 ms) or greater
- When a communication setting of the slave device, such as the communication speed, disagrees with that of the main machine
- When the function code 10h is specified and the number of words or bytes specified, or the number of characters received, does not conform to the specification

3.1.4 Function codes

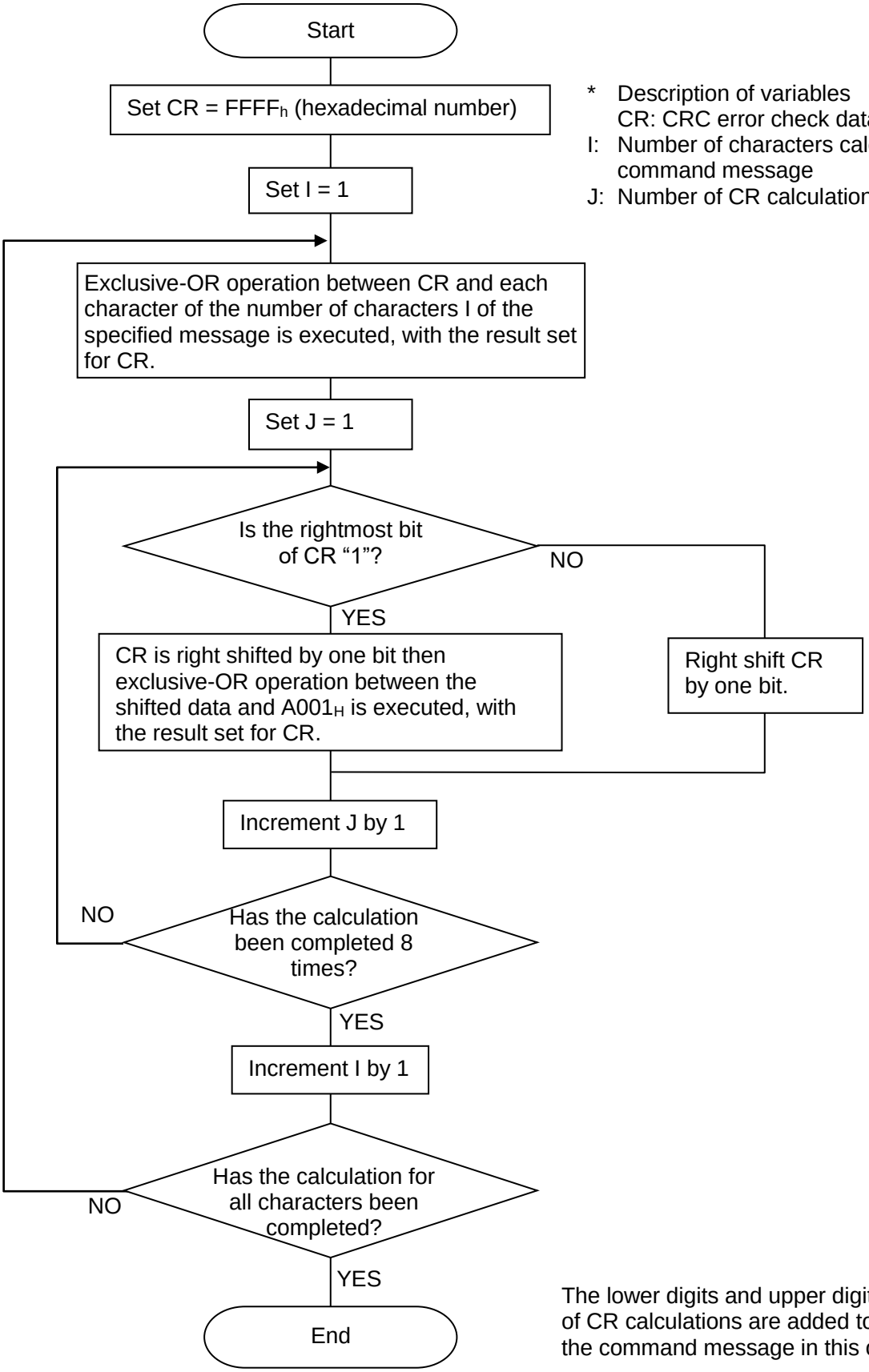
The function codes supported by this product are shown below.

Function code	Function	Object
03h	Reading multiple-word data	Register
06h	Writing single-word data	Register
10h	Writing multiple-word data	Register

3.1.5 Calculating error check codes (CRC-16)

CRC-16 is a 2-byte (16-bit) error check code. The calculation range is from the head (slave address) of the message to the end of the data part. The slave device calculates the CRC of a received message and, if it does not match the received CRC, does not respond.

The following shows the calculation flow for a CRC-16 code.



* Description of variables
CR: CRC error check data (2 bytes)
I: Number of characters calculated in the command message
J: Number of CR calculations

The lower digits and upper digits of the result of CR calculations are added to the end of the command message in this order.

3.1.6 Communication procedure for the master

At the master, communication should be implemented in compliance with the points below.

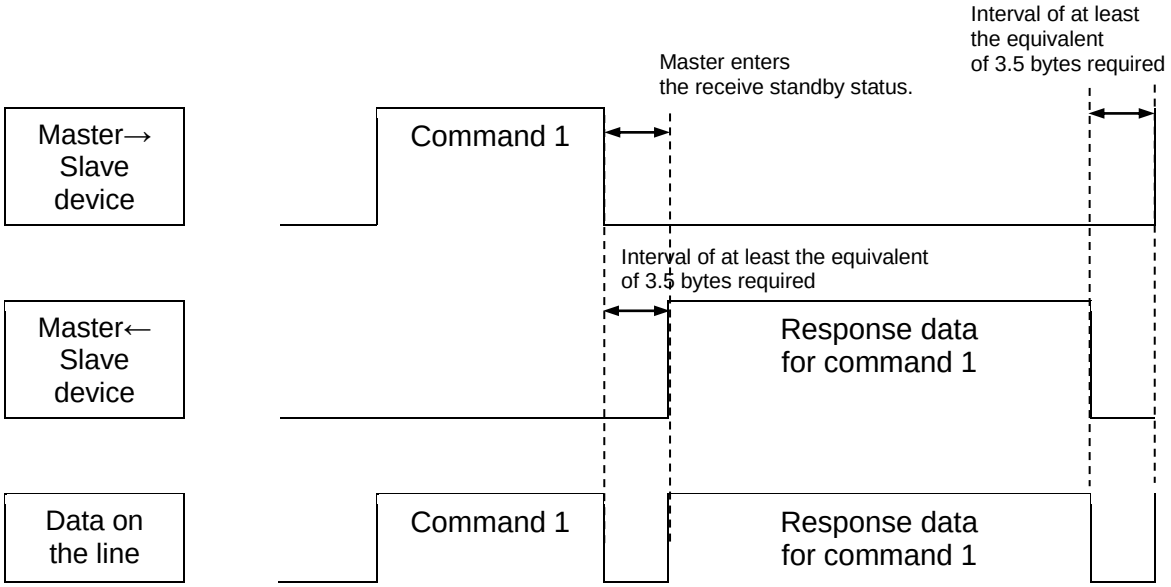
(1) Before transmission of a command message, provide a blank status for at least the time equivalent to 3.5 bytes (9600 bps: approx. 4 ms, 19200 bps: approx. 2 ms).

(2) Transmit individual bytes of a command message within a time interval equivalent to 3.5 bytes (9600 bps: approx. 4 ms, 19200 bps: approx. 2 ms).

(3) After transmission of a command message, enter the receive standby status within the time equivalent to 3.5 bytes (9600 bps: approx. 4 ms, 19200 bps: approx. 2 ms).

(4) After receiving a response message, provide a blank status for at least the time equivalent to 3.5 bytes (9600 bps: approx. 4 ms, 19200 bps: approx. 2 ms), then transmit the next command message. (Return to (1).)

(5) At the master, always check the response message and configure such that at least three retries are made if there is no response or an error occurs.



3.2 Message Details

3.2.1 Read Multiple registers Function code: 03h

Function code	Maximum number of words that can be read in one message	Object
03h	20 words	Register

(1) Message formats

Format of command messages

Slave address		
Function code: 03h		
Read start register number	Upper digits	
	Lower digits	1 to 60
Number of read words	Upper digits	
	Lower digits	
CRC data	Upper digits	
	Lower digits	

Format of response messages

Slave address		
Function code: 03h		
Number of read bytes		Number of read words × 2
Initial read word data content	Upper digits	
	Lower digits	
Next read word data content	Upper digits	
	Lower digits	
~		~
Final read word data content	Upper digits	
	Lower digits	
CRC data	Upper digits	
	Lower digits	

(2) Function explanation

Reads the data of multiple consecutive registers starting from the read start register address.

(3) Example of message transmission

Format of command messages

Slave address		01_h
Function code		03_h
Read register number	Upper digits	00_h
	Lower digits	00_h
Number of read words	Upper digits	00_h
	Lower digits	02_h
CRC data	Upper digits	$C4_h$
	Lower digits	$0B_h$

Format of response messages

Slave address		01_h
Function code		03_h
Number of read bytes		04_h
Initial read word data content	Upper digits	00_h
	Lower digits	$2F_h$
Next read word data content	Upper digits	00_h
	Lower digits	DA_h
CRC data	Upper digits	$4A_h$
	Lower digits	61_h

3.2.2 Write a single register Function code: 06h

Function code	Maximum number of words that can be written in one message	Object
06h	1 word	Register

(1) Message formats

Format of command messages

Slave address	
Function code : 06h	
Write register number	Upper digits
	Lower digits
Write data	Upper digits
	Lower digits
CRC data	Upper digits
	Lower digits

Format of response messages

Slave address	
Function code : 06h	
Write register number	Upper digits
	Lower digits
Write data	Upper digits
	Lower digits
CRC data	Upper digits
	Lower digits

(2) Function explanation

Writes the word data to a single register specified by the write register address.

(3) Example of message transmission

Format of command messages

Slave address		01_h
Function code		06_h
Write register number	Upper digits	01_h
	Lower digits	$F4_h$
Number of write words	Upper digits	01_h
	Lower digits	$3C_h$
CRC data	Upper digits	$C8_h$
	Lower digits	45_h

Format of response messages

Slave address		01_h
Function code		06_h
Write register number	Upper digits	01_h
	Lower digits	$F4_h$
Number of write words	Upper digits	01_h
	Lower digits	$3C_h$
CRC data	Upper digits	$C8_h$
	Lower digits	45_h

■ Points to note when writing single word data

Parameters written by function code 06h are written to RAM and come into effect at the time they are written. To save the settings after change and have those settings come into effect the next time the power is turned on too, save them to the EEPROM (for details, see “4.5 Saving to EEPROM”).

3.2.3 Write multiple word data Function code: 10h

Function code	Maximum number of words that can be written in one message	Object
10h	8 words	Register

(1) Message formats

Format of command messages

Slave address		
Function code: 10h		
Write start register number	Upper digits	
	Lower digits	
Number of write words	Upper digits	1 to 30
	Lower digits	
Number of write bytes		Number of write words × 2
Initial write word data	Upper digits	
	Lower digits	
Next write word data	Upper digits	
	Lower digits	
~		
Final write word data	Upper digits	
	Lower digits	
CRC data	Upper digits	
	Lower digits	

Format of response messages

Slave address	
Function code: 10h	
Write start register number	Upper digits
	Lower digits
Number of write words	Upper digits
	Lower digits
CRC data	Upper digits
	Lower digits

(2) Function explanation

Writes the word data to consecutive registers for the number of write bytes, starting from the write start register address. The master transmits the upper byte of each write word data first and then the lower byte.

(3) Example of message transmission

Format of command messages

Slave address		01h
Function code		10h
Write start register number	Upper digits	01h
	Lower digits	F4h
Number of write words	Upper digits	00h
	Lower digits	03h
Number of write bytes		06h
Initial write word data	Upper digits	01h
	Lower digits	3Ch
Next write word data	Upper digits	01h
	Lower digits	3Dh
Final write word data	Upper digits	01h
	Lower digits	3Eh
CRC data	Upper digits	E7h
	Lower digits	CEh

Format of response messages

Slave address		01h
Function code		10h
Write start register number	Upper digits	01h
	Lower digits	F4h
Number of write words	Upper digits	00h
	Lower digits	03h
CRC data	Upper digits	C0h
	Lower digits	06h

■ Points to note when writing multiple-word data

When writing to multiple registers is specified with function code 10h, if writing to even one is possible a normal response is returned, and data is written to the registers where it is possible. Note that parameters written by function code 10h are written to RAM and come into effect at the time they are written. To save the settings after change and have those settings come into effect the next time the power is turned on too, save them to the EEPROM (for details, see “4.5 Saving to EEPROM”).

3.3 Example of Command/Response Data

Examples of command/response data are shown below.

3.3.1 Contact I/O status

■ Target data

Address (HEX)	Data explanation
012C	Contact input status
012D	Contact output status

Example: When address 0x012C (contact input status) is read as a value “0x1D”

Relationship between response data and contact input status

0	0	0	1	1	1	0	1
DI8 ON (open)	DI7 OFF (open)	DI6 OFF (open)	DI5 OFF (closed)	DI4 ON (closed)	DI3 OFF (closed)	DI2 ON (open)	DI1 ON (closed)

Example: When address 0x012D (contact output status) is read as a value “0x8B”

Relationship between response data and contact output status

1	0	0	0	1	0	1	1
ALM_A ON (closed)	DO7 OFF (open)	DO6 OFF (open)	DO5 OFF (open)	DO4 ON (closed)	DO3 OFF (open)	DO2 ON (closed)	DO1 ON (closed)

3.3.2 Read unit alarms

Reads the alarm history. Returns the number without the alphabetic part of the alarm code. If the information read is a warning, a value with 0x0100 added is returned.

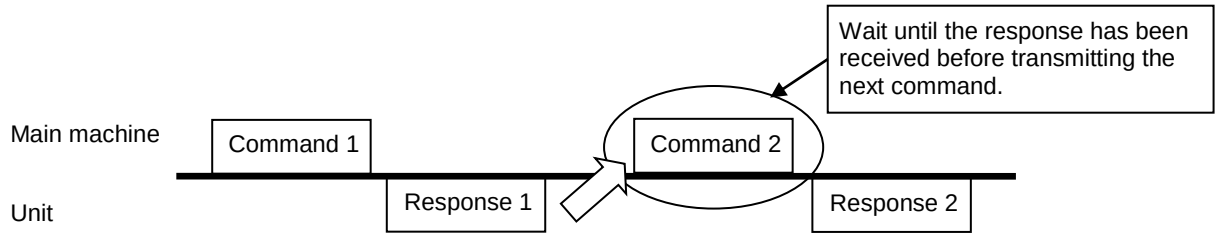
Example: For “E11: Instantaneous overcurrent”
: Response data 0x000B (decimal: 11)
Example: For “L45 : Fin temperature abnormal warning”
: Response data 0x012D (decimal: 45 with 0x0100 added)

■ Target data

Address (HEX)	Data explanation
0131	Current alarm
0140	Occurred alarm (0) Name
0141	Occurred alarm (1) Name
0142	Occurred alarm (2) Name
0143	Occurred alarm (3) Name
0144	Occurred alarm (4) Name
0145	Occurred alarm (5) Name
0146	Occurred alarm (6) Name
0147	Occurred alarm (7) Name
0148	Occurred alarm (8) Name
0149	Occurred alarm (9) Name

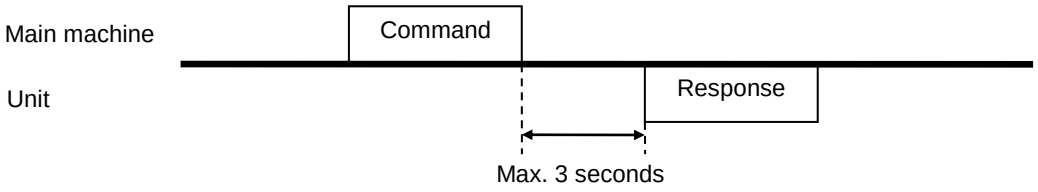
3.4 Command Transmission Interval

When transmitting consecutive commands, wait until the response has been received before transmitting the next command.
If the next command is transmitted before that, correct operation cannot be guaranteed.



3.5 Timeout Error

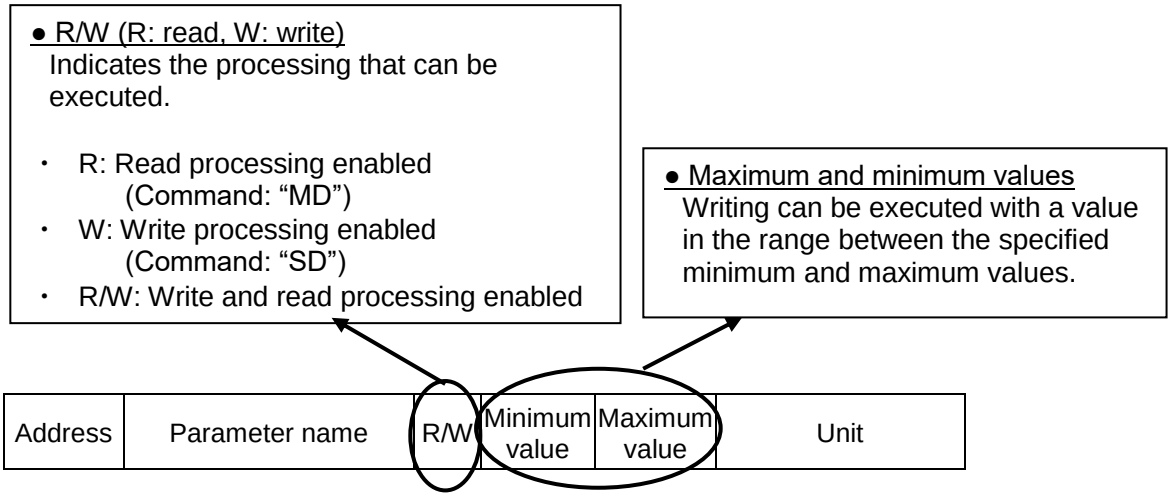
In order to avoid deadlock due to communication errors, detect timeouts at the main machine and deal with them appropriately.
The maximum time from “the hydraulic unit completing command reception” to “starting transmission of the response” is 3 seconds (when saving to EEPROM).
Accordingly, assure that if there is no response from the hydraulic unit for 3 seconds or longer, the main machine judges a communication timeout, then notifies to the operator that a communication error has occurred, and prompts taking appropriate action.



<Memo>

4 Communication Addresses

4.1 How to Read the Address Table



4.2 Monitor Data

Address Decimal (Hexadecimal)	Parameter name	R/W	Minimum value	Maximum value	Unit	Remarks
0 (0h)	Current pressure	R	–	–	0.1 MPa	–
1 (1h)	Pressure command value	R	–	–	0.1 MPa	–
8 (8h)	Actual flow rate	R	–	–	0.1 L/min	–
10 (Ah)	Actual rotational speed	R	–	–	min^{-1}	–
13 (Dh)	Flow rate command value	R	–	–	min^{-1}	–
20 (14h)	Motor load integration rate	R	–	–	0.1%	–
21 (15h)	Controller load integration rate	R	–	–	0.1%	–
22 (16h)	Pressure load integration rate	R	–	–	0.1%	–
23 (17h)	Horsepower load integration rate	R	–	–	0.1%	–
25 (19h)	Power consumption	R	–	–	0.1 kW	–
295 (127h)	Power-on count (in units of 1,000 times)	R	–	–	1000	–
296 (128h)	Power-on count	R	–	–	1	–
297 (129h)	Operation time (minutes)	R	–	–	minute	–
298 (12Ah)	Operation time (hours)	R	–	–	hour	–
299 (12Bh)	Operation time (thousands of hours)	R	–	–	1000 hours	–
300 (12Ch)	Contact input status	R	–	–	–	–
301 (12Dh)	Contact output status	R	–	–	–	–
302 (12Eh)	Regenerative load rate	R	–	–	%	–
304 (130h)	PQ selection No.	R	–	–	–	–
305 (131h)	Current alarm	R	–	–	–	–
306 (132h)	Current maximum pressure setting on the low-pressure side	R	–	–	0.1 MPa	–

Address Decimal (Hexadecimal)	Parameter name	R/W	Minimum value	Maximum value	Unit	Remarks
307 (133h)	Current maximum flow rate setting on the low-pressure side	R	–	–	min^{-1}	–
308 (134h)	Running status (combination / independent flow)	R	–	–	–	–
311 (137h)	Current maximum pressure setting on the high-pressure side	R	–	–	0.1 MPa	–
312 (138h)	Current maximum flow rate setting on the high-pressure side	R	–	–	min^{-1}	–
313 (139h)	Motor thermistor temperature	R	–	–	0.1°C	–
314 (13Ah)	Fin thermistor temperature	R	–	–	0.1°C	–
315 (13Bh)	Main circuit DC voltage	R	–	–	V	–
316 (13Ch)	Pressure command voltage	R	–	–	0.01 V	–
317 (13Dh)	Flow rate command voltage	R	–	–	0.01 V	–
318 (13Eh)	Pressure monitor voltage	R	–	–	0.01 V	–
319 (13Fh)	Flow rate monitor voltage	R	–	–	0.01 V	–

4.3 Setting Mode Parameter

Address Decimal (Hexadecimal)	Parameter name	R/W	Minimum value (Decimal)	Maximum value (Decimal)	Unit	Parameter code
170 (AAh)	P05: Input command voltage scaling value	R/W	(*1)	(*1)	0.01 V	[VMAX]
171 (ABh)	P06: Pressure command scaling value	R/W	(*1)	(*1)	0.1 MPa	[PMAX]
172 (ACh)	P07: Flow rate command scaling value	R/W	(*1)	(*1)	0.1 min^{-1}	[QMAX]
173 (ADh)	P15: Bias pressure	R/W	0	20	0.1 MPa	[BIAS]
363 (16Bh)	P00: Start/stop signal switching	R/W	0	1	–	[DI_A]
370 (172h)	P03: Regenerative load command rate	R/W	30	100	%	[K_RT]
381 (17Dh)	P30: Digital output function selection	R/W	0	15	–	[DO_S]
383 (17Fh)	H47: Pump combination flow signal selection	R/W	0	1	–	[DI_L]
384 (180h)	H54: Pump selection condition (*2)	R/W	0	1	–	[P_C_]
408 (198h)	P08: Pressure rise gain	R/W	1	999	–	[P_UG]
409 (199h)	P09: Pressure fall gain	R/W	1	999	–	[P_DG]
410 (19Ah)	P10: Flow rate rise gain	R/W	1	200	–	[Q_UG]
411 (19Bh)	P11: Flow rate fall gain	R/W	1	200	–	[Q_DG]
412 (19Ch)	P12: Surge pressure detection level	R/W	0	999	–	[SC_L]
413 (19Dh)	P13: Surge pressure reduction gain	R/W	0	999	–	[SC_G]
414 (19Eh)	P14: Lag time setting	R/W	0	100	msec	[D_TM]
416 (1A0h)	P16: Speed differential gain	R/W	0	100	–	[V_KD]

Address Decimal (Hexadecimal)	Parameter name	R/W	Minimum value (Decimal)	Maximum value (Decimal)	Unit	Parameter code
417 (1A1h)	P17: Pressure/proportional gain (DH range)	R/W	1	999	–	[P_P1]
418 (1A2h)	P18: Pressure/proportional gain [override range]	R/W	1	999	–	[P_P2]
419 (1A3h)	P19: Pressure/integration time [small pressure deviation range]	R/W	10	999	–	[P_I1]
420 (1A4h)	P20: Pressure integration time [large range with positive pressure deviation]	R/W	10	999	–	[P_I2]
421 (1A5h)	P21: Pressure integration time [range with negative pressure deviation]	R/W	10	999	–	[P_I3]
422 (1A6h)	P22: Pressure rise time constant	R/W	0	200	msec	[P_UT]
423 (1A7h)	P23: Pressure fall time constant	R/W	0	200	msec	[P_DT]
424 (1A8h)	P24: Cut-off width	R/W	0	100	0.1 MPa	[P_SP]
425 (1A9h)	P25: Regenerative resistance	R/W	1	999	Ω	[BR_R]
426 (1AAh)	P26: Regenerative resistance capacity	R/W	0.01	9.99	0.01 kW	[BR_W]
429 (1ADh)	P29: Overload warning output judgment value	R/W	0	120	%	[WN_L]
431 (1AFh)	P31: Command input destination selection (*2)	R/W	0	15	–	[CM_S]
436 (1B4h)	P36: Independent flow selection pressure offset	R/W	0	100	0.1 MPa	[CS_P]
437 (1B5h)	P37: Independent flow selection flow rate offset	R/W	0	999	–	[CS_N]
438 (1B6h)	P38: Combination flow selection pressure offset	R/W	0	100	0.1 MPa	[CD_P]
439 (1B7h)	P39: Pump maximum independent flow rate	R/W	(*1)	(*1)	L/min	[QH__]
440 (1B8h)	P40: Pump maximum combination flow pressure	R/W	(*1)	(*1)	0.1 MPa	[PL__]
449 (1C1h)	H64: Pressure/proportional gain (DH range) during standby	R/W	0	999	–	[P_PB_]

(*1): The setting range varies depending on the model. For details, refer to the instruction manual for the hydraulic unit.

(*2): The change takes effect upon turning the power off and back on.

■ 8-step PQ specification

Address Decimal (Hexadecimal)	Parameter name	R/W	Minimum value	Maximum value	Unit	Parameter code
28 (1Ch)	P41: PQ0 High-pressure (independent) side pressure setting	R/W	(*)	(*)	0.1 MPa	PH00
29 (1Dh)	P41: PQ0 High-pressure (independent) side flow rate setting	R/W			0.1 L/min^{-1}	QH00

Address Decimal (Hexadecimal)	Parameter name	R/W	Minimum value	Maximum value	Unit	Parameter code
30 (1Eh)	P41: PQ0 Low-pressure (combination) side pressure setting	R/W	(*)	(*)	0.1 MPa	PL00
31 (1Fh)	P41: PQ0 Low-pressure (combination) side flow rate setting	R/W			0.1 L/min^{-1}	QL00
34 (22h)	P41: PQ0 Pump selection condition	R/W			–	PC00
36 (24h)	P42: PQ1 High-pressure (independent) side pressure setting	R/W			0.1 MPa	PH01
37 (25h)	P42: PQ1 High-pressure (independent) side flow rate setting	R/W			0.1 L/min^{-1}	QH01
38 (26h)	P42: PQ1 Low-pressure (combination) side pressure setting	R/W			0.1 MPa	PL01
39 (27h)	P42: PQ1 Low-pressure (combination) side flow rate setting	R/W			0.1 L/min^{-1}	QL01
42 (2Ah)	P42:PQ1 Pump selection condition	R/W			–	PC01
44 (2Ch)	P43: PQ2 High-pressure (independent) side pressure setting	R/W			0.1 MPa	PH02
45 (2Dh)	P43: PQ2 High-pressure (independent) side flow rate setting	R/W			0.1 L/min^{-1}	QH02
46 (2Eh)	P43: PQ2 Low-pressure (combination) side pressure setting	R/W			0.1 MPa	PL02
47 (2Fh)	P43: PQ2 Low-pressure (combination) side flow rate setting	R/W			0.1 L/min^{-1}	QL02
50 (32h)	P43:PQ2 Pump selection condition	R/W			–	PC02
52 (34h)	P44: PQ3 High-pressure (independent) side pressure setting	R/W			0.1 MPa	PH03
53 (35h)	P44: PQ3 High-pressure (independent) side flow rate setting	R/W			0.1 L/min^{-1}	QH03
54 (36h)	P44: PQ3 Low-pressure (combination) side pressure setting	R/W			0.1 MPa	PL03
55 (37h)	P44: PQ3 Low-pressure (combination) side flow rate setting	R/W			0.1 L/min^{-1}	QL03
58 (3Ah)	P44:PQ3 Pump selection condition	R/W			–	PC03
60 (3Ch)	P45: PQ4 High-pressure (independent) side pressure setting	R/W			0.1 MPa	PH04
61 (3Dh)	P45: PQ4 High-pressure (independent) side flow rate setting	R/W			0.1 L/min^{-1}	QH04

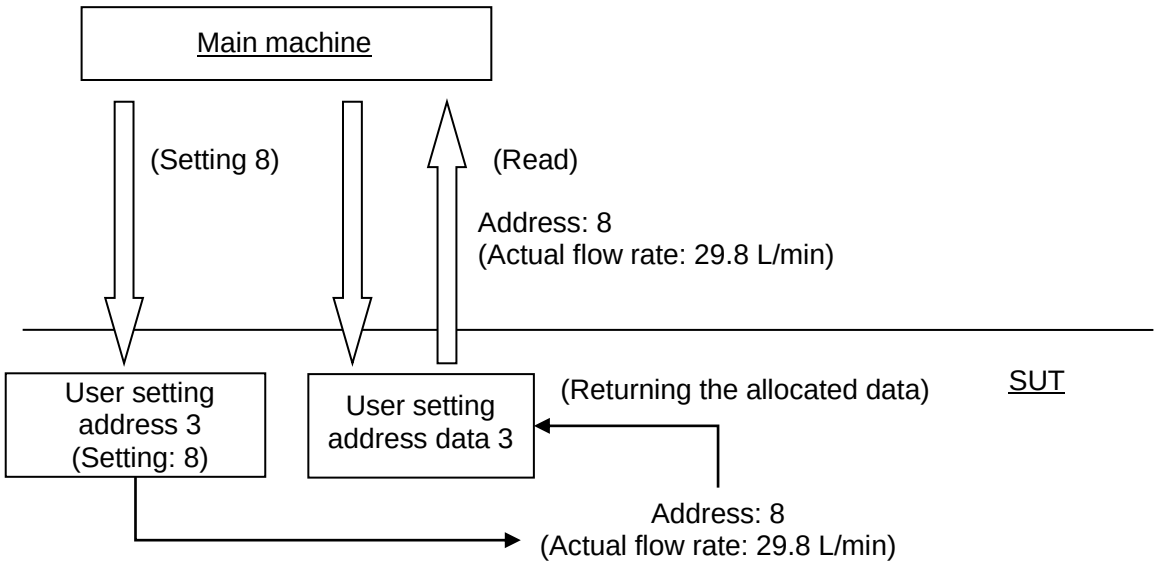
Address Decimal (Hexadecimal)	Parameter name	R/W	Minimum value	Maximum value	Unit	Parameter code
62 (3Eh)	P45: PQ4 Low-pressure (combination) side pressure setting	R/W			0.1 MPa	PL04
63 (3Fh)	P45: PQ4 Low-pressure (combination) side flow rate setting	R/W			0.1 L/min^{-1}	QL04
66 (42h)	P45:PQ4 Pump selection condition	R/W			–	PC04
68 (44h)	P46: PQ5 High-pressure (independent) side pressure setting	R/W			0.1 MPa	PH05
69 (45h)	P46: PQ5 High-pressure (independent) side flow rate setting	R/W			0.1 L/min^{-1}	QH05
70 (46h)	P46: PQ5 Low-pressure (combination) side pressure setting	R/W			0.1 MPa	PL05
71 (47h)	P46: PQ5 Low-pressure (combination) side flow rate setting	R/W			0.1 L/min^{-1}	QL05
74 (4Ah)	P46: PQ5 Pump selection condition	R/W			–	PC05
76 (4Ch)	P47: PQ6 High-pressure (independent) side pressure setting	R/W			0.1 MPa	PH06
77 (4Dh)	P47: PQ6 High-pressure (independent) side flow rate setting	R/W	(*)	(*)	0.1 L/min^{-1}	QH06
78 (4Eh)	P47: PQ6 Low-pressure (combination) side pressure setting	R/W			0.1 MPa	PL06
79 (4Fh)	P47: PQ6 Low-pressure (combination) side flow rate setting	R/W			0.1 L/min^{-1}	QL06
82 (52h)	P47: PQ6 Pump selection condition	R/W			–	PC06
84 (54h)	P48: PQ7 High-pressure (independent) side pressure setting	R/W			0.1 MPa	PH07
85 (55h)	P48: PQ7 High-pressure (independent) side flow rate setting	R/W			0.1 L/min^{-1}	QH07
86 (56h)	P48: PQ7 Low-pressure (combination) side pressure setting	R/W			0.1 MPa	PL07
87 (57h)	P48: PQ7 Low-pressure (combination) side flow rate setting	R/W			0.1 L/min^{-1}	QL07
90 (5Ah)	P48: PQ7 Pump selection condition	R/W			–	PC07

(*): The setting range varies depending on the model.

4.4 User Setting Address Data

Using user setting address data makes it possible to specify any required data for consecutive addresses, and to read multiple data with a single command instance.
Set the addresses of any required data that you want to read into the user setting addresses. Then, by reading the user setting address data corresponding to each of the user setting addresses, you can read the set data of your choice.

■ Reading user setting address data



■ User setting address

Address Decimal (Hexadecimal)	Parameter name	R/W	Minimum value	Maximum value	Default value	Default selection
500 (1F4h)	User setting address 1	R/W	0	9999	0	(Current pressure)
501 (1F5h)	User setting address 2	R/W	0	9999	1	(n04: Pressure command value)
502 (1F6h)	User setting address 3	R/W	0	9999	8	(Actual flow rate)
503 (1F7h)	User setting address 4	R/W	0	9999	10	(Actual rotational speed)
504 (1F8h)	User setting address 5	R/W	0	9999	13	(n05: Flow rate command value)
505 (1F9h)	User setting address 6	R/W	0	9999	20	(Motor load integration rate)
506 (1FAh)	User setting address 7	R/W	0	9999	21	(Controller load integration rate)
507 (1FBh)	User setting address 8	R/W	0	9999	302	(Regenerative load rate)
508 (1FCh)	User setting address 9	R/W	0	9999	313	(Motor thermistor temperature)
509 (1FDh)	User setting address 10	R/W	0	9999	314	(Fin thermistor temperature)
510 (1FEh)	User setting address 11	R/W	0	9999	315	(Main circuit DC voltage)
511 (1FFh)	User setting address 12	R/W	0	9999	316	(n00: Pressure command voltage)

Address Decimal (Hexadecimal)	Parameter name	R/W	Minimum value	Maximum value	Default value	Default selection
512 (200h)	User setting address 13	R/W	0	9999	317	(n01: Flow rate command voltage)
513 (201h)	User setting address 14	R/W	0	9999	318	(n02: Pressure monitor voltage)
514 (202h)	User setting address 15	R/W	0	9999	319	(n03: Flow rate monitor voltage)
515 (203h)	User setting address 16	R/W	0	9999	0	(Current pressure)
516 (204h)	User setting address 17	R/W	0	9999	0	(Current pressure)
517 (205h)	User setting address 18	R/W	0	9999	0	(Current pressure)
518 (206h)	User setting address 19	R/W	0	9999	0	(Current pressure)
519 (207h)	User setting address 20	R/W	0	9999	0	(Current pressure)

■ User setting address data

Address Decimal (Hexadecimal)	Parameter name	R/W	Description
550 (226h)	User setting address data 1	R	Data specified with user setting address 1
551 (227h)	User setting address data 2	R	Data specified with user setting address 2
552 (228h)	User setting address data 3	R	Data specified with user setting address 3
553 (229h)	User setting address data 4	R	Data specified with user setting address 4
554 (22Ah)	User setting address data 5	R	Data specified with user setting address 5
555 (22Bh)	User setting address data 6	R	Data specified with user setting address 6
556 (22Ch)	User setting address data 7	R	Data specified with user setting address 7
557 (22Dh)	User setting address data 8	R	Data specified with user setting address 8
558 (22Eh)	User setting address data 9	R	Data specified with user setting address 9
559 (22Fh)	User setting address data 10	R	Data specified with user setting address 10
560 (230h)	User setting address data 11	R	Data specified with user setting address 11
561 (231h)	User setting address data 12	R	Data specified with user setting address 12
562 (232h)	User setting address data 13	R	Data specified with user setting address 13
563 (233h)	User setting address data 14	R	Data specified with user setting address 14
564 (234h)	User setting address data 15	R	Data specified with user setting address 15
565 (235h)	User setting address data 16	R	Data specified with user setting address 16
566 (236h)	User setting address data 17	R	Data specified with user setting address 17
567 (237h)	User setting address data 18	R	Data specified with user setting address 18
568 (238h)	User setting address data 19	R	Data specified with user setting address 19
569 (239h)	User setting address data 20	R	Data specified with user setting address 20

4.5 Saving to EEPROM

Values written with the write command are stored in RAM and therefore cleared when the power is shut off, with the original value being reinstated.
To save written parameters, specify the save to EEPROM command.

Address Decimal (Hexadecimal)	Parameter name	R/W	Minimum value	Maximum value	Unit	Remarks
360 (168h)	Save to EEPROM	W	0	0	–	–

Memo	・ When a save to EEPROM command is specified after a power-off request has been detected, “error code 04H” is returned without executing the save command, in order to protect data. ・ When multiple data are written with function code 0x10, data with addresses specified after the address to be saved to EEPROM are not saved to EEPROM. ・ If the power is shut off during saving to EEPROM and the response on normal completion of saving cannot be confirmed, it is possible that there is some data that could not be saved. In this case, turn the power back on and check the data. ・ The life of the EEPROM is about 100,000 write operations. Take care about the number of write operations to the EEPROM.

4.6 Alarm History Data

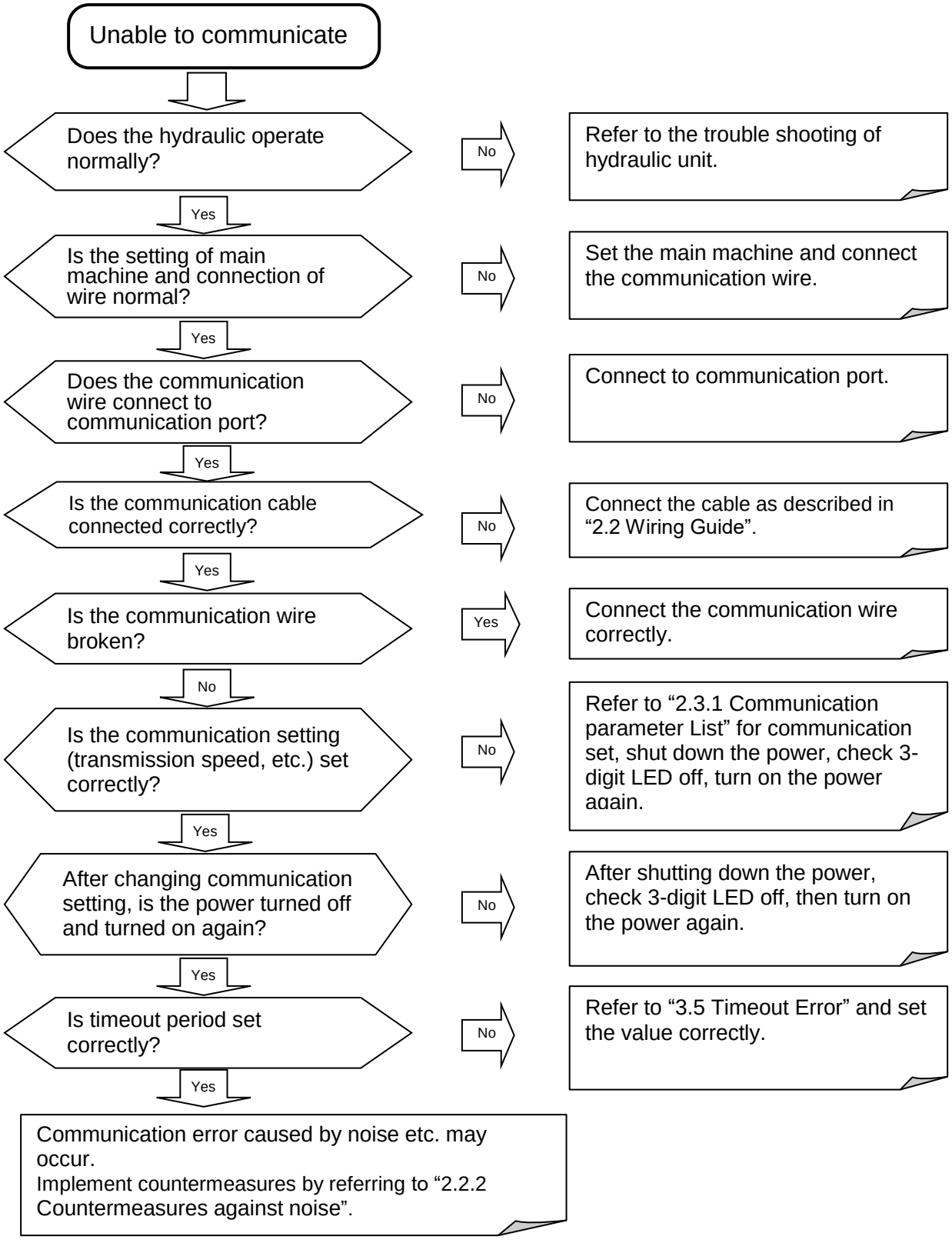
Address Decimal (Hexadecimal)	Parameter name	R/W	Minimum value	Maximum value	Unit	Parameter code
250 (FAh)	Occurred alarm (0) q-axis current	R	–	–	0.1 A	–
251 (FBh)	Occurred alarm (1) q-axis current	R	–	–	0.1 A	–
252 (FCh)	Occurred alarm (2) q-axis current	R	–	–	0.1 A	–
253 (FDh)	Occurred alarm (3) q-axis current	R	–	–	0.1 A	–
254 (FEh)	Occurred alarm (4) q-axis current	R	–	–	0.1 A	–
255 (FFh)	Occurred alarm (5) q-axis current	R	–	–	0.1 A	–
256 (100h)	Occurred alarm (6) q-axis current	R	–	–	0.1 A	–
257 (101h)	Occurred alarm (7) q-axis current	R	–	–	0.1 A	–
258 (102h)	Occurred alarm (8) q-axis current	R	–	–	0.1 A	–
259 (103h)	Occurred alarm (9) q-axis current	R	–	–	0.1 A	–
260 (104h)	Occurred alarm (0) Main circuit DC voltage	R	–	–	0.1 Vdc	–
261 (105h)	Occurred alarm (1) Main circuit DC voltage	R	–	–	0.1 Vdc	–
262 (106h)	Occurred alarm (2) Main circuit DC voltage	R	–	–	0.1 Vdc	–
263 (107h)	Occurred alarm (3) Main circuit DC voltage	R	–	–	0.1 Vdc	–
264 (108h)	Occurred alarm (4) Main circuit DC voltage	R	–	–	0.1 Vdc	–
265 (109h)	Occurred alarm (5) Main circuit DC voltage	R	–	–	0.1 Vdc	–
266 (10Ah)	Occurred alarm (6) Main circuit DC voltage	R	–	–	0.1 Vdc	–
267 (10Bh)	Occurred alarm (7) Main circuit DC voltage	R	–	–	0.1 Vdc	–
268 (10Ch)	Occurred alarm (8) Main circuit DC voltage	R	–	–	0.1 Vdc	–
269 (10Dh)	Occurred alarm (9) Main circuit DC voltage	R	–	–	0.1 Vdc	–
320 (140h)	Occurred alarm (0) Name	R	–	–	–	–
321 (141h)	Occurred alarm (1) Name	R	–	–	–	–
322 (142h)	Occurred alarm (2) Name	R	–	–	–	–
323 (143h)	Occurred alarm (3) Name	R	–	–	–	–
324 (144h)	Occurred alarm (4) Name	R	–	–	–	–
325 (145h)	Occurred alarm (5) Name	R	–	–	–	–
326 (146h)	Occurred alarm (6) Name	R	–	–	–	–
327 (147h)	Occurred alarm (7) Name	R	–	–	–	–
328 (148h)	Occurred alarm (8) Name	R	–	–	–	–
329 (149h)	Occurred alarm (9) Name	R	–	–	–	–
330 (14Ah)	Occurred alarm (0) Power-on count	R	–	–	–	–
331 (14Bh)	Occurred alarm (1) Power-on count	R	–	–	–	–
332 (14Ch)	Occurred alarm (2) Power-on count	R	–	–	–	–
333 (14Dh)	Occurred alarm (3) Power-on count	R	–	–	–	–
334 (14Eh)	Occurred alarm (4) Power-on count	R	–	–	–	–

Address Decimal (Hexadecimal)	Parameter name	R/W	Minimum value	Maximum value	Unit	Parameter code
335 (14Fh)	Occurred alarm (5) Power-on count	R	–	–	–	–
336 (150h)	Occurred alarm (6) Power-on count	R	–	–	–	–
337 (151h)	Occurred alarm (7) Power-on count	R	–	–	–	–
338 (152h)	Occurred alarm (8) Power-on count	R	–	–	–	–
339 (153h)	Occurred alarm (9) Power-on count	R	–	–	–	–
340 (154h)	Occurred alarm (0) Rotational speed	R	–	–	min^{-1}	–
341 (155h)	Occurred alarm (1) Rotational speed	R	–	–	min^{-1}	–
342 (156h)	Occurred alarm (2) Rotational speed	R	–	–	min^{-1}	–
343 (157h)	Occurred alarm (3) Rotational speed	R	–	–	min^{-1}	–
344 (158h)	Occurred alarm (4) Rotational speed	R	–	–	min^{-1}	–
345 (159h)	Occurred alarm (5) Rotational speed	R	–	–	min^{-1}	–
346 (15Ah)	Occurred alarm (6) Rotational speed	R	–	–	min^{-1}	–
347 (15Bh)	Occurred alarm (7) Rotational speed	R	–	–	min^{-1}	–
348 (15Ch)	Occurred alarm (8) Rotational speed	R	–	–	min^{-1}	–
349 (15Dh)	Occurred alarm (9) Rotational speed	R	–	–	min^{-1}	–
350 (15Eh)	Occurred alarm (0) PQ number	R	–	–	–	–
351 (15Fh)	Occurred alarm (1) PQ number	R	–	–	–	–
352 (160h)	Occurred alarm (2) PQ number	R	–	–	–	–
353 (161h)	Occurred alarm (3) PQ number	R	–	–	–	–
354 (162h)	Occurred alarm (4) PQ number	R	–	–	–	–
355 (163h)	Occurred alarm (5) PQ number	R	–	–	–	–
356 (164h)	Occurred alarm (6) PQ number	R	–	–	–	–
357 (165h)	Occurred alarm (7) PQ number	R	–	–	–	–
358 (166h)	Occurred alarm (8) PQ number	R	–	–	–	–
359 (167h)	Occurred alarm (9) PQ number	R	–	–	–	–

5 Maintenance

5.1 Troubleshooting

5.1.1 Unable to communicate



5.2 Maintenance Management

In order to maintain the performance of communication and remote control function for a long period, maintain the following items periodically and take measures to repair or exchange if any problem occurs.
In addition, although the inspection time and period is shown as a guide, inspection time and period differ depending on the condition and environment of usages.

■ Periodical inspection

Target part / items	Inspection time and period	Inspection instruction
● Appearance of communication wire	1 time/ 6 months	Visual check whether the communication wire is not broken or whether there is no crack or breakage in the wiring covering material.
● Disconnection of communication wire	1 time/ 6 months	Measure the resistance at both ends of the communication wire with tester and confirm that there is no abnormality in the resistance value.

⚠ DANGER

(1) Do not get close to or come into contact with rotating parts.
(2) When carrying out wiring work, abide by the following procedure to prevent electric shocks.
• Shut off the main power supply to the hydraulic unit. (Set the circuit breaker of the power supply circuit to “OFF”.)
• Hang a tag stating, for example, “Operation Prohibited (Work in Progress)” on the power supply circuit breaker and related devices, preventing erroneous operation while the work is in progress.
(3) When running the unit, mount all the covers on the terminal boxes before turning the power on.

⚠ CAUTION

Be sure not apply strong force to the communication wire during working.