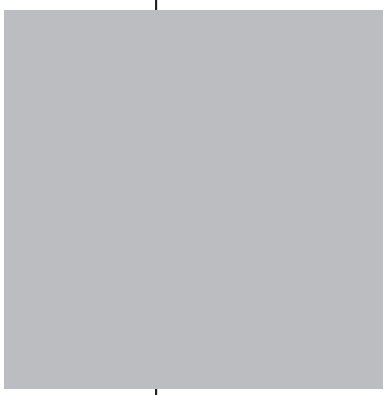
azbil

No. CP-SP-1408E

F4H Series Compact Digital Mass Flow Controller User's Manual for RS-485 Communication Functions



Thank you for purchasing an Azbil Corporation product.

This manual contains information for ensuring the correct use of this product. It also provides necessary information for installation, maintenance, and troubleshooting.

This manual should be read by those who design and maintain equipment that uses this product. Be sure to keep this manual nearby for handy reference.

Azbil Corporation

NOTICE

Be sure that the user receives this manual before the product is used.

Copying or duplicating this user's manual in part or in whole is forbidden. The information and specifications in this manual are subject to change without notice.

Considerable effort has been made to ensure that this manual is free from inaccuracies and omissions. If you should find an error or omission, please contact the azbil Group.

In no event is Azbil Corporation liable to anyone for any indirect, special or consequential damages as a result of using this product.

Modbus™ is a trademark and the property of Schneider Electric SE, its subsidiaries and affiliated companies.

Conventions Used in This Manual

■ The safety precautions explained in the following section aim to prevent injury to the operator and others, and to prevent property damage.

⚠WARNING **Warnings are indicated when mishandling this product might result in death or serious injury.**

⚠CAUTION **Cautions are indicated when mishandling this product might result in minor injury to the user, or physical damage to the product.**

■ In describing the product, this manual uses the icons and conventions listed below.

⚠ Use caution when handling the product.

⃠ The indicated action is prohibited.

❗ Always follow the indicated instructions.

[!] Handling Precautions:
Handling Precautions indicate items that the user should pay attention to when handling the F4H.

Note: Notes indicate information that might benefit the user.

☞ This indicates the item or page that the user is requested to refer to.

(1), (2), (3): Numbers within parentheses indicate steps in a sequence or parts of an explanation.

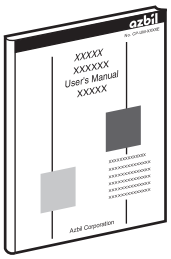
Safety Precautions

⚠ CAUTION

Be sure to use this product within the operating conditions (for temperature, humidity, voltage, vibration, shock, installation orientation, atmosphere, etc.) set forth in the specifications in the Compact Digital Mass Flow Controller User's Manual (CP-UM-5874JE) supplied with the product. Otherwise, a device failure may result.
Before wiring the device, turn the power off. Otherwise, a device failure may result.
Wire this device correctly according to the prescribed standards, using the specified power source and wiring methods. Otherwise, a device failure may result.
Do not allow wire clippings, metal shavings, water, etc., to enter the device. They can cause a device failure.
If there is a risk of a power surge caused by lightning, use a surge absorber (surge protector). Otherwise, a fire or device failure may result.
Make sure that the wiring is correct before turning the power on. Incorrect wiring may result in damage or malfunction.
Do not disassemble this device. Doing so may cause a device failure.
Do not apply excessive force to the connector or cables when the connector cable or AC adapter is connected. Doing so may damage the connector or circuit board.

The Role of This Manual

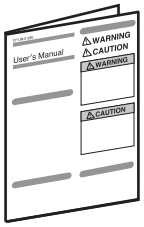
A total of 4 different manuals are available for the F4H. Read them as necessary for your specific requirements. If a manual you require is not available, contact the azbil Group or its dealer.



4H Series Compact Digital Mass Flow Controller User's Manual for RS-485 Communication Functions

Manual No. CP-SP-1408E

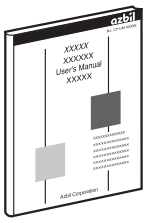
This manual.
Be sure to read this manual when using RS-485 communication.
This manual gives an overview of communications, wiring, and communication procedures. It contains a communication data table for this device, tells how to address problems, and gives communications specifications.



F4H9050/9200/9500/0002/0005/0020 Compact Digital Mass Flow Controller User's Manual

Manual No. CP-UM-5874JE

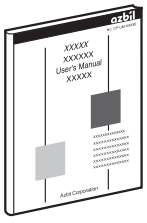
This manual is supplied with the product.
Personnel who are using the F4H for the first time or who are in charge of hardware design and/or maintenance of a control panel containing the F4H should read this manual thoroughly.
This manual provides an overview of the product, explains installation, wiring, troubleshooting, maintenance and inspection, and provides hardware specifications.



F4H9050/9200/9500/0002/0005/0020 Compact Digital Mass Flow Controller User's Manual for Installation and Configuration

Manual No. CP-SP-1405E

Personnel who are using the F4H for the first time or who are in charge of hardware design and/or maintenance of a control panel containing the F4H should read this manual thoroughly.
This manual provides an overview of the product, explains installation, wiring, troubleshooting, maintenance and inspection, and provides hardware specifications.



User's Manual for MLP300A000 Loader Package for F4H Series Compact Digital Mass Flow Controllers

Manual No. CP-SP-1415E

Running the MLP loader package on a personal computer enables you to set up F4H parameters on the personal computer.
This manual describes operations on the personal computer.

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Contents

Chapter 1. OVERVIEW

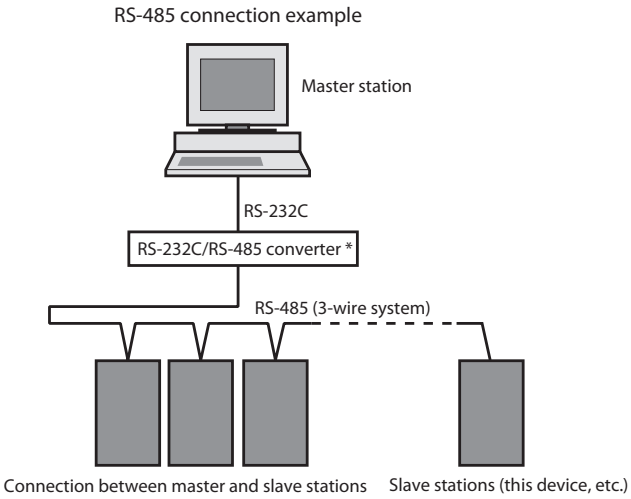
Model F4H (hereafter also “this device” or “the slave station”) can exchange settings, data, etc., with host devices (master stations) such as a personal computer or a PLC device via communication.
The communication program is to be developed by the user.

■ Features

The communication function of this device has the following features:

- RS-485 communication can be used to control this device, collect data, and set parameters.
  Using RS-485 communication, up to 31 slave stations (devices like this device that are compatible with RS-485) can be connected to a master station.
- With RS-485 communication, using a procedure like the following, various data can be read from and written to a device.
  1. The master station transmits instruction messages to slave stations
  2. The master station receives response messages from slave stations
- There are two types of instructions sent from the master station to the slave stations: “read” and “write.”
- The data type to be read/written can be freely selected by the data address.
- Regarding the communication protocol, Controller Peripheral Link (CPL, Azbil Corporation’s communication protocol) and Modbus RTU are supported. (The supported communication protocol varies depending on the model.)
- This device uses an RJ-45 connector for the communication port. In addition, since two communication channels are supplied for each device, it is possible to connect multiple devices in serial.

■ Device Configuration



*An example is the CMC10L Communication Controller available from Azbil Corporation.

Memo

Chapter 2. WIRING

⚠ CAUTION

Before wiring the device, turn the power off.
Otherwise, a device failure may result.

Do not disassemble this device.
Doing so may cause device failure.

Wire this device correctly according to the prescribed standards, using the specified power source and wiring methods.
Otherwise, a device failure may result.

If there is a risk of a power surge caused by lightning, use a surge absorber (surge protector).
Otherwise, a fire or device failure may result.

Do not allow wire clippings, metal shavings, water, etc., to enter the device.
Otherwise, a device failure may result.

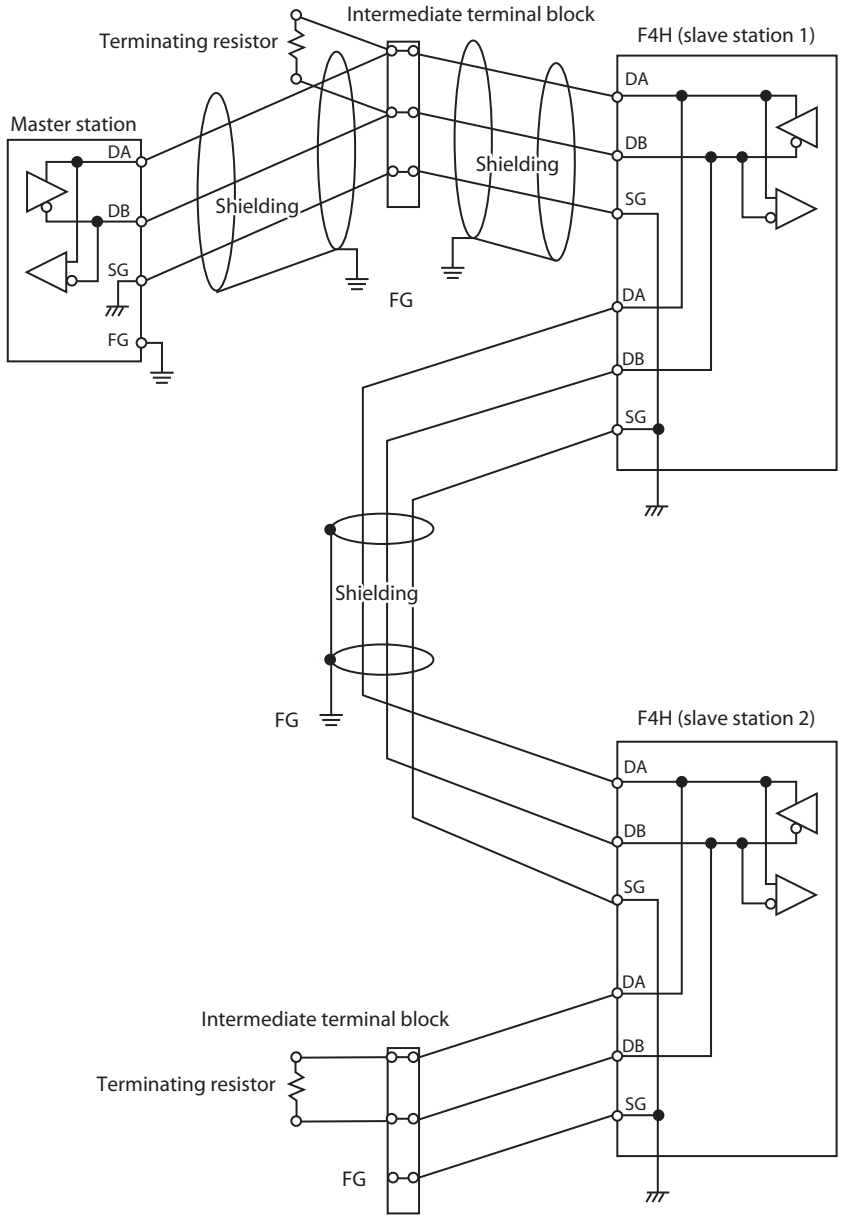
Make sure that the wiring is correct before turning the power on.
Incorrect wiring may result in damage or malfunction.

Do not apply excessive force to the connector or cables when the connector cable or AC adapter is connected.
Doing so may damage the connector or circuit board.

Note

- For wiring not related to the RS-485 communication line,
  ☞ F4H9050/9200/9500/0002/0005/0020 Compact Digital Mass Flow Controller User's Manual for Installation and Configuration, CP-SP-1405E

■ RS-485 Connection



- Connect terminating resistors (150 Ω ± 5 %, 1/2 W or more) at both ends of the transmission line. (An intermediate terminal block is required because the F4H Series uses a connector type connection.)
- The cable to the terminal block from the F4H Series device must be as short as possible.
- The shielded wire should be grounded at one side, not at both ends of the shielded wire.
- For communication with a PLC or PC, an Azbil Corporation CMC10L (RS-232C/RS-485 converter) or CMC15G (multifunction gateway) communication controller can be used as a converter for the master station.

[!] Handling Precautions

- Be sure to connect the signal ground (SG). Otherwise, communication may be unreliable.

■ Terminal layout of this device

The communication terminal layout is as shown below.

● Connector specifications

RJ-45

● Connector pin layout

87654321

Connector pin signal table

Pin No.	Signal	Description
1	SG	RS-485 Communication SG
2	SG	RS-485 Communication SG
3	N.C	---
4	DB	RS-485 Communication DB
5	DA	RS-485 Communication DA
6	N.C	---
7	N.C	---
8	N.C	---

Memo

Chapter 3. SETTINGS

■ Setup of the communication function

In order to use the RS-485 communication function, the communication parameters and station address of this device must be configured in advance so that they are compatible with the settings of the master station.

Procedure

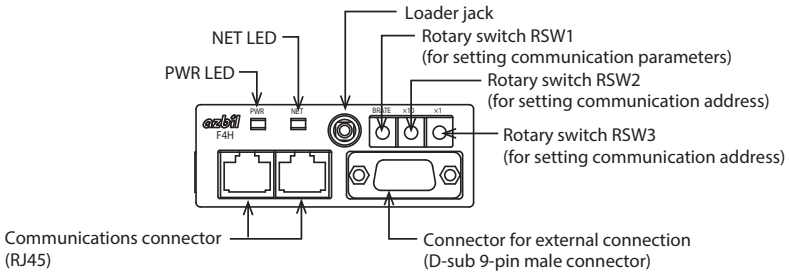
(1) Operate the RSW1 rotary switch (for communication parameters) on the top panel of this device to select the communication speed and other communication parameters.

(2) Operate the RSW2 and RSW3 rotary switches (communication address settings) on the top panel of this device to set the device address.

(3) Turn off the power of this device and then turn it back on again.

! Handling Precautions

- The setting that is read when the power is turned on is the setting that is applied. Therefore, only changing the rotary switch does not put the new setting into effect.



■ Communication function settings

Rotary switch settings

RSW1 setting	Communication speed and conditions
0	Set by the loader*1
1	38400 bps, even parity, 1 stop bit
2	38400 bps, even parity, 2 stop bits
3	38400 bps, no parity, 1 stop bit (CPL model only)*3
4	38400 bps, no parity, 2 stop bits
5	19200 bps, even parity, 1 stop bit
6	19200 bps, even parity, 2 stop bits
7	19200 bps, no parity, 1 stop bit (CPL model only)*3
8	19200 bps, no parity, 2 stop bits
9	9600 bps, even parity, 1 stop bit
A	9600 bps, even parity, 2 stop bits
B	9600 bps, no parity, 1 stop bit (CPL model only)*3
C	9600 bps, no parity, 2 stop bits
D	*2
E	*2
F	*2

*1. Communication settings can also be configured using the MLP300A000 Smart Loader Package for F4H Series Compact Digital Mass Flow Controllers.
(A separately purchased loader cable, No. 81441177-001, is required.)
☞ User's Manual for MLP300A000 Loader Package for F4H Series Compact Digital Mass Flow Controllers (CP-SP-1415E) (for details on MLP 300 operation)

*2. This is the same as selecting "0."

*3. On the Modbus-RTU model, this is the same as selecting "0."

RSW2 Setting	RSW3 Setting	Station address
0 to 9	0 to 9	Station address [decimal] (SW2: starting digits; SW3: ending digits) Setting range: 00 to 99 ("00" is for no communication function) *4, *5

*4. When SW1 is set to "0," the settings from the loader take precedence.

*5 .A selection outside the setting range (A to F) is the same as selecting "00."

Chapter 4. COMMUNICATION PROCEDURE (CPL COMMUNICATION)

4 - 1 Overview of Communication Procedure and Messages

■ Communication procedure

The following is the communication procedure in its most simple form:

(1) The master station sends an instruction message to slave stations specifying the station it wishes to communicate with.

(2) The slave station receives the instruction message, and executes a read or write process, depending on the contents of the message.

(3) Additionally, the slave station transmits a response message appropriate for the processing details.

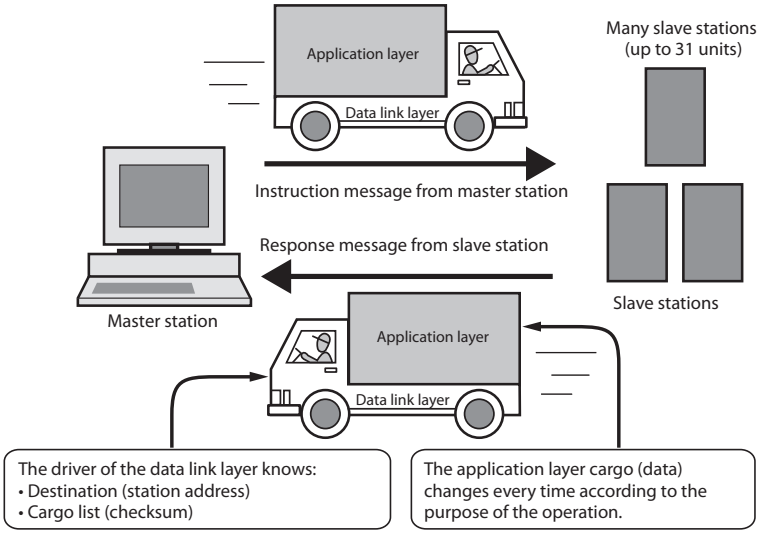
(4) The master station receives the response message.

■ Message structure

A message consists of two layers, as shown below. Both the instruction message from the master station and the response message from the slave station take this form.

- Data link layer
  This layer contains the basic information required for communication.
  This information includes the message destination and information for error-checking of the message.

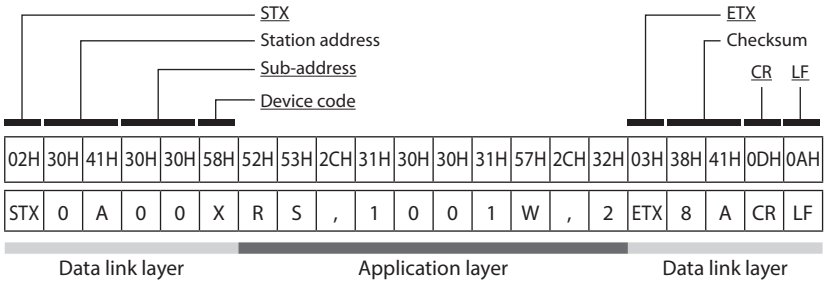
- Application layer
  This is the layer that reads and writes data.
  The contents of this layer vary according to the purpose.



4 - 2 Data Link Layer

■ Description of data link layer

- The data link layer contains eight items of basic information necessary for transmitting a message.
- The instruction message and response message have the same structure in the data link layer.
  __Underlined characters are always the same when using this device



Each function of the data link layer is described below:

● STX (Start of TeXt)

◆ Role: Indicates the beginning of a message.

◊ Description
- It is always 02H.
- A station receiving an STX interprets it as the first character of a new instruction message, even if the station was previously in the middle of some other message.

● Station address

◆ Role: This specifies the destination station. It makes communication with a specific station possible.

◊ Description
- If a station's address is set to "0," its communication function is disabled. To enable a station to communicate, be sure to set its address to "1" or above.
- The address is two characters expressed by hexadecimal numbers. For details, see the example.

❐ Example: The station address of the destination is "10"
(1) 10 (decimal) = 0AH (hexadecimal)
(2) Replacement of characters by their hexadecimal character codes
0 = 30H
A = 41H
(3) The characters "0A" (30H, 41H) obtained in step 2 are used as the station address.

Note

- ☞ Chapter 3. MOUNTING AND WIRING (for details on settings)

Handling Precautions

- Note that the function of the station address differs entirely from that of the data address in the application layer. Be sure to note the difference.

● **Subaddress**

◊ Description: Always the same for this device. Be sure to set the subaddress "00" (30H, 30H), the same format as the station address.

● **Device code**

◊ Description: Only the hex character codes for "X" (58H) or "x" (78H) can be used on this device.

● **ETX (End of TeXt)**

◆ Role: This indicates the end of the application layer.

◊ Description: Always 03H.

● **Checksum**

◆ Role: The checksum is used to check whether the message changed due to some problem (e.g., electrical noise) during communication.

◊ Description
- The hexadecimal codes for two characters.
- How to calculate a checksum
  (1) Add all the values of each byte of the message from STX to ETX.
  (2) Take the 2's complement of the sum.
  (3) Convert the result to character codes.

☐ Example: The instruction message on the previous page is used in the following example:

(1) Add all the character codes from STX to ETX.
The lowest 1 byte of the calculation result is 76H.

(2) Take the two's complement of the addition result.
The result is 8AH.

(3) Replace the characters of the result with their hexadecimal character codes. The result is used for the checksum.
"8A" becomes 38H and 41H.
For replacement by hex character codes, see the station address example.

Handling Precautions

- The checksum of the instruction message cannot be omitted.

● CR and LF (Carriage Return/Line Feed)

◆ Role: These indicate the end of a message.

◊ Description
- "CR" is (0DH), and "LF" is (0AH).
- Be sure to use CR and LF as a pair.

[!] Handling Precautions

- If any of the following problems is found in the data link layer, the device will not respond.
  - The communication parameters of the stations do not match (transmission speed, parity, etc.).
  - The station address transmitted is different from the station address of the target device.
  - The station address is set to "00."
  - STX, ETX, CR or LF are not in the right positions.
  - The device code is not "X" or "x."
  - The station address, subaddress, or checksum is not two characters.
  - The calculated checksum does not match the checksum in the message.
  - The message contains invalid characters.
  - Superfluous characters were sent after CR and LF.
- In the data link layer, the same message (except for the checksum) as the instruction message to the station is used as the response message.
- Use capital letters from "A" to "F" for the hexadecimal numbers used in the station address and checksum.

4 - 3 Application Layer

■ Overview

- The application layer contains instructions, data, number of data words, and information on the success of the instruction message (termination code).
- In the application layer, the structure of the instruction message is different from that of the response message.
- There are two types of instruction message: read and write.
  The response message corresponds to one of these types of instruction message.
- The termination code indicates how the instruction message was processed.

The application layer of the instruction message is composed of the following 4 items:

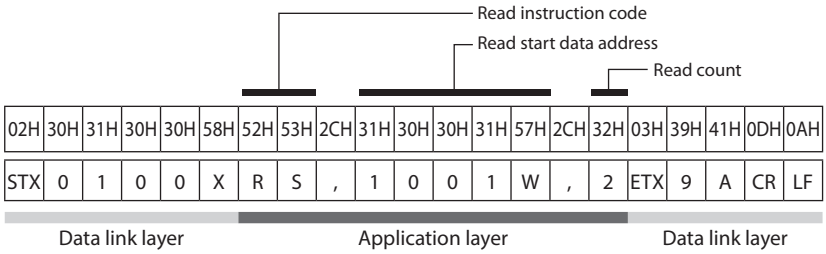
Item	Description
(1) Command	"RS" (consecutive address data read command in decimal format)
	"WS" (consecutive address data write command in decimal format)
	"RD" (fixed length consecutive address data read command in hexadecimal format)
	"WD" (fixed length consecutive address data write command in hexadecimal format)
(2) Data delimiter	RS/WS: "," (comma)
	RD/WD: None
(3) Word address	RS/WS: "W" is added to the decimal number, as in "1001W."
	RD/WD: A four-digit hexadecimal number such as "03E9"
(4)-1 Read count	RS: A decimal number such as "1"
	RD: A four-digit hexadecimal number such as "0001"
(4)-2 Value to write	WS: Value of character expression such as "123"
	WD: A four-digit hexadecimal number such as "007B"

4 - 4 Data Read

■ Decimal format consecutive data read (RS command)

● RS command instruction message

- This is a command—in one message—to read the contents of consecutive data addresses from the specified read start data address.
- The application layer of the read instruction consists of the three types of data shown below.



- Individual data words are delimited by commas (character code 2CH).
- Capital letters are used for all numbers and characters in the application layer.
- All numbers are in base 10.
- Unnecessary zeros or spaces are not allowed.
  - ☐ Ex.: The underlined portion of "RS, 01001W, 2" is not allowed.
  - ☐ Ex.: Underlined portions of "RS, 1001W, 02" are not allowed.
  - ☐ Ex.: The above figure shows how a single message instructs the reading of two pieces of data (starting from 1001W).

1. Read instruction code (RS)

◆ Role: This is a command for reading.

◊ Description • Two characters, "RS" (52H, 53H).

2. Read start data address

◆ Role: This specifies the first data address to read.

◊ Description • ☞6-2 Communication Data Table (P. 6-3). (for the relationship between data addresses and read data)

• Be sure to add "W" (57H) after the data address number.

3. Number of read data words

◆ Role: This specifies how many consecutive data words to read, starting from the specified data address.

◊ Description • There is a limit to the number of data that can be read in one message. ☞■ Number of data words that can be read or written (P. 6-2).

● Response message to the RS command

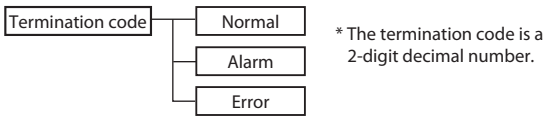
If the message in the data link layer is correct, a response message appropriate for the contents of the instruction message is returned.

All data in the application layer is expressed in decimal character.

● Termination code

◆ Role: This numerical code tells how the instruction message was processed by the device. Different values are set according to the result of processing.

◊ Description • The response message must include a termination code. The types of termination code are as follows.



1. Normal response

◆ Role: The specified number of data words is returned.

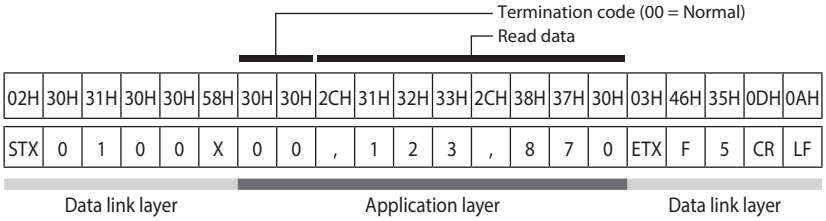
• The data is delimited by commas (2CH).

• The range and number of digits of each piece of data depends on the data read.

• Each piece of data is expressed as a number without a decimal point.

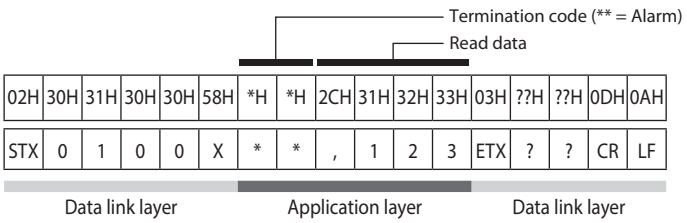
☐ Ex.: "20.0" is converted to "200."

The figure below shows an example of a normal response. (In a case of two pieces of data to read, both are read correctly.)



2. Alarm response

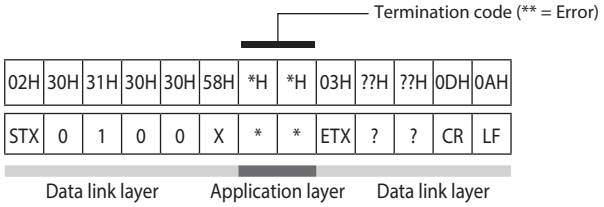
The figure below shows an example of an alarm response. ("**" stands for the alarm termination code.)



3. Error response

If there is an error in the instruction message so that reading out of the data could not be done normally, an error response is returned.

The figure below shows an example of an error response. ("**" stands for the error code.)



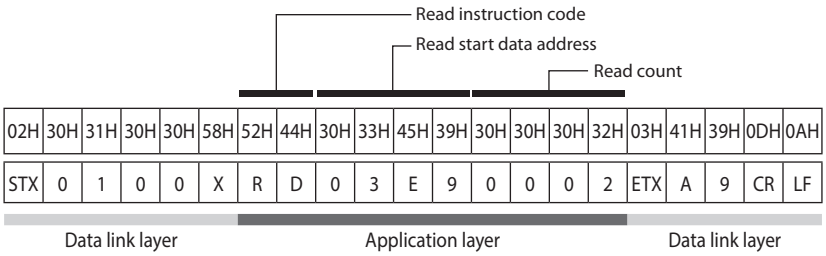
! Handling Precautions

- The data address, read count, value to write, and data to read must all conform to the following rules.
  - A negative number is preceded by a minus sign (2DH).
    ☐ Ex.: "−123" (2DH, 31H, 32H, 33H)
  - If the number is 0, one "0" is used.
    ☐Ex.: "0" (30H).
    ☐ Ex.: "00" (30H, 30H) is not allowed.
  - Positive numbers are not preceded by a plus sign.
    ☐ Ex.: "+123" (2BH, 31H, 32H, 33H) is not allowed.
  - Unnecessary leading zeros and spaces are not allowed.
    ☐ Ex.: "0123" (30H, 31H, 32H, 33H) is not allowed.
    ☐ Ex.: " 123" (20H, 31H, 32H, 33H) is not allowed.

■ Hexadecimal format consecutive data read (RD command)

● RD command instruction message

• This is a command—in one message—to read the contents of consecutive data addresses of fixed-length pieces of data in hexadecimal format starting from the specified read start data address. Because each piece of data is of fixed length, this command is suitable for handling data using a ladder program in communication with a PLC.



• Capital letters are used for all numbers and characters in the application layer.

• Each numerical value is expressed as a four-digit hexadecimal number.

• A comma (",") cannot be used to separate the data.

• The above figure shows how a single message instructs the reading of two pieces of data (starting from address "03E9").

1. Read instruction code (RD)

◆ Role: This is the command for reading fixed-length data in hexadecimal format.

◊ Description • Two characters, "RD" (52H, 44H).

2. Read start data address

◆ Role: This specifies by a four-digit hexadecimal number the first data address to be read.

◊ Description • ☞6-2 Communication Data Table (P. 6-3). (for the relationship between data addresses and read data)

• "W" (57H) is not added after the data address number.

3. Number of read data words

◆ Role: This specifies how many consecutive pieces of data to read, starting from the data address specified with four hexadecimal digits.

◊ Description • There is a limit on the amount of data that can be read in one message. ☞▪ Number of data words that can be read or written (P. 6-2).

● Response message to the RD command

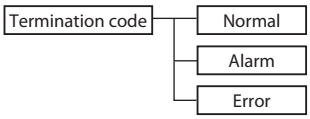
If the message in the data link layer is correct, a response message appropriate for the contents of the instruction message is returned.

The data in the application layer is the termination code (two decimal digits) and the number of pieces of data to read (four hexadecimal digits × number of items), which is specified by the instruction message. (However, in the case of an error response, read data is not included.)

● Termination code

◆ Role: This tells how the instruction message was processed by the device. Different codes are used according to the result of processing.

◊ Description • The response message must include a termination code. The types of termination code are as follows.



* The termination code is a 2-digit decimal number.

1. Normal response

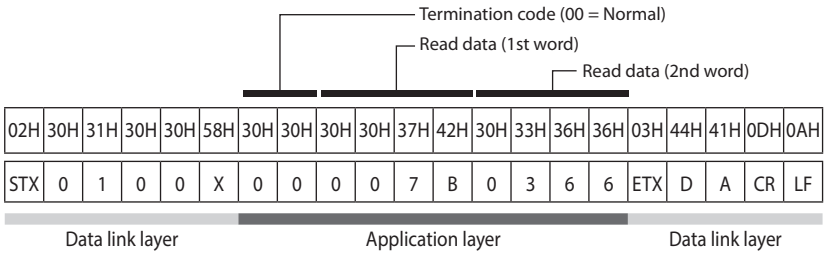
◆ Role: It sends back the specified number of data words as a four-digit hexadecimal number.

- The range of the data words depends on the individual data read.
- The data is expressed without a decimal point.

☐ Ex.: The decimal number "20.0" is expressed as "00C8."

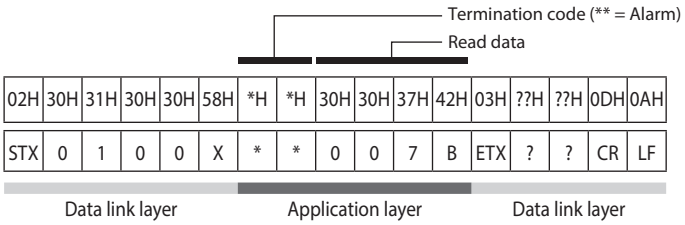
- Since the data is of fixed length, commas (2CH) are not added as delimiters between data.

The figure below shows an example of a normal response (two pieces of data are read normally).



2. Alarm response

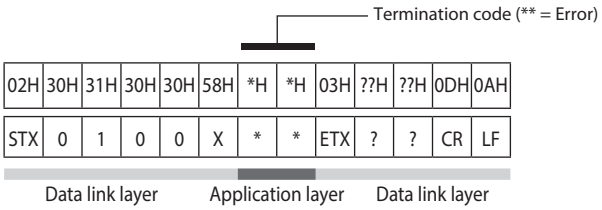
The figure below shows an example of an alarm response. ("**" stands for the alarm termination code.)



3. Error response

If there is an error in the instruction message so that data cannot be read out normally, an error response is returned.

The figure below shows an example of an error response. ("**" stands for the error code.)



! Handling Precautions

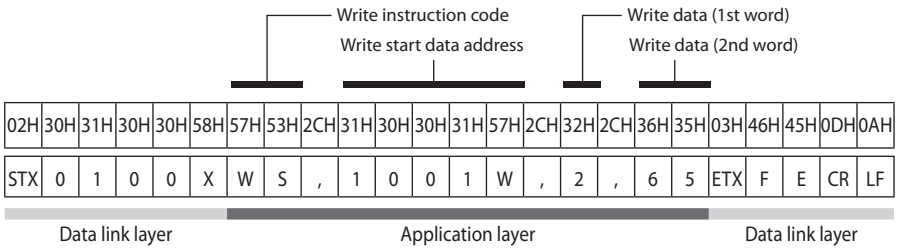
- The data address, read count, value to write, and data to read must conform to the following rules.
  - Even when the number contains fewer than four digits, it must be made into a 4-digit hexadecimal number.
    ☐ Ex.: If the number is the decimal number "0," it is written as "0000" (30H, 30H, 30H, 30H).
  - ☐ Ex.: If the number is the decimal number "123," it is written as "007B" (30H, 30H, 37H, 42H).
  - If the number is negative, it is expressed by converting it to a two's complement expressed as a 4-digit hexadecimal number.
    ☐ Ex.: If the number is the decimal number "–123," it is written as "FF85" (46H, 46H, 38H, 35H).
    A minus sign ("-") is not written.

4 - 5 Writing Data

■ Decimal format consecutive data write (WS command)

● WS command instruction message

- This is a command—in one message—to consecutively write the contents of multiple consecutive data addresses starting at the specified start data address.
- The application layer of the write instruction consists of the following three types of data.



- Individual data words in the message are delimited by commas (character code 2CH).
- It is not necessary to specify the number of data words to write.
- Capital letters are used for all numbers and characters in the application layer.
- All numbers are in base 10.
- Unnecessary zeros (30H) and spaces are not allowed.
  - ☐ Ex.: The underlined portion of "WS,01001W,2" is not allowed.
  - ☐ Ex.: The underlined portion of "WS,_1001W,02" is not allowed.
  - ☐ Ex.: The above figure shows how a single message instructs the writing of "2" and "65" at the addresses 1001W and 1002W respectively.

1. Write Instruction Code (WS)

◆ Role: This is a command for writing.

◊ Description: Two characters, "WS" (57H, 53H).

2. Write start data address

◆ Role: This specifies the first data address at which to write.

- ☞6-2 Communication Data Table (P. 6-3). (for the relationship between data addresses and write data)
- Be sure to add "W" (57H) after the data address number.

3. Write data

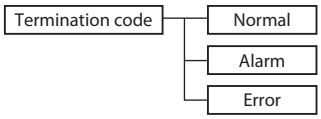
◆ Role: This is the data used to be written to consecutive data addresses starting from the specified data address.

◊ Description
- The range of numbers that can be written varies depending on the data address.
- Each piece of data is delimited by commas (2CH).
- Each consecutive piece of data is written to the data address obtained by successively incrementing the first data address by 1. (See the example on the previous page.)
- There is a limit on the number of pieces of data that can be written in one message. ☞ Number of data words that can be read or written (P. 6-2).

● Response message to the WS command

◆ Role: If the message in the data link layer is correct, only a termination code is returned.

◊ Description •The types of termination code are as follows.

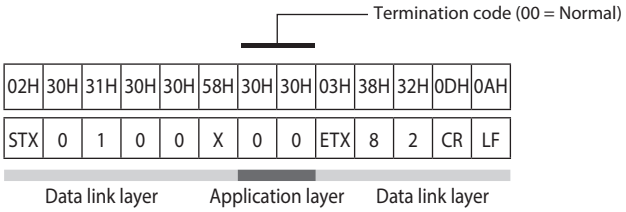


* The termination code is a 2-digit decimal number.

1. Normal response

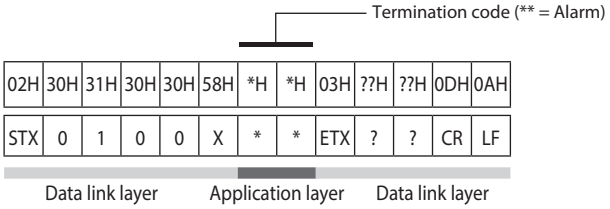
◆ Role: When the writing is successfully completed, a normal response is returned.

☐ Ex.: A normal response like the one below is returned when all the data is correctly written.



2. Alarm response

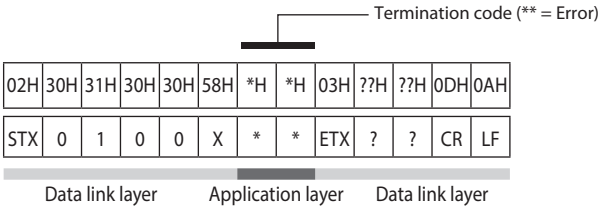
The figure below shows an example of an alarm response. ("**" stands for the alarm termination code.)



3. Error response

◆ Role: If there is an error in the instruction message so that writing cannot be carried out, an error response is returned.

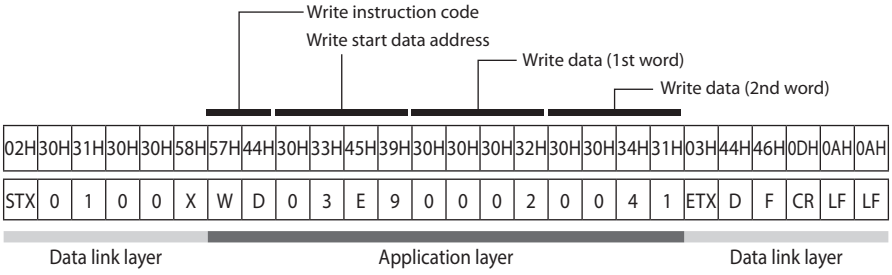
☐ Ex.: Error response ("**" stands for the error termination code)



■ Hexadecimal format consecutive data write (WD command)

● WD command instruction message

- This is a command—in one message—to consecutively write fixed-length data in hexadecimal format to multiple consecutive data addresses starting from the specified start data address.
- Because each piece of data is of fixed length, this command is suitable for handling data using a ladder program in communication with a PLC.
- The application layer of the write instruction consists of the following three types of data.



- It is not necessary to specify the number of data words to write.
- Capital letters are used for all numbers and characters in the application layer.
- Each value is expressed as a four-digit hexadecimal number.
- Since the data length is fixed, commas are not used to delimit the data.
- The figure above illustrates the use of a single message to write "0002" and "0041" (2 and 65 in decimal numerals) to the addresses "03E9" and "03EA" respectively.

1. Write Instruction Code (WD)

◆ Role: This is a command for writing fixed-length data in hexadecimal format.

◊ Description: Two characters, "WD" (57H, 44H).

2. Write start data address

◆ Role: This specifies in a four-digit hexadecimal number the data address at which to begin writing.

- ☞6-2 Communication Data Table (P. 6-3). (for the relationship between data addresses and write data)
- "W" (57H) is not added after the data address number.

3. Write data

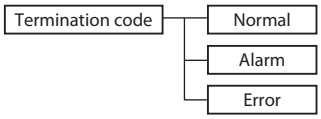
◆ Role: This is the data, expressed in four-digit hexadecimal numbers, that is written to consecutive data addresses starting from the specified data address.

◊ Description
- The range of numbers that can be written varies depending on the data address.
- The consecutive pieces of data are written to addresses obtained by successively incrementing the first data address by 1. (See the example on the previous page.)
- There is a limit to the number of pieces of data that can be written in one message. ☞■ Number of data words that can be read or written (P. 6-2).

● **Response message to the WD command**

◆ Role: If the message in the data link layer is correct, only a termination code is returned.

◊ Description
- The types of termination code are as follows.

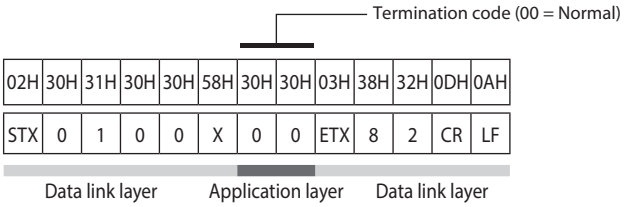


* The termination code is a 2-digit decimal number.

1. Normal response

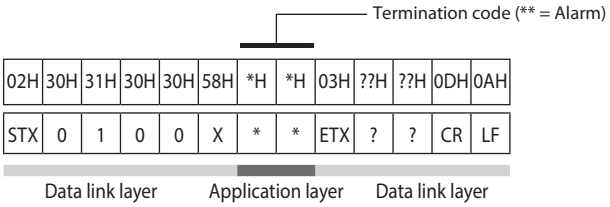
◆ Role: When the writing is successfully completed, a normal response is returned.

☐ Ex.: A normal response like the one below is returned when all the data is correctly written.



2. Alarm response

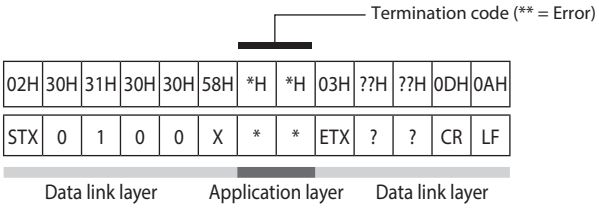
The figure below shows an example of an alarm response. ("**" stands for the alarm termination code.)



3. Error response

◆ Role: If there is an error in the instruction message so that writing cannot be carried out, an error response is returned.

☐ Ex.: Error response ("**" stands for the error termination code.)



4 - 6 Termination Code

■ Normal and alarm termination

Termination code	Type	Contents and action
00	Normal	Normal termination
21	Alarm	An attempt was made to write data to an address whose data cannot be altered by communication for some reason such as the assignment of settings by external switching input. Processing continued but nothing was written to the specified address.
23	Alarm	Reading stopped due to access of an out-of-range address. Writing stopped due to access of an out-of-range address. However, all writing was executed up to that point.

■ Error termination

Termination code	Type	Contents and action
40	Error	Address does not contain "W." The entire message was scrapped.
41	Error	"WS" or "RS" was not specified. The entire message was scrapped.
43	Error	ETX (03H) is not in the correct position. The address is not followed by "," (a comma). The entire message was scrapped.
46	Error	The address is erroneous. The entire message was scrapped.
47	Error	The number of read words is erroneous. The entire message was scrapped.
48	Error	A number in the write data is erroneous. Writing was carried out except at the address where the number was erroneous.
99	Error	Undefined command or other message error. The entire message was scrapped.

4 - 7 Timing Specifications

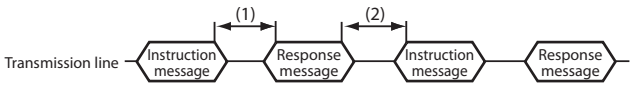
■ Timing specifications for instruction and response messages

Regarding the timing for transmission of the instruction message from the master station and the response message from the slave station, it is necessary to pay attention to the following matters.

● Response monitoring time

The maximum time for a response, from the time when the master station finishes sending the instruction message until the time when it begins to receive the response message from the slave station, is two seconds. ((1) in the figure below). Therefore, the response monitoring time should be set to two seconds.
Generally, when the response monitoring time expires, the instruction message is resent.

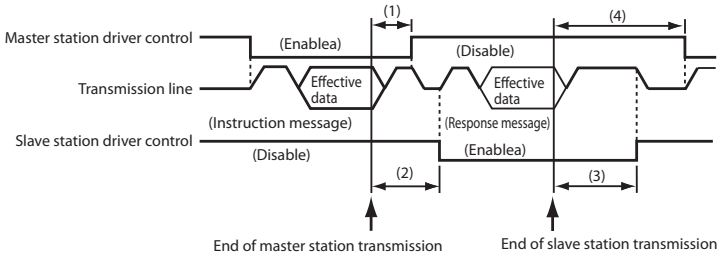
● Transmission start time



(1) Time from the completion of the master station transmission to the start of the slave station transmission = 2000 ms or less
(For the master station, the response monitoring time after completion of transmission of the instruction message should be set to 2 s.)
(2) Time from the completion of the slave station transmission to the start of a master station transmission = 10 ms or more
(The master station should be set to wait at least 10 ms from the completion of receiving response message until the start of the next transmission.)

■ RS-485 driver control timing specifications

When directly controlling RS-485 transmission/reception at the master station, pay attention to the following timing.



(1) Time from completion of the master station transmission to driver disable time = 500 μs max.
(2) Time from completion of slave station receiving to driver enable time = 30 ms
Note: This can be changed by setting (1: 20 ms, 2: 25 ms, 3: 30 ms, 4: 35 ms, 5: 40 ms). Factory setting is 3: 30 ms.
(3) Time from completion of slave station transmission to driver disable time: 10 ms max.
(4) Time from completion of master station reception to driver enable time: 10 ms min.

■ Other precautions

The time from when the master station finishes sending the instruction message to when the slave station starts transmitting the response message will vary according to the amount of data to be read or written. If a faster response from the slave station is required, reduce the amount of data to be read or written by one message.

4 - 8 Code Table

Upper / Lower	0	1	2	3	4	5	6	7
0			Space	0	@	P	,	p
1			!	1	A	Q	a	q
2	STX		"	2	B	R	b	r
3	ETX		#	3	C	S	c	s
4			$	4	D	T	d	t
5			%	5	E	U	e	u
6			&	6	F	V	f	v
7			'	7	G	W	g	w
8			(	8	H	X	h	x
9			)	9	I	Y	i	y
A	LF		*	:	J	Z	j	z
B			+	;	K	[	k	{
C			,	<	L	¥	l	¦
D	CR		-	=	M	]	m	}
E			.	>	N	^	n	~
F			/	?	O	_	o	^

The shaded parts of the table above ( ) are not used in this communication system.

(The codes used differ depending on the device.)

Memo

Chapter 5. COMMUNICATION PROCEDURE (Modbus COMMUNICATION)

5 - 1 Overview of Communication Procedure and Messages

This section briefly describes the procedure used for communication and the format of messages.

■ Communication procedure

The communication procedure is as follows:

(1) The master station sends an instruction message to slave stations specifying the slave station it wishes to communicate with.

(2) The slave station processes the instruction message, and executes a reading or writing process.

(3) Additionally, the slave station transmits a response message appropriate for the processing details.

(4) The master station receives the response message and processes it.

■ Supported communication format and function code

● Communication format (Transmission Modes)

As for communication protocol, Modbus RTU is supported.

	The format for each byte in RTU mode
Coding System	8-bit binary
Bits per Byte	8 data bits, even parity, 1 stop bit 8 data bits, even parity, 2 stop bits 8 data bits, no parity, 2 stop bits
Checking System	CRC (Cyclic Redundancy Checking)

● Function Codes

Of the Modbus protocol public function codes, the following are supported.

Function Code	Description
0x03	Read Holding Registers (read multiple data words)
0x06	Write Single Register (write one data word)
0x10	Write Multiple Registers (write multiple data words)

■ Station address

Addresses from 0 to 99 can be set using the rotary switch on this device. In addition, addresses 0 to 127 can be set with the MLP300A000 loader package.

If the station address is set to 0, the communication function does not operate.

In Modbus protocol, when the station address in a command is 0, it works as broadcast, however, this device does not support broadcast.

■ Maximum number of data words

Read: 10 words

Write: 10 words

5 - 2 Modbus RTU Communications Frame

■ Communications frame

All data is binary.

RTU Communication Frame

Frame structure	Number of bytes	Description
Start (≥ 3.5 character gap)	0	Silent interval
Address	1	Station address
Function	1	For details, see on the particular function code
Data	n*	For details, see on the particular function code
CRC check	2	Check code
End (≥ 3.5 character gap)	0	Silent interval

* 1 byte or more

■ Silent interval

In the Modbus RTU protocol, the period equivalent to a minimum of 3.5 characters (depending on the baud rate) without communication is prescribed to mark the start and end of command and response messages.

Length of silent interval

Transmission speed	Silent interval for this device	Period equivalent to 5 characters (8-bit data)	Period equivalent to 3.5 characters (8-bit data)
		With parity 1 stop bit (11 bits)	With parity 1 stop bit (11 bits)
38400 bps	1 to 2 ms	1.43 ms	1 ms
19200 bps	2 to 3 ms	2.86 ms	2 ms
9600 bps	4 to 6 ms	5.73 ms	4 ms

■ Check code

CRC check codes are attached to both commands and responses.

● Calculation of CRC check code

The part of the message from the station address up to the point immediately before the check code is the object of calculation. (The object of calculation is 8-bit data of each character. It does not include the start bit, stop bit, or parity bit.)

The binary data in the message is used as is in the calculation.

The 16-bit CRC check code can be calculated with the following C language function get_crc16().

In the CRC in the message, the lower byte precedes the upper byte. This order is the opposite of that in other 16-bit data.

```
/*****************************************
Argument 1: Length of character string (number of bytes)
Argument 2: Pointer to beginning of character string
Function value: Calculation result
*****************************************/
UH get_crc16 (INT len, UB *p)
{
  UH dt_16;
  UH next;
  UH carry;
  INT i;

  dt_16 = 0xffff;
  while (len > 0) {
    next = (UH)*p;
    dt_16 ^= next;
    for (i = 0; i < 8; i++) {
      carry = (UH)(dt_16 & 0x0001);
      dt_16 >>= 1;
      if (carry != 0) {
        dt_16 ^= 0xA001;
      }
    }
    p++;
    len--;
  }
  return dt_16;
}
```

● Example of CRC calculation

Example of communication frame: Station address is 1, function code is 03, first data word is 2001 (decimal), and number of read data words is 1.

01	01H	Address
03	03H	Function
07	07H	Data 1: 1st byte
D1	D1H	Data 1: 2nd byte
00	00H	Data 2: 1st byte
01	01H	Data 2: 2nd byte
D5	D5H	CRC: 1st byte
47	47H	CRC: 2nd byte

The object of calculation is the part of the message from the station address to just before the check code, "01 03 07 D1 00 01." In this case, the result of calculation is 47D5H.

☞ ● Calculation of CRC check code (P. 5-2). (for the calculation)

When entering the calculation result 47D5H into the message, the order is changed so that the lower byte precedes the upper byte: D547H.

■ Error termination code

When an error occurs, an error response according to the Modbus protocol is returned.
The error response is the same for all function codes.

Error response format

Frame structure	Number of bytes	Description
Start (≥ 3.5 character gap)	0	Silent interval
Address	1	Station address
Function	1	Function code + 0x80
Data	1	Error termination code
CRC check	2	Check code
End (≥ 3.5 character gap)gap	0	Silent interval

Error termination code (exception code)

Error code	Description	Remarks
01	ILLEGAL FUNCTION	・Unsupported function code ・No processing was performed.
02	ILLEGAL DATA ADDRESS	・Start address error (inaccessible area) ・Error in number of data words (illegal address included in the specified data) ・In a consecutive data access, an undefined data address follows or is included. ・No processing was performed.
03	ILLEGAL DATA VALUE	・ Nothing was read because the specified read count was out of range. ・ Nothing was written because the value to write was out of range. ・ If a number to be written is out of range, processing continues except for the address in question. ・ If a character conversion abnormality occurs in the middle of a frame, processing is interrupted at the corresponding data address (word address), and processing on subsequent data is not performed. Data processing performed before the error occurred remains valid.

■ Conditions under which no response message is returned (no-response conditions)

No response message is returned under the following conditions:

- When a message is received during the device initialization period after power-on. (Initialization takes about 10 seconds after the power is turned on.)
- When a CRC error occurs
- Overflow (excessive length) of the received message (a message longer than 100 bytes)
- If a message comes after another message has been received but before completion of the response transmission.

5 - 3 Explanation of Commands

■ Function 0x03 (multiple data read command)

Function 0x03 (Read Holding Registers) is the command for reading multiple data words.

☞ ▪ Error termination code (P. 5-4). Error response format

● Send command format

Frame structure		Number of bytes	Description
Start		0	Silent interval
Address		1	Station address
Function		1	0x03
Data	Data address (upper byte)	1	First (upper) eight bits of data address
	Data address (lower byte)	1	Last (lower) eight bits of data address
	Number of data words (upper byte)	1	First (upper) eight bits of number of data words
	Number of data words (lower byte)	1	Last (lower) eight bits of number of data words
CRC check		2	Check code
End		0	Silent interval

Example:

01H	03H	07H	D1H	00H	02H	95H	46H
(1)	(2)	(3)		(4)		(5)	

(1) Station address (2) Function code (3) Data start address
(4) Number of read data (5) CRC

● Normal response format

Frame structure		Number of bytes	Description
Start		0	Silent interval
Address		1	Station address
Function		1	0x03
Data	Number of data bytes	1	Number (8-bit) of data bytes (number of bytes = 2 × number of words)
	1st data word (upper byte)	1	First eight bits of data
	1st data word (lower byte)	1	Last eight bits of data
	:		(more data)
	nth data word (upper byte)	1	First eight bits of data
	nth data word (lower byte)	1	Last eight bits of data
CRC check		2	Check code
End		0	Silent interval

Example:

01H	03H	04H	00H	00H	00H	01H	3BH	F3H
(1)	(2)	(3)	(4)		(5)		(6)	

(1) Station address (2) Function code (3) Read count × 2 (= number of bytes)
(4) Read data 1 (5) Read data 2 (6) CRC

■ Function 0x06 (one data write command)

Function 0x06 (Write Single Register) is one data write command.

The command and the normal response are the same.

☞ ▪ Error termination code (P. 5-4). Error response format

● Send command format

Frame structure		Number of bytes	Description
Start		0	Silent interval
Address		1	Station address
Function		1	0x06
Data	Data address (Upper byte)	1	Upper eight bits of data address
	Data address (Lower byte)	1	Lower eight bits of data address
	Data (Upper byte)	1	Upper eight bits of data
	Data (Lower byte)	1	Lower eight bits of data
CRC check		2	Check code
End		0	Silent interval

Example:

01H	06H	07H	D1H	00H	01H	D5H	47H
(1)	(2)	(3)		(4)		(5)	

(1) Station address (2) Function code (3) Data address
(4) Write data (5) CRC

● Normal response

The same as the case of the send command.

■ Function 0x10 (Multiple data write command)

Function 0x10 (Write Multiple Registers) is a command for writing multiple data words.

☞ ▪ Error termination code (P. 5-4). Error response format

● Send command format

Frame structure		Number of bytes	Description
Start		0	Silent interval
Address		1	Station address
Function		1	0x10
Data	Data address (upper byte)	1	First eight bits of data address
	Data address (lower byte)	1	Last eight bits of data address
	Number of data words (upper byte)	1	First eight bits of number of data words
	Number of data words (lower byte)	1	Last eight bits of number of data words
	Number of data bytes	1	Number (8-bit) of data bytes (number of bytes = 2 × number of data words)
	1st data word (upper byte)	1	First eight bits of data
	1st data word (lower byte)	1	Last eight bits of data
	: :	-	(more data)
	nth data word (upper byte)	1	First eight bits of data
	nth data word (lower byte)	1	Last eight bits of data
CRC check		2	Check code
End		0	Silent interval

Example:

01H	10H	07H	D1H	00H	02H	04H	00H	01H	00H	02H	C9H	0EH
(1)	(2)	(3)		(4)		(5)	(6)		(7)		(8)	

(1) Station address (2) Function code (3) Data start address (4) Number of data words to write
(5) Number of bytes to write (= 2 × number of data words to write) (6) Data 1 to write (7) Data 2 to write (8) CRC

● Normal response format

Frame structure		Number of bytes	Description
Start		0	Silent interval
Address		1	Station address
Function		1	0x10
Data	Data address (upper byte)	1	First eight bits of data address
	Data address (lower byte)	1	Last eight bits of data address
	Number of data words (upper byte)	1	First eight bits of number of data words
	Number of data words (lower byte)	1	Last eight bits of number of data words
CRC check		2	Check code
End		0	Silent interval

Example:

01H	10H	07H	D1H	00H	02H	10H	85H
(1)	(2)	(3)		(4)		(5)	

(1) Station address (2) Function code (3) Data start address (4) Number of data words to write (5) CRC

5 - 4 Timing Specifications

Note

- Timing specifications are the same as those of CPL communications.
  ☞ 4-7 Timing Specifications (P. 4-18).

Chapter 6. COMMUNICATION DATA TABLE

6 - 1 Basic Information for Handling Communication Data

■ Communication data types and formats

● Types of communication data

Communication data can be categorized as being related to one of the following:

- Device
- Operating status
- Instantaneous flow rate setpoint
- Function settings
- Parameter settings
- Maintenance

● Format of communication data

Communication data has one of the following formats:

- Numeric data: Data that represents a number.
- Bit data: Data in which each individual bit has its own meaning (alarm, etc.). Bit data must be aggregated for transmission and deaggregated when it is received.

IMPORTANT

Data can be written to EEPROM a maximum of 1,000,000 times.
If it is necessary to write data such as the SP frequently via communication, use RAM as the target memory.
Do not turn off the power when data is being written to the EEPROM. Doing so might cause a problem.

■ Communication data storage memory

● Memory type

Communication data is stored in the following two types of memory:

- RAM: Data is erased when the power is turned OFF. Data can be written to the memory any number of times.
- EEPROM: Stored data is retained even when the power is turned OFF. However, there is a limit of 1,000,000 data write cycles due to the characteristics of the device.

● Target memories

When reading/writing data in the process of communication, it is necessary to distinguish between the above two types of memory according to the intended use. There is a difference between the target memories as follows:

- RAM: Data is read from and written to RAM only. If the power is turned off after writing data to RAM, when the power is turned back on, the data stored in EEPROM is copied to RAM, so that RAM and EEPROM contain the same data.

Communication Data Related to:	RAM		EEPROM	
	Offset in Decimal (Hexadecimal)	Address in Decimal (Hexadecimal)	Offset in Decimal (Hexadecimal)	Address in Decimal (Hexadecimal)
Device	1000 (03E8)	1001 to 1199 (03E9 to 04AF)	4000 (0FA0)	4001 to 4199 (0FA1 to 1067)
Operating status	1200 (04B0)	1201 to 1399 (04B1 to 0577)	4200 (1068)	4201 to 4399 (1069 to 112F)
Instantaneous flow rate setpoint	1400 (0578)	1401 to 1599 (0579 to 063F)	4400 (1130)	4401 to 4599 (1131 to 11F7)
Function settings	2000 (07D0)	2001 to 2199 (07D1 to 0897)	5000 (1388)	5001 to 5199 (1389 to 144F)
Parameter settings	2200 (0898)	2201 to 2399 (0899 to 095F)	5200 (1450)	5201 to 5399 (1451 to 1517)
Maintenance	9500 (251C)	9501 to 9999 (251D to 270F)	-	-

■ Number of data words that can be read or written

The number of data words that can be read or written in a single communication is shown in the table below.

	RAM	EEPROM
Read	1 to 10	1 to 10
Write	1 to 10	1 to 10

■ Units and decimal point position of data

Read/write data does not have a decimal point.

The unit and decimal point position is determined for each type of data.

For details on the unit and decimal point position for each type of data, see the specifications for the F4H device.

6 - 2 Communication Data Table

The following table shows the predefined address for each type of data and whether or not reading or writing is allowed.

✔: Reading (or writing) is allowed
- : Reading (or writing) is not allowed

■ Data related to the device

Item	Data range*	RAM			EEPROM			Remarks
		Address in Decimal (Hexadecimal)	R	W	Address in Decimal (Hexadecimal)	R	W	
Gas type	0:C.F. for gas type is set by the user 1: Air/nitrogen 2: Oxygen 3: Argon 4: Carbon dioxide 9: Hydrogen 10: Helium	1001 (03E9)	✔	-	4001 (0FA1)	-	-	Gas type can be changed using the function setup (address 5018). Setting a numeric value that is not within the data range may result in incorrect setup. Change to the correct setting using "Gas type" (address 5018).
Full scale flow rate	Dependent on the flow range	1002 (03EA)	✔	-	4002 (0FA2)	-	-	Value is without a decimal point. For the decimal point position, check "Decimal point position for the instantaneous flow rate" (address 1003). For the unit of reading, check "The unit of the instantaneous flow rate" (address 1005).
Decimal point position for instantaneous flow rate	0: No decimal point 1: xxxx. 2: xxx.x 3: xx.xx 4: x.xxx 5: 0.xxxx 6: 0.0xxxx	1003 (03EB)	✔	-	4003 (0FA3)	-	-	Any parameter that reads or writes the instantaneous flow rate will use the decimal point position set here.
Undefined	Normally 0	1004			4004			
The unit of the instantaneous flow rate	0: mL/min 1: L/min 2: L/hr 3: m^3/hr 4: mg/min 5: g/min 9: % FS	1005 (03ED)	✔	-	4005 (0FA5)	-	-	The unit is determined by a combination of the model number and the value selected with C-37, "Flow rate display unit change function" (address 2037W or 5037W).
Undefined	Unused	1006	✔	-	4006	-	-	
Model No. info 1		1011 (03F3)	✔	-	4011 (0FAB)	-	-	
Model No. info 2		1012 (03F4)	✔	-	4012 (0FAC)	-	-	
Model No. info 3		1013 (03F5)	✔	-	4013 (0FAD)	-	-	
Model No. info 4		1014 (03F6)	✔	-	4014 (0FAE)	-	-	
Serial No. 1		1015 (03F7)	✔	-	4015 (0FAF)	-	-	
Serial No. 2		1016 (03F8)	✔	-	4016 (0FB0)	-	-	
Serial No. 3		1017 (03F9)	✔	-	4017 (0FB1)	-	-	

* For RD and WD commands, data is expressed using four hexadecimal digits.

■ Data related to operating status

Item	Data range*	RAM			EEPROM			Remarks
		Address in Decimal (Hexadecimal)	R	W	Address in Decimal (Hexadecimal)	R	W	
Alarm condition	(0: OFF, 1: ON) Bit 0: Alarm Bit 1: Event	1201 (04B1)	✔	-	4201 (1069)	-	-	A code indicating the status is given for reference.
Event condition bit	See section 2 on page 6-7.	1202 (04B2)	✔	-	4202 (106A)	-	-	For an RS command, statuses are expressed as decimal numbers.
Control condition bit	See section 3 on page 6-7.	1203 (04B3)	✔	-	4203 (106B)	-	-	For an RS command, statuses are expressed as decimal numbers.
Operation mode	0: Valve fully closed 1: Valve control 2: Valve fully open	1204 (04B4)	✔	✔	4204 (106C)	✔	✔	Write is disabled if 5, 6 or 8 is selected in C-10, "External contact input function" (address 5010) and the valve is forced fully closed (OFF) or forced fully open (FULL).
Undefined	Normally 0	1205 (04B5)	✔	✔	4205 (106D)	✔	✔	
SP in use (set flow rate)	(0 to 100 % FS) L/min	1206 (04B6)	✔	-	4206 (106E)	-	-	Value is without a decimal point. For the decimal point position, check "Decimal point position for the instantaneous flow rate" (address 1003). For the unit of the reading, check "The unit of the instantaneous flow rate" (address 1005).
PV (control flow rate)	(0 to 100 % FS) L/min	1207 (04B7)	✔	-	4207 (106F)	-	-	
Valve driving current	0.0 to 100.0 %	1208 (04B8)	✔	-	4208 (1070)	-	-	Value is without a decimal point.
Alarm detail 1	See section 1 on page 6-5.	1209 (04B9)	✔	-	4209 (1071)	-	-	
Alarm detail 2	See section 1 on page 6-6	1210 (04BA)	✔	-	4210 (1072)	-	-	

* For RD and WD commands, data is expressed using four hexadecimal digits.

● 1 Configuration of alarm detail (address 1209 or 1210) 0: Normal 1: Error

Alarm detail 1 (address 1209) 0: Normal, 1: Error

Bit No.	15	14	13	12	11	10	9	8
Code	AL900	AL990	-	-	AL940	AL930	AL920	AL910

Bit No.	7	6	5	4	3	2	1	0
Code	-	-	AL8205	AL8204	AL8103	AL8102	AL8101	AL8100

Bit No.	Code	Description*	Cause	Remedy
0	AL8100	[ALARM] Sensor error 0 (Heater voltage Va lower limit error)	Sensor failure, foreign object on sensor, condensation on sensor, etc.	Remove possible causes (except in the case of a sensor failure) and then turn the power off for 20 to 30 seconds and turn it back on. If normal operation is not restored, request repair.
1	AL8101	[ALARM] Sensor error 1 (Heater voltage Va upper limit error)		
2	AL8102	[ALARM] Sensor error 2 (Heater voltage Vb lower limit error)		
3	AL8103	[ALARM] Sensor error 3 (Heater voltage Vb upper limit error)		
4	AL8204	[ALARM] Sensor error 4 (Measured flow rate signal lower limit error)	Excessively large flow rate, reverse flow, sensor failure, foreign object on sensor, etc.	
5	AL8205	[ALARM] Sensor error 5 (Measured flow rate signal upper limit error)		
6		Reserved (normally 0)		
7		Reserved (normally 0)		
8	AL910	[ALARM] Sensor calibration data error	Data corrupted due to electrical noise.	Request repair if an alarm persists after turning the unit off and back on again.
9	AL920	[ALARM] Error in factory setting data for sensor		
10	AL930	[ALARM] Zero point shift data error		
11	AL940	[ALARM] Alarm threshold data error		
12		Undefined (normally 0)		
13		Undefined (normally 0)		
14	AL990	[ALARM] Memory alarm	Data corrupted due to electrical noise.	The adjustment data saved in the sensor unit contains an error. The system has recovered and is operating with the backup data. If the backup data is also corrupted in the future, data errors AL910–940 might occur. Having the device repaired is recommended.

Bit No.	Code	Description*	Cause	Remedy
15	AL900	[ALARM] Sensor unit data error	Due to electrical noise	If the alarm persists for more than approximately 10 seconds, turn the unit off and back on again. Request repair if the alarm persists for another 10 seconds.

* "[ALARM]" indicates an alarm (sensor error) for which the PWR LED lights up red.
"[EVENT]" indicates an event for which the PWR LED blinks orange slowly.

Alarm detail 2 (Address 1210) 0: Normal, 1: Error

Bit No.	15	14	13	12	11	10	9	8
Code	-	-	-	-	AL931	AL921	AL911	AL61

Bit No.	7	6	5	4	3	2	1	0
Code	AL62	AL51	AL72	AL71	AL12	AL11	AL02	AL01

Bit No.	Code	Description*	Cause	Remedy
0	AL01	[EVENT] Instantaneous flow rate deviation lower limit alarm	Insufficient alarm judgment delay time, insufficient power voltage, insufficient inlet pressure, excessive inlet voltage, excessive operating temperature, etc.	Request repair if there are no problems related to the items listed to the left.
1	AL02	[EVENT] Instantaneous flow rate deviation upper limit alarm	Insufficient alarm judgment delay time, valve problem, sensor problem, etc.	Request repair if there are no problems related to the delay time.
2	AL11	[EVENT] Valve drive current lower limit alarm	Insufficient alarm judgment delay time, alarm setting current value too high, excessive inlet voltage, etc.	Check the setting for P-12, “Valve drive current lower limit alarm” (2212 or 5212)
3	AL12	[EVENT] Valve drive current upper limit alarm	Insufficient alarm judgment delay time, alarm setting current value too low, insufficient power voltage, insufficient inlet voltage, etc.	Check the setting for P-11, "Valve drive current upper limit alarm" (address 2211/5211).
4	AL71	[EVENT] Valve overheat prevention limit activated	During the control or fully-open mode, the gas is forcibly shut off for five minutes or longer by an external device.	When the gas is continuously shut off by an external device, set the set flow rate to zero or set the valve to fully closed mode.
5	AL72	[EVENT] Valve overheat prevention limit activated (#2)	During the control or fully open mode, the gas is forcibly shut off for 30 minutes or longer by an external device.	When the gas is continuously shut off by an external device, set the set flow rate to zero or set the valve to fully closed mode.
6	AL51	[EVENT] Multipoint flow rate correction value set-up error	An incorrect correction value entered.	Adjust the setting so that the correction does not result in a negative slope.
7	AL62	[ALARM] Sensor unit error (PV error)	Correct instantaneous flow rate (PV) cannot be obtained because of a built-in electronic board error due to a failure or disconnection.	Request repair if an alarm persists after turning the unit off and back on again.
8	AL61	[ALARM] Sensor unit error (set-up error)	Piping orientation (C-34) cannot be properly corrected because of a built-in electronic board error due to a failure or disconnection.	Reset C-34, "Piping orientation" (address 5034). Request repair if this does not solve the problem or if the alarm persists after turning the unit off and back on again.
9	AL911	[ALARM] Error in factory adjustment data	Data corrupted due to electrical noise.	Request repair if an alarm persists after turning the unit off and back on again.
10	AL921	[ALARM] Error in parameter function setup data		
11	AL931	[ALARM] Error in function setup data		
12		Undefined (normally 0)		
13		Undefined (normally 0)		
14		Undefined (normally 0)		
15		Undefined (normally 0)		

* “[ALARM]” indicates an alarm (sensor error) for which the PWR LED up red.
“[EVENT]” indicates an event for which the PWR LED blinks orange slowly.

• 2 Configuration of event condition bit (address 1202)

Bit No.	15	14	13	12	11	10	9	8
Code	-	-	-	-	-	-	-	-

Bit No.	7	6	5	4	3	2	1	0
Code	-	-	-	-	DI1	-	-	EVAL1

Bit No.		Description
0	EVAL1	Digital output status 0: Off, 1: On
1	-	Undefined (normally 0)
2	-	Undefined (normally 0)
3	DI1	External contact input status 0: Off, 1: On
4	-	Undefined (normally 0)
5	-	Undefined (normally 0)
6	-	Undefined (normally 0)
7	-	Undefined (normally 0)
8	-	Undefined (normally 0)
9	-	Undefined (normally 0)
10	-	Undefined (normally 0)
11	-	Undefined (normally 0)
12	-	Undefined (normally 0)
13	-	Undefined (normally 0)
14	-	Undefined (normally 0)
15	-	Undefined (normally 0)

• 3 Configuration of control condition bit (address 1203)

Bit No.	15	14	13	12	11	10	9	8
Code	-	-	-	-	-	-	-	-

Bit No.	7	6	5	4	3	2	1	0
Code	-	-	-	-	-	SP_SEL	-	PVOK

Bit No.		Description
0	PVOK	OK lamp (PV control status) 0: Off 1: Lit (PV OK)
1	-	Undefined (normally 0)
2	SP_SEL	Digital setting/Analog setting 0: Digital setting 1: Analog setting
3	-	Undefined (normally 0)
4	-	Undefined (normally 0)
5	-	Undefined (normally 0)
6	-	Undefined (normally 0)
7	-	Undefined (normally 0)
8	-	Undefined (normally 0)
9	-	Undefined (normally 0)
10	-	Undefined (normally 0)
11	-	Undefined (normally 0)
12	-	Undefined (normally 0)
13	-	Undefined (normally 0)
14	-	Undefined (normally 0)
15	-	Undefined (normally 0)

■ Data related to the instantaneous flow rate setpoint

Item	Data range*	RAM			EEPROM			Remarks
		Address in Decimal (Hexadecimal)	R	W	Address in Decimal (Hexadecimal)	R	W	
Flow rate setpoint (SP)	(0 to 100 % FS)	1401 (0579)	✔	✔	4401 (1131)	✔	✔	Value is without a decimal point. For the decimal point position, check "Decimal point position for the instantaneous flow rate" (address 1003). For the unit of the reading, check "The unit of the instantaneous flow rate" (address 1005).
Undefined	Normally 0	1402 (057A)	✔	✔	4402 (1132)	✔	✔	
Undefined	Normally 0	1403 (057B)	✔	✔	4403 (1133)	✔	✔	
Undefined	Normally 0	1404 (057C)	✔	✔	4404 (1134)	✔	✔	
Undefined	Normally 0	1405 (057D)	✔	✔	4405 (1135)	✔	✔	
Undefined	Normally 0	1406 (057E)	✔	✔	4406 (1136)	✔	✔	
Undefined	Normally 0	1407 (057F)	✔	✔	4407 (1137)	✔	✔	
Undefined	Normally 0	1408 (0580)	✔	✔	4408 (1138)	✔	✔	

* For RD and WD commands, data is expressed using four hexadecimal digits.

■ Data related to function settings

Item	Data range*1	RAM			EEPROM			Remarks
		Address in Decimal (Hexadecimal)	R	W	Address in Decimal (Hexadecimal)	R	W	
Undefined	Normally 0	2001 (07D1)	✔	✔	5001 (1389)	✔	✔	
(C-02) Operation mode at power-ON	0: Operation starts in control mode 1: Operation starts in the operating mode used before power was shut off 2: Operation starts in the fully closed mode	2002 (07D2)	✔	✔	5002 (138A)	✔	✔	*2
(C-03) Flow rate (SP) setup method	0: Digital setup (by communication) 1: Analog setup (by analog input signal)	2003 (07D3)	✔	✔	5003 (138B)	✔	✔	
Undefined	Normally 0	2004 (07D4)	✔	✔	5004 (138C)	✔	✔	
Undefined	Normally 0	2005 (07D5)	✔	✔	5005 (138D)	✔	✔	
(C-06) Analog signal type	0: 0–5 V input/output 1: 1–5 V input/output 2: 4–20 mA input/output	2006 (07D6)	✔	✔	5006 (138E)	✔	✔	The voltage or current input is automatically selected according to the setting of C-06, "Analog signal type" (address 2006/5006).
Undefined	Normally 0	2007 (07D7)	✔	✔	5007 (138F)	✔	✔	
Undefined	Normally 0	2008 (07D8)	✔	✔	5008 (1390)	✔	✔	
Undefined	Normally 0	2009 (07D9)	✔	✔	5009 (1391)	✔	✔	
(C-10) External contact input function	0: Disabled 5: When contact ON, forced full close; when contact OFF, forced full close is released 6: When contact ON, forced full open; when contact OFF, forced full open is released 7: SP ramp control setting switchover 8: Operation mode switchover (ON for control, OFF for fully close) 9: Flow rate zero adjustment 12: SP ramp control gradient switchover 13: Alarm reset	2010 (07DA)	✔	✔	5010 (1392)	✔	✔	1–4, 10–11 are undefined and should not be set.
Undefined	Normally 0	2011 (07DB)	✔	✔	5011 (1393)	✔	✔	
Undefined	Normally 0	2012 (07DC)	✔	✔	5012 (1394)	✔	✔	

Item	Data range*1	RAM			EEPROM			Remarks
		Address in Decimal (Hexadecimal)	R	W	Address in Decimal (Hexadecimal)	R	W	
Undefined	Normally 0	2013 (07DD)	✔	✔	5013 (1395)	✔	✔	
Undefined	Normally 0	2014 (07DE)	✔	✔	5014 (1396)	✔	✔	
Undefined	Normally 0	2015 (07DF)	✔	✔	5015 (1397)	✔	✔	
(C-16)Operation at alarm/event occurrence*3	0: Control continues and digital output is OFF when alarm/event occurs 1: Control continues and digital output is ON when alarm/event occurs 2: Forced full close and digital output is ON when alarm/event occurs 3: Forced full open and digital output is ON when alarm/event occurs 4: Control continues and digital output is ON when alarm occurs, control continues and digital output is OFF when event occurs 5: Forced full close and digital output is ON when alarm occurs, forced full close and digital output is OFF when event occurs 6: Forced full open and digital output is ON when alarm occurs, forced full open and digital output is OFF when event occurs 7: Control continues and digital output is ON when alarm occurs, control continues and digital output is OFF when event occurs 8: Forced full close and digital output is ON when alarm occurs, control continues and digital output is OFF when event occurs 9: Forced full open and digital output is ON when alarm occurs, control continues and digital output is OFF when event occurs	2016 (07E0)	✔	✔	5016 (1398)	✔	✔	Even if it is set to 0, alarm information is stored in "Alarm condition" (address 1201), "Alarm detail 1" (address 1209), and "Alarm detail 2" (address 1210) if an alarm occurs.
Undefined	Normally 0	2017 (07E1)	✔	✔	5017 (1399)	✔	✔	

Item	Data range*1	RAM			EEPROM			Remarks
		Address in Decimal (Hexadecimal)	R	W	Address in Decimal (Hexadecimal)	R	W	
(C-18) Gas type	0: C.F. for gas type is set by the user 1: Air/Nitrogen (N_2) 2: Oxygen (O_2) 3: Argon (Ar) 4: Carbon dioxide (CO_2) 9: Hydrogen (H_2) 10: Helium (He)	2018 (07E2)	✔	✔	5018 (139A)	✔	✔	If set to 0, set P-24, "Density for unit conversion (for user-set units)" (address 2224) and P-10, "Conversion factor set by the user" (address 2210). "2: Oxygen (O_2)" can be set only on the oxygen model.
(C-19) Flow rate standard condition	0: 20°C 101.325 kPa (1 atm) 1: 0°C 101.325 kPa (1 atm) 2: 25°C 101.325 kPa (1 atm) 3: 35°C 101.325 kPa (1 atm)	2019 (07E3)	✔	✔	5019 (139B)	✔	✔	Convert to the volumetric flow rate at the temperature and pressure set here.
(C-20) Valve drive current alarm	0: Valve drive current alarm disabled 1: Only upper limit alarm enabled 2: Only lower limit alarm enabled 3: Upper and lower limit alarm enabled	2020 (07E4)	✔	✔	5020 (139C)	✔	✔	Set thresholds with the P-11, "Valve drive current upper limit alarm" (address 2211/5211) and P-12, "Valve drive current lower limit alarm" (address 2212/5212) parameter settings.
Undefined	Normally 0	2021 (07E5)	✔	✔	5021 (139D)	✔	✔	
Undefined	Normally 0	2022 (07E6)	✔	✔	5022 (139E)	✔	✔	
(C-23) PV filter (process for equalizing the instantaneous flow rate)	0:No PV filter 1: 2-sample moving average 2: 4-sample moving average 3: 8-sample moving average	2023 (07E7)	✔	✔	5023 (139F)	✔	✔	
(C-24) Flow rate range	0:Standard range 10 to 99: 10–99 % of the standard range	2024 (07E8)	✔	✔	5024 (13A0)	✔	✔	
Undefined	Normally 0	2025 (07E9)	✔	✔	5025 (13A1)	✔	✔	
Undefined	Normally 0	2026 (07EA)	✔	✔	5026 (13A2)	✔	✔	
(C-27) SP ramp control	0: Disabled 1: SP ramp control type 1 (during SP ramp up, gradient 1, and during SP ramp down, gradient 2) 2: SP ramp control type 2 (during external contact OFF, gradient 1; during external contact ON, gradient 2)	2027 (07EB)	✔	✔	5027 (13A3)	✔	✔	
(C-28) Optional analog scaling	0: Disabled 1:Enabled	2028 (07EC)	✔	✔	5028 (13A4)	✔	✔	Set the scale in P-17, "Optional analog scaling" (address 2217/5217).

Item	Data range*1	RAM			EEPROM			Remarks
		Address in Decimal (Hexadecimal)	R	W	Address in Decimal (Hexadecimal)	R	W	
(C-29) Low flow cutoff	0: Disabled 1: Enabled	2029 (07ED)	✔	✔	5029 (13A5)	✔	✔	The delay time can be set in P-20, "Low flow cutoff delay time" (address 2220/5220).
(C-30) Device address	0:Communication function is disabled 1–127: Device address	2030 (07EE)	✔	-	5030 (13A6)	✔	-	If rotary switch 1 is set to a position other than 0, switch status is read.
(C-31) Transmission speed	0:38400 bps 1: 19200 bps 2: 9600 bps	2031 (07EF)	✔	-	5031 (13A7)	✔	-	If rotary switch 1 is set to a position other than 0, switch status is read.
(C-32) Data format	0:Even parity, 1 stop bit 1: Even parity, 2 stop bits 2:No parity, 1 stop bit 3:No parity, 2 stop bit 4:Odd parity, 1 stop bit 5: Odd parity, 2 stop bits	2032 (07F0)	✔	-	5032 (13A8)	✔	-	If rotary switch 1 is set to a position other than 0, switch status is read.
Reserved (do not change)		2033 (07F1)	✔	-	5033 (13A9)	✔	-	
(C-34) Piping orientation	0: Horizontal 1: Vertical (flow from bottom to top) 2: Vertical (flow from top to bottom)	2034 (07F2)	✔	✔	5034 (13AA)	✔	✔	Set P-23, "Primary pressure setting (for correcting vertical pressure)" (address 2223/5223). The correction amount is determined in combination with this setting.
Undefined	Normally 0	2035 (07F3)	✔	✔	5035 (13AB)	✔	✔	
(C-36) Control response	0: Emphasis on response 1:Standard 2: Emphasis on stability	2036 (07F4)	✔	✔	5036 (13AC)	✔	✔	
(C-37) Flow rate display unit change function	[F4H9050,9200,9500] 0: mL/min 1: L/hr 2: mg/min 9: % FS [F4H0002,0005,0020] 0: L/min 1: m^3/hr 2: g/min 9: % FS	2037 (07F5)	✔	✔	5037 (13AD)	✔	✔	Based on the value selected here and the model number, the unit for the flow rate parameters is determined. If 0 is selected, for example, the unit varies depending on the model number. For the unit according to the model number, see "The unit of the instantaneous flow rate" (address 1005).
Undefined	Normally 0	2038 (07F6)	✔	✔	5038 (13AE)	✔	✔	

Item	Data range*1	RAM			EEPROM			Remarks
		Address in Decimal (Hexadecimal)	R	W	Address in Decimal (Hexadecimal)	R	W	
(C-39) Zero point adjustment (when hydrogen/He gas is selected)	0: Do nothing 1: Adjust the zero-point	2039 (07F7)	✔	✔	5039 (13AF)	✔	✔	Note: Please only use for H_2/He gas. Correction is performed, and then it automatically returns to 0. Available only when the valve is fully closed.
(C-40) PV communication data filter (process for equalizing instantaneous flow rate)	0: No PV filter 1: 4-sample moving average 2: 8-sample moving average 3: 16-sample moving average 4: Special filter N = 32 5: Special filter N = 64 6: Special filter N = 128 7: Special filter N = 256	2040 (07F8)	✔	✔	5040 (13B0)	✔	✔	
(C-41) Multipoint flow rate correction	0: Disabled 1: Enabled	2041 (07F9)	✔	✔	5041 (13B1)	✔	✔	
(C-42) Display resolution	0: Normal resolution 1: High resolution	2042 (07FA)	✔	✔	5042 (13B2)	✔	✔	
Undefined	Normally 0	2043 (07FB)	✔	✔	5043 (13B3)	✔	✔	
Undefined	Normally 0	2044 (07FC)	✔	✔	5044 (13B4)	✔	✔	
(C-45) Slave unit reception completion - driver enable time	1: 20 ms 2: 25 ms 3: 30 ms 4: 35 ms 5: 40 ms	2045 (07FD)	✔	✔	5045 (13B5)	✔	✔	Time (2) in ■ RS-485 driver control timing specifications (P. 4-18). can be selected.

*1 For RD and WD commands, data is expressed using four hexadecimal digits.

*2 Notes on the behavior when 1, "Operation starts in the operating mode used before power was shut off" is selected
The device is started in the operating mode recorded last (which is stored in EEPROM) before the power was turned off. Note that if RAM is set with C-02, "Operation mode at power-ON" (address 2002) and the power is turned off, the operating mode that was in effect before the power was turned off is not stored.

* 3 Behavior when an alarm or event occurs

The following shows the device behavior that is dependent on C-16, "Operation at alarm/event occurrence," in the function setup.

	At alarm occurrence			At event occurrence		
C-16 setting	Control mode	Digital output	LED	Control mode	Digital output	LED
0	Control continues	OFF	Red LED is lit.	Control continues	OFF	Orange LED blinks slowly.
1	Control continues	ON	Red LED is lit.	Control continues	ON	Orange LED blinks slowly.
2	Forced fully closed	ON	Red LED is lit.	Forced fully closed	ON	Orange LED blinks slowly.
3	Forced fully open	ON	Red LED is lit.	Forced fully open	ON	Orange LED blinks slowly.
4*	Control continues	ON	Red LED is lit.	Control continues	OFF	Orange LED blinks slowly.
5	Forced fully closed	ON	Red LED is lit.	Forced fully closed	OFF	Orange LED blinks slowly.
6	Forced fully open	ON	Red LED is lit.	Forced fully open	OFF	Orange LED blinks slowly.
7*	Control continues	ON	Red LED is lit.	Control continues	OFF	Orange LED blinks slowly.
8	Forced fully closed	ON	Red LED is lit.	Control continues	OFF	Orange LED blinks slowly.
9	Forced fully open	ON	Red LED is lit.	Control continues	OFF	Orange LED blinks slowly.

* The behavior of settings 4 and 7 is identical.

Classes of alarms and events are based on the following table.

Class	Code	Description
Event	AL01	Instantaneous flow rate deviation lower limit alarm
Event	AL02	Instantaneous flow rate deviation upper limit alarm
Event	AL11	Valve drive current lower limit alarm
Event	AL12	Valve drive current upper limit alarm
Event	AL71	Valve overheat prevention limit activated
Event	AL72	Valve overheat prevention limit activated (#2)
Event	AL51	Multipoint flow rate correction value setup error
Alarm	AL62	Sensor unit error (PV error)
Alarm	AL61	Sensor unit error (setup error)
Alarm	AL8100	Sensor error 0 (Heater voltage Va lower limit error)
Alarm	AL8101	Sensor error 1 (Heater voltage Va upper limit error)
Alarm	AL8102	Sensor error 2 (Heater voltage Vb lower limit error)
Alarm	AL8103	Sensor error 3 (Heater voltage Vb upper limit error)
Alarm	AL8204	Sensor error 4 (Measured flow rate signal lower limit error)
Alarm	AL8205	Sensor error 5 (Measured flow rate signal upper limit error)
Alarm	AL911	Error in factory adjustment data
Alarm	AL921	Error in parameter function setup data
Alarm	AL931	Error in function setup data
Alarm	AL910	Sensor calibration data error
Alarm	AL920	Error in factory setting data for sensor
Alarm	AL930	Zero point shift data error
Alarm	AL940	Alarm threshold data error
Alarm	AL990	Memory alarm
Alarm	AL900	Sensor unit data error

■ Data related to parameter settings

Item*1	Data range*2	RAM			EEPROM			Remarks
		Address in Decimal (Hexadecimal)	R	W	Address in Decimal (Hexadecimal)	R	W	
(P-1) Flow rate OK judgment range	(0.5 to 100 % FS)*3	2201 (0899)	✔	✔	5201 (1451)	✔	✔	* The unit to be set is not a percentage unit. • For the unit in effect at the time of setting, check "The unit of the instantaneous flow rate" (address 1005). • Value is without a decimal point. For the decimal point position, check "Decimal point position for the instantaneous flow rate" (address 1003).
(P-2) Flow rate OK judgment hysteresis	(0.5 to 100 % FS)*3	2202 (089A)	✔	✔	5202 (1452)	✔	✔	
(P-3) Instantaneous flow rate deviation upper limit alarm	(0.5 to 100 % FS)*3	2203 (089B)	✔	✔	5203 (1453)	✔	✔	
(P-4) Instantaneous flow rate deviation upper limit alarm hysteresis	(0.5 to 100 % FS)*3	2204 (089C)	✔	✔	5204 (1454)	✔	✔	
(P-5) Instantaneous flow rate deviation lower limit alarm	(0.5 to 100 % FS)*3	2205 (089D)	✔	✔	5205 (1455)	✔	✔	
(P-6) Instantaneous flow rate deviation lower limit alarm hysteresis	(0.5 to 100 % FS)*3	2206 (089E)	✔	✔	5206 (1456)	✔	✔	
(P-7) Instantaneous flow rate deviation alarm/valve drive current alarm judgment delay time	0.5 to 999.9 s	2207 (089F)	✔	✔	5207 (1457)	✔	✔	
(P-8) Digital output delay time	0.0 to 999.9 s	2208 (08A0)	✔	✔	5208 (1458)	✔	✔	
Undefined	Normally 0	2209 (08A1)	✔	✔	5209 (1459)	✔	✔	
(P-10) Conversion factor set by the user	0.040 to 9.999	2210 (08A2)	✔	✔	5210 (145A)	✔	✔	Before using this, please contact us. (Some gas types may not be supported.)
(P-11) Valve drive current upper limit alarm	0.1 to 100.0 %	2211 (08A3)	✔	✔	5211 (145B)	✔	✔	
(P-12) Valve drive current lower limit alarm	0.0 to 99.9 %	2212 (08A4)	✔	✔	5212 (145C)	✔	✔	
Undefined	Normally 0	2213 (08A5)	✔	✔	5213 (145D)	✔	✔	
Undefined	Normally 0	2214 (08A6)	✔	✔	5214 (145E)	✔	✔	
(P-15) SP ramp control gradient 1	(0 to 500 % FS)*3	2215 (08A7)	✔	✔	5215 (145F)	✔	✔	
(P-16) SP ramp control gradient 2	(0 to 500 % FS)*3	2216 (08A8)	✔	✔	5216 (1460)	✔	✔	

Item*1	Data range*2	RAM			EEPROM			Remarks
		Address in Decimal (Hexadecimal)	R	W	Address in Decimal (Hexadecimal)	R	W	
(P-17) Optional analog scaling	(10 to 100 % FS)*3	2217 (08A9)	✔	✔	5217 (1461)	✔	✔	• For the unit in effect at the time of setting, check "The unit of the instantaneous flow rate" (address 1005). • A value without a decimal point. For the decimal point position, check "Decimal point position for the instantaneous flow rate" (address 1003). • Set C-29, "Low flow cutoff" (address 2029/5029), to 1, "Enabled," in advance and enable the setting.
Undefined	Normally 0	2218 (08AA)	✔	✔	5218 (1462)	✔	✔	
Undefined	Normally 0	2219 (08AB)	✔	✔	5219 (1463)	✔	✔	
(P-20) Low flow cutoff delay time	0.0 to 999.9 s	2220 (08AC)	✔	✔	5220 (1464)	✔	✔	Set C-29, "Low flow cutoff" (address 2029/5029), to 1, "Enabled," in advance and enable the setting.
Undefined	Normally 0	2221 (08AD)	✔	✔	5221 (1465)	✔	✔	
Undefined	Normally 0	2222 (08AE)	✔	✔	5222 (1466)	✔	✔	
(P-23) Primary pressure setting (for correcting vertical pressure)	0 to 500 kPa (gauge)	2223 (08AF)	✔	✔	5223 (1467)	✔	✔	Works when C-34, "Piping orientation" is set to "Vertical."
(P-24) Density for unit conversion (for user-set units)	0.0500 to 6.0000 (kg/m^3)	2224 (08B0)	✔	✔	5224 (1468)	✔	✔	Set this item if the following conditions are met. If C-18, "Gas type," (address 2018/5018) is set to 0, "C.F. for gas type is set by the user," and C-37, "Flow rate display unit change function" (address 2037/5037), is set to 2," mg/min"
(P-25) Amount of zero point adjustment	-2000 to +2000	2225 (08B1)	✔	-	5225 (1469)	✔	-	
(P-26) Low flow cutoff threshold	0 to 100 % FS	2226 (08B2)	✔	✔	5226 (146A)	✔	✔	
(P-27) Multipoint flow rate correction value X1	(5 to 45 % FS)*3	2227 (08B3)	✔	✔	5227 (146B)	✔	✔	
(P-28) Multipoint flow rate correction value X2	(30 to 70 % FS)*3	2228 (08B4)	✔	✔	5228 (146C)	✔	✔	

Item*1	Data range*2	RAM			EEPROM			Remarks
		Address in Decimal (Hexadecimal)	R	W	Address in Decimal (Hexadecimal)	R	W	
(P-29) Multipoint flow rate correction value X3	(55 to 95 % FS)*3	2229 (08B5)	✔	✔	5229 (1476D)	✔	✔	
(P-30) Multipoint flow rate correction value X4	(80 to 120 % FS)*3	2230 (08B6)	✔	✔	5230 (146E)	✔	✔	
(P-31) Multipoint flow rate correction value Y1	(5 to 45 % FS)*3	2231 (08B7)	✔	✔	5231 (146F)	✔	✔	
(P-32) Multipoint flow rate correction value Y2	(30 to 70 % FS)*3	2232 (08B8)	✔	✔	5232 (1470)	✔	✔	
(P-33) Multipoint flow rate correction value Y3	(55 to 95 % FS)*3	2233 (08B9)	✔	✔	5233 (1471)	✔	✔	
(P-34) Multipoint flow rate correction value Y4	(80 to 120 % FS)*3	2234 (08BA)	✔	✔	5234 (1472)	✔	✔	
Undefined	Normally 0	2235 (08BB)	✔	✔	5235 (1473)	✔	✔	
Undefined	Normally 0	2236 (08BC)	✔	✔	5236 (1474)	✔	✔	
Undefined	Normally 0	2237 (08BD)	✔	✔	5237 (1475)	✔	✔	
Undefined	Normally 0	2238 (08BE)	✔	✔	5238 (1476)	✔	✔	

*1 For RD and WD commands, data is expressed using four hexadecimal digits.

*2 All data is without decimal points.

*3 The setting range is the full scale flow rate multiplied by the percentage in parentheses. (Setting range varies depending on model and gas type.)

Note: If you change the unit by function setup C-37, "Flow rate display unit change function" (address 2037/5037), switching to the changed unit is automatic. Before setting the parameters, check the setting of C-37, "Flow rate display unit change function."

■ Data related to maintenance

This is a data area for maintenance.

● Number of times the valve is actuated / accumulated flow volume

Item	Data range*	RAM			Remarks
		Address in Decimal (Hexadecimal)	R	W	
Number of times the valve is actuated Last four digits	0 to 9999	9501 (251D)	✔	-	
Number of times the valve is actuated First four digits	0 to 9999	9502 (251E)	✔	-	

* For RD and WD commands, data is expressed using four hexadecimal digits.

● Alarm history

The alarm history stores the total operating time and the status of Alarm detail 1 and Alarm detail 2 if the related alarm flag changes. (Triggered and reset alarms are logged.)

Alarms are recorded in the built-in non-volatile memory (EEPROM) either when the alarm history is updated or when the regular 10-minute writing cycle occurs.

There are five alarm histories. History 1 contains the most recent alarm, and History 5 the oldest one.

When a new alarm is recorded, the record in History 1 is pushed to History 2, etc., and the oldest one in History 5 is deleted.

Item	Data range*1	RAM			Remarks
		Address in Decimal (Hexadecimal)	R	W	
Current total operating time (min)	0 to 50000	9511 (2527)	✔	-	
Alarm history 1					
Total operating time (min)	0 to 50000	9512 (2528)	✔	-	
Alarm detail 1*2	0 to 65535	9513 (2529)	✔	-	
Alarm detail 2*2	0 to 65535	9514 (252A)	✔	-	
Alarm history 2					
Total operating time (min)	0 to 50000	9515 (252B)	✔	-	
Alarm detail 1*2	0 to 65535	9516 (252C)	✔	-	
Alarm detail 2*2	0 to 65535	9517 (252D)	✔	-	
Alarm history 3					
Total operating time (min)	0 to 50000	9518 (252E)	✔	-	
Alarm detail 1*2	0 to 65535	9519 (252F)	✔	-	
Alarm detail 2*2	0 to 65535	9520 (2530)	✔	-	
Alarm history 4					
Total operating time (min)	0 to 50000	9521 (2531)	✔	-	
Alarm detail 1*2	0 to 65535	9522 (2532)	✔	-	
Alarm detail 2*2	0 to 65535	9523 (2531)	✔	-	
Alarm history 5					
Total operating time (min)	0 to 50000	9524 (2533)	✔	-	
Alarm detail 1*2	0 to 65535	9525 (2534)	✔	-	
Alarm detail 2*2	0 to 65535	9526 (2535)	✔	-	

*1 For RD and WD commands, data is expressed using four hexadecimal digits.

*2 For the data in Alarm detail 1 and Alarm detail 2, each bit is assigned an alarm flag. For the contents of the bits, see "Alarm detail 1" (address 1209; page 6-5) and "Alarm detail 2" (page 6-6; address 1210).

● **Analog forced output, forced valve drive amperage output**

Item	Data range	RAM		
		Address in Decimal (Hexadecimal)	R	W
Forced test flag	Bit 0: Forced analog output is valid Bit 1: Forced valve current output is valid	9991 (2707)	✔	✔
Forced AO level	0.0 to 100.0 %	9992 (2708)	✔	✔
Forced valve current output level	0.0 to 100.0 %	9993 (2709)	✔	✔

Memo

Chapter 7. TROUBLESHOOTING

■ Communication failure

If communication is not successful, check the following:

- Check if the device is turned on.
- Check the wiring.
- Verify that this device and the host computer are set to the same communication parameters.
- Check that the following communication parameters are correctly configured. If one of them is incorrect, communication cannot take place. (These parameters can be configured on this device.)

  Transmission speed: 38400 bps, 19200 bps, 9600 bps
  Data length: 8 bits
  Stop bits: 1 or 2
  Parity: No parity, even, odd
- For CPL communications, use uppercase letters for all character codes other than the Device ID code (X or x for this device).
- Check that the destination address of the command frame transmitted from the host computer matches the address set for this device.
- Check if the address of this device is set to 0. Zero cannot be used as the device address. Be sure to set the device address to a number other than 0.
- Check whether the communications address setting varies between multi-dropped units of this device.
- Check that the communications timing conforms to 4-7 Timing Specifications (P. 4-18).

Memo

Chapter 8. SPECIFICATIONS

■ RS-485 specifications

Item	Specifications
Transmission mode	Balanced type
Transmission line	3-wire system
Transmission distance	500 m max.
Transmission speed (bps)	38400, 19200, 9600
Communication system	Half duplex
Synchronization	Start-stop synchronization
Data format	Parity: even / no parity / odd Data length: 8 bits Stop bits: 1 or 2 See Communication function settings (P. 3-2)
Error detection	Parity check, checksum
Station address	0 to 127 (communication function is disabled if address is set to 0)
Network type	1:N (up to 31 units)

Memo

Revision History (CP-SP-1408E)

Printed	Edn.	Revised pages	Description
Feb. 2017	**1**		
Apr. 2018	**2**	6-1 6-5, 6-6 6-14 6-15	Description was added to IMPORTANT notice. In the Configuration of Alarm Detail table, alarms were assigned to Bit Nos. 10, 11, 14, and 15. Settings 4 to 7 were added to the data range of C-40. C-42 was added. Alarms AL930, AL940, AL990, and AL900 were added.

Terms and Conditions

We would like to express our appreciation for your purchase and use of Azbil Corporation's products.
You are required to acknowledge and agree upon the following terms and conditions for your purchase of Azbil Corporation's products (system products, field instruments, control valves, and control products), unless otherwise stated in any separate document, including, without limitation, estimation sheets, written agreements, catalogs, specifications and instruction manuals.

1. Warranty period and warranty scope

1.1 Warranty period

Azbil Corporation's products shall be warranted for one (1) year from the date of your purchase of the said products or the delivery of the said products to a place designated by you.

1.2 Warranty scope

In the event that Azbil Corporation's product has any failure attributable to azbil during the aforementioned warranty period, Azbil Corporation shall, without charge, deliver a replacement for the said product to the place where you purchased, or repair the said product and deliver it to the aforementioned place.
Notwithstanding the foregoing, any failure falling under one of the following shall not be covered under this warranty:

(1) Failure caused by your improper use of azbil product
(noncompliance with conditions, environment of use, precautions, etc. set forth in catalogs, specifications, instruction manuals, etc.);
(2) Failure caused for other reasons than Azbil Corporation's product;
(3) Failure caused by any modification or repair made by any person other than Azbil Corporation or Azbil Corporation's subcontractors;
(4) Failure caused by your use of Azbil Corporation's product in a manner not conforming to the intended usage of that product;
(5) Failure that the state-of-the-art at the time of Azbil Corporation's shipment did not allow Azbil Corporation to predict; or
(6) Failure that arose from any reason not attributable to Azbil Corporation, including, without limitation, acts of God, disasters, and actions taken by a third party.

Please note that the term "warranty" as used herein refers to equipment-only-warranty, and Azbil Corporation shall not be liable for any damages, including direct, indirect, special, incidental or consequential damages in connection with or arising out of Azbil Corporation's products.

2. Ascertainment of suitability

You are required to ascertain the suitability of Azbil Corporation's product in case of your use of the same with your machinery, equipment, etc. (hereinafter referred to as "Equipment") on your own responsibility, taking the following matters into consideration:

(1) Regulations and standards or laws that your Equipment is to comply with.
(2) Examples of application described in any documents provided by Azbil Corporation are for your reference purpose only, and you are required to check the functions and safety of your Equipment prior to your use.
(3) Measures to be taken to secure the required level of the reliability and safety of your Equipment in your use
Although azbil is constantly making efforts to improve the quality and reliability of Azbil Corporation's products, there exists a possibility that parts and machinery may break down.
You are required to provide your Equipment with safety design such as fool-proof design, *1 and fail-safe design*2 (anti-flame propagation design, etc.), whereby preventing any occurrence of physical injuries, fires, significant damage, and so forth. Furthermore, fault avoidance, *3 fault tolerance,*4 or the like should be incorporated so that the said Equipment can satisfy the level of reliability and safety required for your use.

*1. A design that is safe even if the user makes an error.
*2. A design that is safe even if the device fails.
*3. Avoidance of device failure by using highly reliable components, etc.
*4. The use of redundancy.

3. Precautions and restrictions on application

Azbil Corporation's products other than those explicitly specified as applicable (e.g. azbil Limit Switch For Nuclear Energy) shall not be used in a nuclear energy controlled area (radiation controlled area).
Any Azbil Corporation's products shall not be used for/with medical equipment.
The products are for industrial use. Do not allow general consumers to install or use any Azbil Corporation's product.
However, azbil products can be incorporated into products used by general consumers. If you intend to use a product for that purpose, please contact one of our sales representatives.
In addition,
you are required to conduct a consultation with our sales representative and understand detail specifications, cautions for operation, and so forth by reference to catalogs, specifications, instruction manual, etc. in case that you intend to use azbil product for any purposes specified in (1) through (6) below.
Moreover, you are required to provide your Equipment with fool-proof design, fail-safe design, anti-flame propagation design, fault avoidance, fault tolerance, and other kinds of protection/safety circuit design on your own responsibility to ensure reliability and safety, whereby preventing problems caused by failure or nonconformity.

(1) For use under such conditions or in such environments as not stated in technical documents, including catalogs, specification, and instruction manuals
(2) For use of specific purposes, such as:
* Nuclear energy/radiation related facilities
[For use outside nuclear energy controlled areas] [For use of Azbil Corporation's Limit Switch For Nuclear Energy]
* Machinery or equipment for space/sea bottom
* Transportation equipment
[Railway, aircraft, vessels, vehicle equipment, etc.]
* Antidisaster/crime-prevention equipment

* Burning appliances
* Electrothermal equipment
* Amusement facilities
* Facilities/applications associated directly with billing

(3) Supply systems such as electricity/gas/water supply systems, large-scale communication systems, and traffic/air traffic control systems requiring high reliability
(4) Facilities that are to comply with regulations of governmental/public agencies or specific industries
(5) Machinery or equipment that may affect human lives, human bodies or properties
(6) Other machinery or equipment equivalent to those set forth in items (1) to (5) above which require high reliability and safety

4. Precautions against long-term use

Use of Azbil Corporation's products, including switches, which contain electronic components, over a prolonged period may degrade insulation or increase contact-resistance and may result in heat generation or any other similar problem causing such product or switch to develop safety hazards such as smoking, ignition, and electrification.
Although acceleration of the above situation varies depending on the conditions or environment of use of the products, you are required not to use any Azbil Corporation's products for a period exceeding ten (10) years unless otherwise stated in specifications or instruction manuals.

5. Recommendation for renewal

Mechanical components, such as relays and switches, used for Azbil Corporation's products will reach the end of their life due to wear by repetitious open/close operations.
In addition, electronic components such as electrolytic capacitors will reach the end of their life due to aged deterioration based on the conditions or environment in which such electronic components are used.
Although acceleration of the above situation varies depending on the conditions or environment of use, the number of open/close operations of relays, etc. as prescribed in specifications or instruction manuals, or depending on the design margin of your machine or equipment, you are required to renew any Azbil Corporation's products every 5 to 10 years unless otherwise specified in specifications or instruction manuals.
System products, field instruments (sensors such as pressure/flow/level sensors, regulating valves, etc.) will reach the end of their life due to aged deterioration of parts.
For those parts that will reach the end of their life due to aged deterioration, recommended replacement cycles are prescribed. You are required to replace parts based on such recommended replacement cycles.

6. Other precautions

Prior to your use of Azbil Corporation's products, you are required to understand and comply with specifications (e.g., conditions and environment of use), precautions, warnings/cautions/notices as set forth in the technical documents prepared for individual Azbil Corporation's products, such as catalogs, specifications, and instruction manuals to ensure the quality, reliability, and safety of those products.

7. Changes to specifications

Please note that the descriptions contained in any documents provided by azbil are subject to change without notice for improvement or for any other reason.
For inquires or information on specifications as you may need to check, please contact our branch offices or sales offices, or your local sales agents.

8. Discontinuance of the supply of products/parts

Please note that the production of any Azbil Corporation's product may be discontinued without notice.
For repairable products, we will, in principle, undertake repairs for five (5) years after the discontinuance of those products. In some cases, however, we cannot undertake such repairs for reasons, such as the absence of repair parts.
For system products, field instruments, we may not be able to undertake parts replacement for similar reasons.

9. Scope of services

Prices of Azbil Corporation's products do not include any charges for services such as engineer dispatch service.
Accordingly, a separate fee will be charged in any of the following cases:

(1) Installation, adjustment, guidance, and attendance at a test run
(2) Maintenance, inspection, adjustment, and repair
(3) Technical guidance and technical education
(4) Special test or special inspection of a product under the conditions specified by you

Please note that we cannot provide any services as set forth above in a nuclear energy controlled area (radiation controlled area) or at a place where the level of exposure to radiation is equivalent to that in a nuclear energy controlled area.

azbil

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1st edition: Feb. 2017 (V)
2nd edition: Apr. 2018