User's Manual

JUXTA

M Series
Digital Limit Alarms
Communication Functions

YOKOGAWA
Yokogawa Electric Corporation

IM 77J04J11-01E
2nd Edition

Introduction

This user's manual describes the communication functions of the M Series digital limit alarms (hereinafter simply referred to as M Series) and contains information on how to create communication programs.

Read the manual carefully to understand the communication functions of the M Series.

The M Series have the following communication protocols.

- PC link communication protocol
- MODBUS communication protocol
- Ladder communication protocol

Note that the M Series cannot communicate with a higher-level device with a communication protocol other than these.

You are required to have background knowledge of the communication specifications of higher-level devices, their communication hardware, language used for creating communication programs, and so on.

Intended Readers

This manual is intended for people familiar with the functions of the M Series, control engineers and personnel in charge of maintaining instrumentation and control equipment.

Related Documents

The following user's manuals all relate to the communication functions of the M Series. Read them as necessary.

- Model MVHK Digital Limit Alarm (DC Input Type)
  Document number: IM 77J04H31-01E

- Model MVRK Digital Limit Alarm (RTD Input Type)
  Document number: IM 77J04R31-01E

- Model MVTK Digital Limit Alarm (Thermocouple Input Type)
  Document number: IM 77J04T31-01E

  The user's manuals above describe mounting, wiring, and how to operate the digital limit alarms.

QR code

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Documentation Conventions

Symbols

The following symbols are used in this manual.

Symbols Used in the Main Text

Note	Draws attention to information that is essential for understanding the operation and/or features of the product.
TIP	Gives additional information to complement the present topic.
See Also	Gives reference locations for further information on the topic.

Description of Displays

(1) Some of the representations of product displays shown in this manual may be exaggerated, simplified, or partially omitted for reasons of convenience when explaining them.

(2) Although, figures and illustrations representing the digital limit alarm's displays may differ from the real displays in regard to the position and/or indicated characters (upper-case or lower-case, for example), the extent of difference does not impair a correct understanding of the functions and the proper operations and monitoring of the system.

Notices

Regarding This User's Manual

(1) This manual should be passed on to the end user. Keep the manual in a safe place.
(2) Read this manual carefully to gain a thorough understanding of how to operate this product before you start using it.
(3) This manual is intended to describe the functions of this product. Yokogawa Electric Corporation (hereinafter simply referred to as Yokogawa) does not guarantee that these functions are suited to the particular purpose of the user.
(4) Under absolutely no circumstance may the contents of this manual, in part or in whole, be transcribed or copied without permission.
(5) The contents of this manual are subject to change without prior notice.
(6) Every effort has been made to ensure accuracy in the preparation of this manual. Should any errors or omissions come to your attention however, please contact your nearest Yokogawa representative or our sales office.

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(1) In order to protect the product and the system controlled by it against damage and ensure its safe use, be certain to strictly adhere to all of the instructions and precautions relating to safety contained in this document. Yokogawa does not guarantee safety if products are not handled according to these instructions.
(2) The following safety symbols are used on the product and/or in this manual.

Symbols Used on the Product and in This Manual

CAUTION
This symbol on the product indicates that the operator must refer to an explanation in the user's manual in order to avoid the risk of injury or death of personnel or damage to the instrument. The manual describes how the operator should exercise special care to avoid electric shock or other dangers that may result in injury or loss of life.

Protective Grounding Terminal
This symbol indicates that the terminal must be connected to ground prior to operating the equipment.

Functional Grounding Terminal
This symbol indicates that the terminal must be connected to ground prior to operating the equipment.

Force Majeure

(1) Yokogawa does not make any warranties regarding the product except those mentioned in the WARRANTY that is provided separately.
(2) Yokogawa assumes no liability to any party for any loss or damage, direct or indirect, caused by the use or any unpredictable defect of the product.
(3) Be sure to use the spare parts approved by Yokogawa when replacing parts or consumables.
(4) Modification of the product is strictly prohibited.
(5) Reverse engineering such as the disassembly or decompilation of software is strictly prohibited.
(6) No portion of the software supplied by Yokogawa may be transferred, exchanged, leased or sublet for use by any third party without the prior permission of Yokogawa.

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Contents

1.1 Setup Procedure

This chapter describes the setup procedure required to use the communication functions (PC link, Ladder and MODBUS) and the communication parameters of the M Series.
Set up the communication functions on the M Series as follows:

Set up the communication function parameters of the M Series. (See section 1.2.)

↓

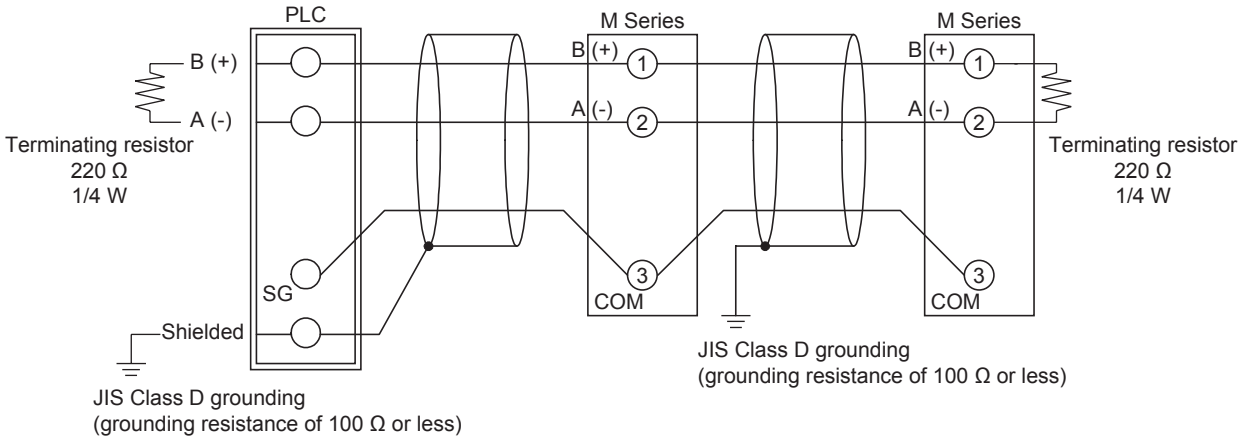
Connect a higher-level device and a M Series. (See the connection diagram below.)

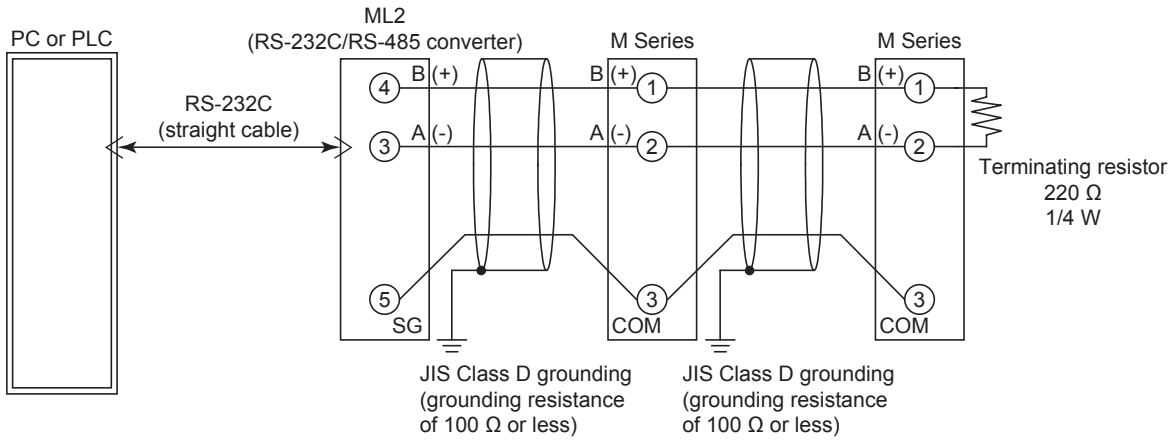
↓

Create communication programs for the higher-level device to perform communication.

Note: Refer to the documentation of each higher-level device when creating communication programs.

• Connection





1.2 Notes on Setting Parameters

This section describes the setting parameters for using the communication functions and their setting ranges.

Note

The details of M Series communication functions need to be the same as those of the communication functions of the higher-level device to be connected. Check the communication parameters of the higher-level device first, then set up those of the M Series.

Table 1-1 Parameters to be Set for Communication Functions

Parameter Name	Symbol	Setting Range		Default
Protocol selection	PSL	PC link communication	Without checksum (0) With checksum (1)	PC link communication without checksum (0)
		MODBUS communication	ASCII mode (3) RTU mode (4)	
		Ladder communication	Ladder (2)	
Address	ADR	1 to 99		1
Baud rate	BPS	1.2 (0), 2.4 (1), 4.8 (2), 9.6 (3), 19.2 (4), 38.4 (5) kbps		9.6 (3)
Parity	PRI	NON (0), EVN (1), ODD (2)		EVN (1)
Stop bit	STP	1, 2		1
Data length	DLN	7, 8 (*1)		8

*1: When “Ladder communication” is selected in protocol selection, the data length is fixed to 8. When “MODBUS communication” is selected, the data length is fixed to 7 for ASCII mode and to 8 for RTU mode.

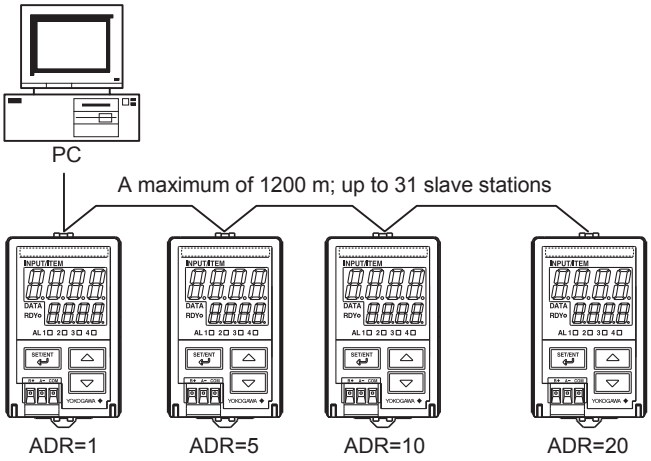
- **Protocol selection (PSL)**

  Set the communication protocol identical to that of the higher-level device to be connected.

- **Address number (ADR)**

  Set the address number of the M Series itself. An address number of 1 to 99 can be assigned in any order. Note that the number of M Series that can be connected to a single communication port is limited to 31.

  Example of connecting four M Series to a higher-level device by setting address numbers of 1, 5, 10 and 20



- **Baud rate (BPS)**

  Set the baud rate identical to that of the higher-level device to be connected. (Otherwise, proper communication cannot be achieved.) The unit of the baud rate is kbps (kbits per second).

- **Parity (PRI)**

  Set the handling of parity to be carried out when data is sent or received. Set the parity bit state identical to that of the higher-level device to be connected.

- **Stop bit (STP)**

  Set the stop bit identical to that of the higher-level device to be connected.

- **Data length (DLN)**

  Set the data length identical to that of the higher-level device to be connected. (When Ladder or MODBUS communication is selected in protocol selection, the data length is fixed.)

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2.1 RS-485 Communication Specifications

The RS-485 communication interface has the PC link communication, Ladder communication and MODBUS communication protocols.

Table 2-1 M Series Communication Specifications

Communication Hardware	2-wire RS-485 communication system
Terminal	Monitor output terminal connector: A(−), B(+), COM
Communication Protcol Specifications	PC link communication without checksum PC link communication with checksum MODBUS communication (ASCII mode) MODBUS communication (RTU mode) Ladder communication
Maximum Baud Rate	38400 bps

Table 2-2 Types of Devices to be Connected

Connected Device	Communication Protocol	Example of Connected Device
PC	MODBUS communication	General-purpose PC
PC, touch panel and PLC (FA-M3 UT link module)	PC link communication	General-purpose PC, FA-M3 and GP Series
PLC (sequencer) (FA-M3 ladder communication module)	Ladder communication	General-purpose PLC (sequencer)

Table 2-3 RS-485 Communication Interface

Item	Specifications
Compliant standard	EIA, RS-485
Maximum number of devices to be connected	31
Communication system	2-wire, half duplex
Synchronization	Asynchronous (start-stop)
Communication method	No handshaking
Maximum communication distance	1200 m
Baud rate	1200, 2400, 4800, 9600, 19200, 38400 bps

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3.1 Overview

The use of PC link communication enables the M Series to communicate with a device such as a PC, graphic panel and FA-M3 UT link module easily. In this commu- nication, you can use such device to read/write data from/into D registers or I relays, both of which are internal registers of the M Series.

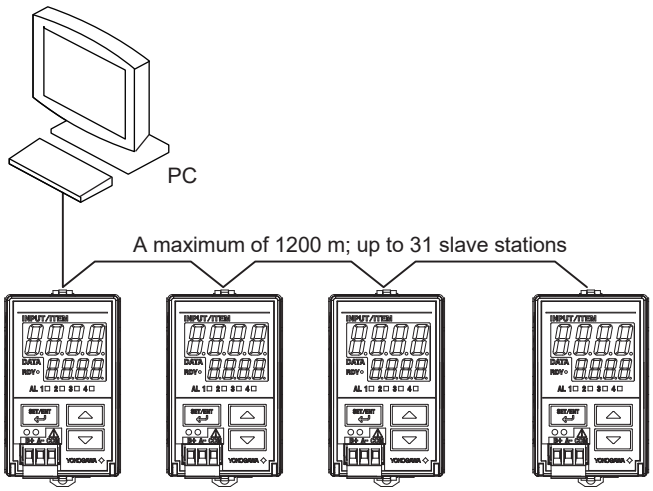


Figure 3-1 Example of Connection for PC Link Communication

Hereafter, PCs etc. are generically called “higher-level devices.”

See Also

Chapters 6 and 7 for information on the D registers and I relays.

In PC link communication, a higher-level device identifies each M Series with an address number, which ranges from 01 to 99.

3.1.1 Configuration of Command

Commands sent from a higher-level device to the M Series consist of the following elements.

Number of Bytes	1	2	2	1	3	Variable length	2	1	1
Element	STX	Adress nuber (ADR)	CPU number 01	Time to wait for response 0	Command	Data corresponding to command	Checksum	ETX	CR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

(1)STX (Start of Text)

This control code indicates the start of a command. The ASCII code is 02 in hexadecimal.

(2)Address Number (01 to 99)

Adress numbers are used by a higher-level device to identify the M Series at the communication destination. (Identification numbers specific to individual M Series.)

(3)CPU Number

This is fixed to 01.

(4)Time to Wait for Response

This is fixed to 0.

(5)Command (See subsection 3.2.)

This specifies a command to be issued from the higher-level device.

(6)Data Corresponding to Command

This specifies an internal register (D register or I relay), number of data pieces and others.

(7)Checksum

This converts the ASCII codes of texts between the character next to STX and the character immediately before the checksum into hexadecimal values and adds them byte by byte. It then fetches the single lowermost byte of the added results as the checksum.

This column is only required for PC link communication with checksum. PC link communication without checksum does not require this 2-byte space of ASCII code.

(8)ETX (End of Text)

This control code indicates the end of a command string. The ASCII code is 03 in hexadecimal.

(9)CR (Carriage Return)

This control code indicates the end of a command. The ASCII code is 0D in hexadecimal.

Note

The control codes STX, ETX and CR are essential for commands when you create a communication program for PC link communication. Omission of any of them or incorrect order of them results in communication failure.

3.1.2 Configuration of Response

Responses from the M Series with respect to a command sent from the higher-level device consist of the following elements, which differ depending on the condition of communication; normal or failure.

1) Normal Communication

If communication succeeded, a character string “OK” is returned with the data corresponding to a command.

Number of Bytes	1	2	2	2	Variable length	2	1	1
Element	STX	Address nuber (ADR)	CPU number 01	OK	Parameter data	Checksum	ETX	CR

2) In the Event of Failure

If communication failed, a character string “ER” is returned with error codes (EC1 and EC2). (See subsection 3.1.3, “Response Error Codes.”)

- No response is returned in case of an error in address number specification or CPU number specification.
- If ETX in a command cannot be received, a response may not be returned.

Note: As a countermeasure, provide a timeout process in the communication functions of the higher-level device or in communication programs.

Number of Bytes	1	2	2	2	2	2	3	2	1	1
Element	STX	Address number (ADR)	CPU number 01	ER	EC1	EC2	Command	Checksum	ETX	CR

3.1.3 Response Error Codes

See Also

3.1.2, “Configuration of Response”, for the structure of response in the event of error.

The error codes (EC1) and detailed error codes (EC2) of responses are as follows.

Table 3-1 List of Error Codes EC1

Error Code	Meaning	Cause(s)
02	Command error	• No command exists. • Command not executable
03	Register specification error	• No register number exists. • Invalid specification of bit register (I relay) when it is used on a word basis
04	Out of setpoint range	• Any character other than 0 or 1 is used for bit setting. • A value other than 0000 to FFFF has been specified in word specification. • The position of a start for a data load is out of the address range.
05	Out of data count range	• The specification of the number of bits, words, etc. is out of the range of use. • The number of data specified and that of parameters for registers and others are not consistent.
06	Monitor error	• An attempt was made to execute monitoring without specifying the monitor (BRS or WRS).
08	Parameter error	• An illegal parameter is set.
42	Sum error	• The sum does not match the expected value.
43	Internal buffer overflow	• A data value greater than the specified was received.
44	Character reception interval timeout	• The end-of-data or end-of-text character has not been received.

Table 3-2 List of Detailed Error Codes EC2

Error Code (EC1)	Meaning	Detailed Error Code (EC2)
03	Register specification error	Parameter number where error occurred (HEX) This is the sequence number of a parameter that first resulted in an error when counted from the leading parameter. e.g.: Register specification error ↓ [STX]01010BRR02 I0001,D0001[ETX][CR] Parameter numbers 1 2 3 [STX]0101ER0303BRR[ETX][CR]
04	Out of setpoint range	
05	Out of data count range	
08	Parameter error	• An illegal parameter is set.

For error codes other than those noted as EC1, there is no EC2 meaning.

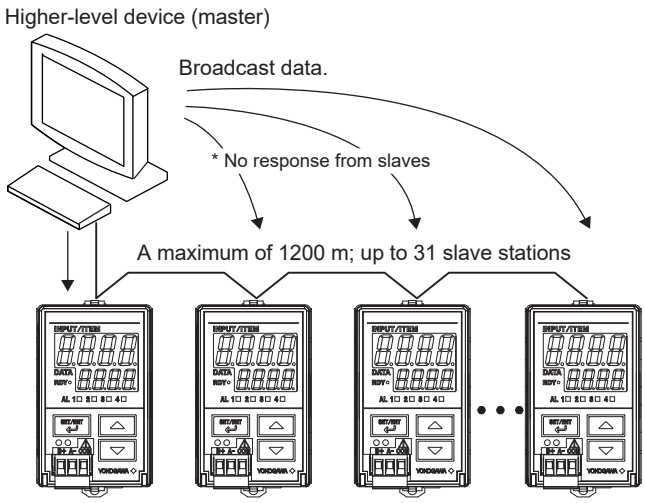
Priority of Error Codes

Priority	Error code EC1
High	44
↑	43
	42
↓	02
Low	03, 04, 05, 06, 08

When no response is returned
(1) Retransmission error (overrun, framing, parity)
(2) When the communication address in the command is wrong (including broadcast specification)
(3) When the CPU No. in the command is not “01”

3.1.4 Specifying Broadcast

Broadcast addressing allows the corresponding multiple M Series to receive the command.
(1) To use this function, specify BM for the address number in a command.
(2) Broadcast addressing works independently of the address number.
(3) Broadcast addressing is only applicable to write commands (BWR, BRW, BRS, WWR, WRW, WRS).
(4) No response is returned if broadcast addressing is used.



For the M Series communication, D registers and I relays are used.

3.2 Commands

3.2.1 List of Commands

The following shows lists of commands available in PC link communication. Their details are explained in the description of each command.

(1) Bit-basis Access Commands Dedicated to I Relays

Command	Description	Number of Bits to be Handled
BRD	Bit-basis read	1 to 256 bits
BWR	Bit-basis write	1 to 256 bits
BRR	Bit-basis random read	1 to 32 bits
BRW	Bit-basis random write	1 to 32 bits
BRS	Specifies registers to be monitored on a bit-by-bit basis.	1 to 32 bits
BRM	Bit-basis monitoring	————————————

(2) Word-basis Access Commands

Command	Description	Number of Words to be Handled
WRD	Word-basis read	1 to 64 words
WWR	Word-basis write	1 to 64 words
WRR	Word-basis random read	1 to 32 words
WRW	Word-basis random write	1 to 32 words
WRS	Specifies registers to be monitored on a word-by-word basis.	1 to 32 words
WRM	Word-basis monitoring	————————————

(3) Information Command

Command	Description	Number of Units to be Handled
INF	Reads model, input range code, number of alarms and revision.	1

BRD Reads I relays on a bit-by-bit basis

- **Function**

  Reads the ON/OFF statuses of a sequence of contiguous I relays by the specified number of bits, starting at a specified I relay number.
  - The number of bits to be read at a time is 1 to 256.
  - For the format of response in the event of failure, see subsection 3.1.2.
  - The command shown below includes the checksum function. When performing communication without checksum, do not include the 2-byte checksum element in the command.

- **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	5	1	3	2	1	1
Command element	STX	Address number (ADR)	CPU number 01	0	BRD	I relay number	Comma or space	Number of bits (n)	Checksum	ETX	CR

Number of Bytes	1	2	2	2	1	1	1	• • •	1	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	d1	d2	d3	• • •	dn	Checksum	ETX	CR

Responses 0 and 1 indicate OFF and ON respectively.

dn: read data of the specified number of bits (n=1 to 256)
dn=0 (OFF)
dn=1 (ON)

- **Example:**

  Reading the status of alarm 1 of the M Series with address number 01.
  The following command reads the status of alarm 1 (I0001) of address number 01.

  [Command]

  [STX]01010BRDI0001,00191[ETX][CR]

  The following response is returned with respect to the above command. (Alarm 1 is ON.)

  [Response]

  [STX]0101OK18D[ETX][CR]

  Alarm has been ON since 1 was returned.

BWR Writes data into I relays on a bit-by-bit basis

- **Function**

  Writes ON/OFF data into a sequence of contiguous I relays by the specified number of bits, starting at a specified I relay number.
  - The number of bits to be written into at a time is 1 to 256.
  - For the format of response in the event of failure, see subsection 3.1.2.
  - The command shown below includes the checksum function. When performing communication without checksum, do not include the 2-byte checksum element in the command.

- **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	5	1	3	2	1	1
Command element	STX	Address number (ADR)	CPU number 01	0	BWR	I relay number	Comma or space	Number of bits (n)	Comma or space	d1	d2

Command (continued)

• • •	1	2	1	1
• • •	dn	Checksum	ETX	CR

Write data 0 and 1 indicate OFF and ON respectively.

dn: write data of the specified number of bits (n=1 to 256)
dn=0 (OFF)
dn=1 (ON)

Number of Bytes	1	2	2	2	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	Checksum	ETX	CR

- **Example:**

  Setting the user-defined flag of the M Series with address number 01 to ON.
  The following command writes ON into the user-defined flag (I0033) of address number 01.

  [Command]

  [STX]01010BWRI0033,001,106[ETX][CR]

  Note: The user-defined flags are flags that the user can freely read/write.

  OK is returned in response to the above command.

  [Response]

  [STX]0101OK5C[ETX][CR]

BRR Reads I relays on a bit-by-bit basis in random order

- **Function**

  Reads the ON/OFF statuses of the individual I relays specified in random order by the specified number of bits.
  - The number of bits to be read at a time is 1 to 32.
  - For the format of response in the event of failure, see subsection 3.1.2.
  - The command shown below includes the checksum function. When performing communication without checksum, do not include the 2-byte checksum element in the command.

- **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	2	5	1	5	1
Command element	STX	Address number (ADR)	CPU number 01	0	BRR	Number of bits (n)	I relay number 1	Comma or space	I relay number 2	Comma or space

Command (continued)

• • •	5	2	1	1
• • •	I relay number n	Checksum	ETX	CR

Number of Bytes	1	2	2	2	1	1	• • •	1	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	d1	d2	• • •	dn	Checksum	ETX	CR

Responses 0 and 1 indicate OFF and ON respectively.

dn: read data of the specified number of bits (n=1 to 32)
dn=0(OFF)
dn=1(ON)

- **Example:**

  Reading the statuses of alarms 1 and alarm 2 of the M Series with address number 01. The following command reads the statuses of alarm 1 (I0001) and alarm 2 (I0002) of address number 01.

  [Command]

  [STX]01010BRR02I0001,I00027B[ETX][CR]

  The ON and OFF responses are returned for alarm1 and alarm 2 respectively with respect to the above command.

  [Response]

  [STX]0101OK10BD[ETX][CR]

  Alarm 1 has been ON.

BRW Writes data into I relays on a bit-by-bit basis in random order

- **Function**

  Writes ON/OFF data into the individual I relays specified in random order by the specified number of bits.
  - The number of bits to be written into at a time is 1 to 32.
  - For the format of response in the event of failure, see subsection 3.1.2.
  - The command shown below includes the checksum function. When performing communication without checksum, do not include the 2-byte checksum element in the command.

- **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	2	5	1	1	1
Command element	STX	Address number (ADR)	CPU number 01	0	BRW	Number of bits (n)	I relay number 1	Comma or space	d1	Comma or space

Command (continued)

5	1	1	1	• • •	5	1	1	2	1	1
I relay number 2	Comma or space	d2	Comma or space	• • •	I relay number n	Comma or space	dn	Checksum	ETX	CR

Write data 0 and 1 indicate OFF and ON respectively.

dn: write data of the specified number of bits (n=1 to 32)
dn=0 (OFF)
dn=1 (ON)

Number of Bytes	1	2	2	2	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	Checksum	ETX	CR

- **Example:**

  Setting the four user-defined flags (I0033, I0034, I0035 and I0036) of the M Series with address number 05 to ON, OFF, OFF and ON respectively.

  [Command]

  [STX]05010BRW04I0033,1,I0034,0,I0035,0,I0036,17D[ETX][CR]
  Note: The user-defined flags are flags that the user can freely read/write.

  OK is returned in response to the above command.

  [Response]

  [STX]0501OK60[ETX][CR]

BRS Specifies I relays to be monitored on a bit-by-bit basis

- **Function**

  Specifies the I-relay numbers to be monitored on a bit-by-bit basis. Note that this command simply specifies I relays. Actual monitoring is performed by the BRM command after the I relay numbers are specified by this command.
  When the volume of data is large and you wish to increase the baud rate, it is effective to use a combination of the BRS and BRM commands rather than just the BRR command.
  If the power supply is turned off, the specified I-relay numbers will be erased.
  - The number of I relays to be specified at a time is 1 to 32.
  - For the format of response in the event of failure, see subsection 3.1.2.
  - The command shown below includes the checksum function.
    When performing communication without checksum, do not include the 2-byte checksum element in the command.

- **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	2	5	1	5	1
Command element	STX	Address number (ADR)	CPU number 01	0	BRS	Number of bits (n)	I relay number 1	Comma or space	I relay number 2	Comma or space

Command (continued)

• • •	5	2	1	1
• • •	I relay number n	Checksum	ETX	CR

Number of Bytes	1	2	2	2	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	Checksum	ETX	CR

- **Example:**

  Specifying that the burnout, alarm 1 and alarm 2 of the M Series with address number 01 are to be monitored.
  (This command simply specifies the registers to be monitored.)

  [Command]

  [STX]01010BRS03I0007,I0001,I0002B9[ETX][CR]

  OK is returned in response to the above command.

  [Response]

  [STX]0101OK5C[ETX][CR]

BRM Monitors I relays on a bit-by-bit basis

- **Function**

  Reads the ON/OFF statuses of the I relays that have been specified in advance by the BRS command.
  - Before executing this command, the BRS command must always be executed to specify which I relays are to be monitored. If no relay has been specified, error code 06 is returned.
  - For the format of response in the event of failure, see subsection 3.1.2.
  - The command shown below includes the checksum function. When performing communication without checksum, do not include the 2-byte checksum element in the command.

- **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	2	1	1
Command element	STX	Address number (ADR)	CPU number 01	0	BRM	Checksum	ETX	CR

Number of Bytes	1	2	2	2	1	1	1	• • •	1	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	d1	d2	d3	• • •	dn	Checksum	ETX	CR

Responses 0 and 1 indicate OFF and ON respectively.

dn: read data of the number of bits specified by the BRS command (n=1 to 32)
dn=0 (OFF)
dn=1 (ON)

- **Example:**

  Monitoring the burnout, alarm 1 and alarm 2 of the M Series with address number 01 when they have been specified to be monitored.
  (This command reads the statuses of the I relays specified by the BRS command.)

  [Command]

  [STX]01010BRMD3[ETX][CR]

  The ON/OFF statuses of the I relays are returned with respect to the above command.

  [Response]

  [STX]0101OK000EC[ETX][CR]
  ↑ All have been OFF.

WRD Reads D registers and I relays on a word-by-word basis

- **Function**

  Reads a sequence of contiguous register data on a word-by-word basis by the specified number of words, starting at a specified register number.
  - The number of words to be read at a time is 1 to 64.
  - For the format of response in the event of failure, see subsection 3.1.2.
  - The command shown below includes the checksum function. When performing communication without checksum, do not include the 2-byte checksum element in the command.

- **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	5	1	2	2	1	1
Command element	STX	Address number (ADR)	CPU number 01	0	WRD	Register number	Comma or space	Number of words (n)	Checksum	ETX	CR

Number of Bytes	1	2	2	2	4	4	• • •	4	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	dddd1	dddd2	• • •	ddddn	Checksum	ETX	CR

The response is returned in a 4-digit character string (0000 to FFFF) in hexadecimal.

ddddn: read data of the specified number of words
ddddn is a character string in hexadecimal.
n=1 to 64

- **Example:**

  Reading the alarm-1 setpoint (D0101) of the M Series with address number 01.

  [Command]

  [STX]01010WRDD0101,0172[ETX][CR]

  The alarm-1 setpoint 500 (01F4 [HEX]) is returned in response to the above command (50.0 is expressed as 500).

  [Response]

  [STX]0101OK01F437[ETX][CR]

  500 in decimal (Alarm-1 setpoint [A1] is 50.0.)

WWR Writes data into D registers and I relays on a word-by-word basis

- **Function**

  Writes data into a sequence of contiguous registers on a word-by-word basis by the specified number of words, starting at a specified register number .
  - The number of words to be written into at a time is 1 to 64.
  - For the format of response in the event of failure, see subsection 3.1.2.
  - The command shown below includes the checksum function.
    When performing communication without checksum, do not include the 2-byte checksum element in the command.-

- **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	5	1	2	1	4
Command element	STX	Address number (ADR)	CPU number 01	0	WWR	Register number	Comma or space	Number of words (n)	Comma or space	dddd1

Command (continued)

4	• • •	4	2	1	1
dddd2	• • •	ddddn	Checksum	ETX	CR

Write data is specified in a 4-digit character string (0000 to FFFF) in hexadecimal.

ddddn: write data of the specified number of words
ddddn is a character string in hexadecimal.
n=1 to 64

Number of Bytes	1	2	2	2	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	Checksum	ETX	CR

- **Example:**

  Writing 200 (00C8 [HEX]) into the alarm-1 setpoint (D0101) of the M Series with address number 03.

  [Command]

  [STX]03010WWRD0101,01,00C88E[ETX][CR]

  OK is returned in response to the above command.

  [Response]

  [STX]0301OK5E[ETX][CR]

WRR Reads D registers and I relays on a word-by-word basis in random order

- **Function**

  Reads the statuses of the individul registers on a word-by-word basis specified in random order by the specified number of words.
  - The number of words to be read at a time is 1 to 32.
  - For the format of response in the event of failure, see subsection 3.1.2.
  - The command shown below includes the checksum function. When performing communication without checksum, do not include the 2-byte checksum element in the command.

- **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	2	5	1	5	1
Command element	STX	Address number (ADR)	CPU number 01	0	WRR	Number of words (n)	Register number 1	Comma or space	Register number 2	Comma or space

Command (continued)

• • •	5	2	1	1
• • •	Register number n	Checksum	ETX	CR

Number of Bytes	1	2	2	2	4	4	• • •	4	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	dddd1	dddd2	• • •	ddddn	Checksum	ETX	CR

The response is returned in a 4-digit character string (0000 to FFFF) in hexadecimal.

ddddn: read data of the specified number of words
ddddn is a character string in hexadecimal.
n=1 to 32

- **Example:**

  Reading the alarm-1 setpoint (D0101) and alarm-2 setpoint (D0102) of the M Series with address number 01.

  [Command]

  [STX]01010WRR02D0101,D010288[ETX][CR]

  The alarm-1 setpoint 500 (01F4 [HEX]) and alarm-2 setpoint 500 (01F4 [HEX]) are returned with respect to the above command (50.0 is expressed as 500).

  [Response]

  [STX]0101OK01F4 01F412[ETX][CR]

  500 in decimal (Alarm-1 setpoint is 50.0.)
  500 in decimal (Alarm-2 setpoint is 50.0.)

WRW Writes data into D registers and I relays on a word-by-word basis in random order

- **Function**

  Writes register data specified for each register into the registers specified in random order by the specified number of words.
  - The number of words to be written into at a time is 1 to 32.
  - For the format of response in the event of failure, see subsection 3.1.2.
  - The command shown below includes the checksum function. When performing communication without checksum, do not include the 2-byte checksum element in the command.

- **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	2	5	1	4	1
Command element	STX	Address number (ADR)	CPU number 01	0	WRW	Number of words (n)	Register number 1	Comma or space	dddd1	Comma or space

Command (continued)

5	1	4	• • •	5	1	4	2	1	1
Register number 2	Comma or space	dddd2	• • •	Register number n	Comma or space	ddddn	Checksum	ETX	CR

Write data is specified in a 4-digit character string (0000 to FFFF) in hexadecimal.

ddddn: write data of the specified number of words
ddddn is a character string in hexadecimal.
n=1 to 32

Number of Bytes	1	2	2	2	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	Checksum	ETX	CR

- **Example:**

  Writing 20.0 and 15.0 into the alarm-1 setpoint (D0101) and alarm-2 setpoint (D0102) of the M Series with address number 10 respectively.

  [Command]

  [STX]10010WRW02D0101,00C8,D0102,00968F[ETX][CR]

  200 in decimal (Alarm-1 setpoint is 20.0.)
  150 in decimal (Alarm-2 setpoint is 150.0.)

  OK is returned in response to the above command.

  [Response]

  [STX]1001OK5C[ETX][CR]

WRS Specifies D registers and I relays to be monitored on a word-by-word basis

- **Function**

  Specifies the register numbers to be monitored on a word-by-word basis. Note that this command simply specifies the registers. Actual monitoring is performed by the WRM command after the register numbers are specified by this command.
  When the volume of data is large and you wish to increase the baud rate, it is effective to use a combination of the WRS and WRM commands rather than just the WRR command.
  If the power supply is turned off, the specified register numbers will be erased.
  - The number of words to be specified at a time is 1 to 32.
  - For the format of response in the event of failure, see subsection 3.1.2.
  - The command shown below includes the checksum function.
    When performing communication without checksum, do not include the 2-byte checksum element in the command.

- **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	2	5	1	5	1
Command element	STX	Address number (ADR)	CPU number 01	0	WRS	Number of words (n)	Register number 1	Comma or space	Register number 2	Comma or space

Command (continued)

• • •	5	2	1	1
• • •	Register number n	Checksum	ETX	CR

Number of Bytes	1	2	2	2	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	Checksum	ETX	CR

- **Example:**

  Specifying that the alarm-1 setpoint and alarm-2 setpoint of the M Series with address number 01 are to be monitored
  (This command simply specifies the registers to be monitored.)

  [Command]

  [STX]01010WRS02D0101,D010289[ETX][CR]

  CPU number: 01 — D register numbers

  OK is returned in response to the above command.

  [Response]

  [STX]0101OK5C[ETX][CR]

WRM Monitors D registers and I relays on a word-by-word basis

- **Function**

  Reads the register data that have been specified in advance by the WRS command.
  - Before executing this command, the WRS command must always be executed to specify which registers are to be monitored. If no register has been specified, error code 06 is generated.
  - For the format of response in the event of failure, see subsection 3.1.2.
  - The command shown below includes the checksum function. When performing communication without checksum, do not include the 2-byte checksum element in the command.

- **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	2	1	1
Command element	STX	Address number (ADR)	CPU number 01	0	WRM	Checksum	ETX	CR

Number of Bytes	1	2	2	2	4	4	• • •	4	2	1	1
Response element	STX	Address number (ADR)	CPU number 01	OK	dddd1	dddd2	• • •	ddddn	Checksum	ETX	CR

The response is returned in a 4-digit character string (0000 to FFFF) in hexadecimal.

ddddn: read data of the number of words specified by the WRS command
ddddn is a character string in hexadecimal.
n=1 to 32

- **Example:**

  Monitoring the alarm-1 setpoint (D0101) and alarm-2 setpoint (D0102) of the M Series with address number 01.
  (This command reads the registers specified by the WRS command.)

  [Command]

  [STX]01010WRME8[ETX][CR]
  ↑ CPU number: 01

  The alarm-1 setpoint 500 (01F4 [HEX]) and alarm-2 setpoint 500 (01F4 [HEX]) are returned with respect to the above command (50.0 is expressed as 500).

  [Response]

  [STX]0101OK01F401F412[ETX][CR]

INF Reads the model, range code number, number of alarms and revision

- **Function**

  Returns the model, range code number, number of alarms and revision of the M Series.
  - For the format of response in the event of failure, see subsection 3.1.2.

- **Command/Response (for normal operation)**

Number of Bytes	1	2	2	1	3	1	2	1	1
Command element	STX	Address number (ADR)	CPU number 01	Response time (0)	INF	6	Checksum	ETX	CR

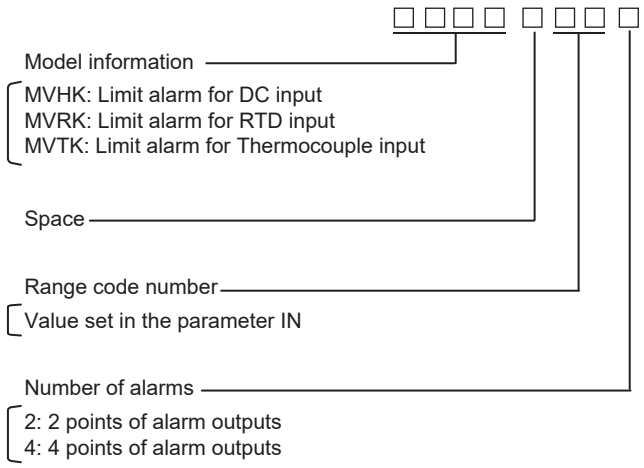
Number of Bytes	1	2	2	2	8	8	4	4
Response element	STX	Address number (ADR)	CPU number 01	OK	□□□□□□□□ (Note 1)	Version Revision (Note 2)	Start register specified for readout refreshing *	Number of registers specified for readout refreshing *

Response (continued)

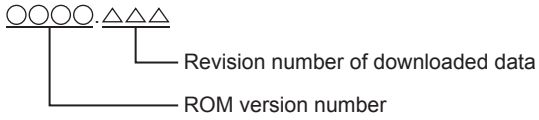
4	4	2	1	1
Start register specified for write refreshing *	Number of registers specified for write refreshing *	Checksum	ETX	CR

The * mark indicates fields the FA-M3 UT link module refers to.

Note 1: Model and input/output information of the M Series



Note 2: Version number and revision number

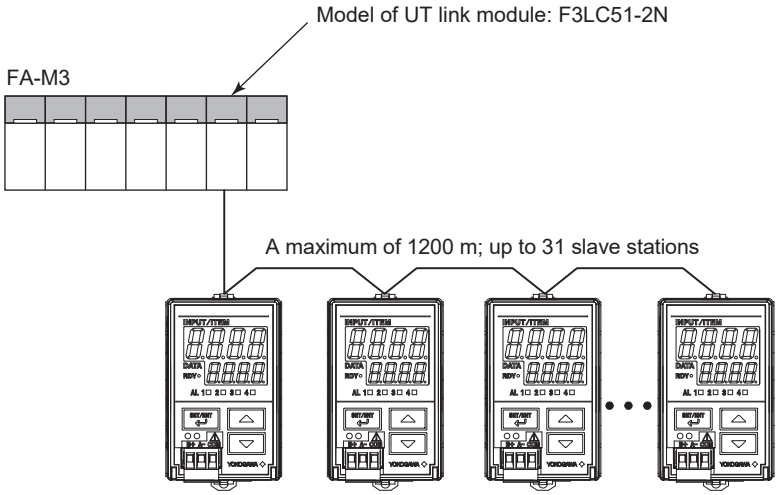


3.3 Communication with Higher-level Devices

Higher-level devices are those capable of using the PC link communication protocol. As an example of a communication program, the Basic program created using Microsoft Visual Basic is given in subsection 3.3.1. Further, communications with an FA-M3 UT link module or touch panel can be achieved without creating a complex program. Examples of communication with them are given in subsections 3.3.2 and 3.3.3.

3.3.1 Communication with UT Link Module

Communication with FA-M3 is achieved by simply connecting the M Series to a UT link module using the PC link communication protocol. Set the communication conditions of the M Series identical to those of the UT link module.



The UT link module supports the following two types of communication modes and command communication, which allow you to communicate with FA-M3 without being aware of it. For more information, see the optionally available “UT Link Module User’s Manual (IM 34M6H25-01E).”

1. Automatic mode
   This mode enables the instrument’s fixed devices (those that cannot be specified by the user) to be constantly refreshed by reading from them. The fixed devices are D0001 to D0004. They are read-only areas and cannot be written into.

2. Manual mode
   This mode enables the instrument’s devices (those that can be specified by the user) to be constantly refreshed by reading from and/or writing into them.

See Also

The devices mentioned here are D registers and I relays. For more information on D registers and I relays, see Chapters 6 and 7.

3. Command communication
   Command communication allows the user to communicate with instruments as and when required.

4.1 Overview

The use of Ladder communication enables the M Series to communicate with a sequencer (PLC). By specifying the register numbers of D registers of the M Series as parameters in the ladder program, you can read/write data from/into the registers using BCD codes (0 to 9).

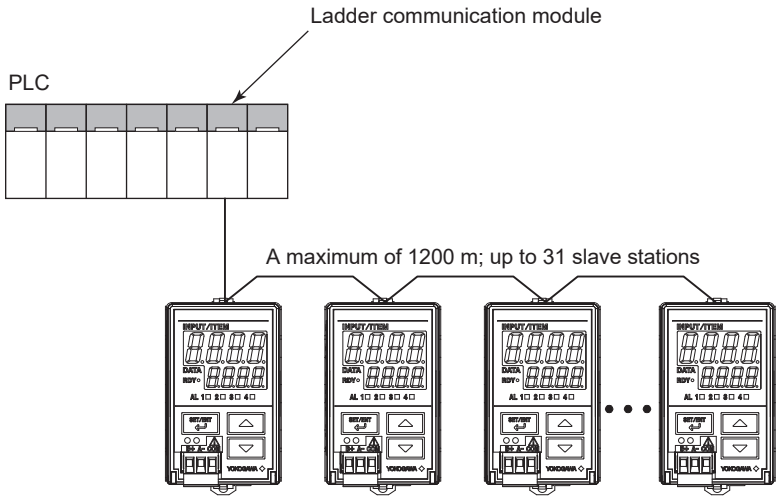


Figure 4-1 Example of Connection for Ladder Communication

- **Connecting the M Series to a PLC of another company**
  When the M Series are connected to a PLC manufactured by Mitsubishi Electric (MELSEC- Q series), you can use the no-handshaking mode of the computer link unit.

4.2 Commands/Responses at the PLC

The PLC sends commands and receives responses to these commands. The com- mands and responses that can be used are as follows.

4.2.1 Configuration of Command/Response

Commands sent from the PLC to the M Series and responses from the M Series with respect to a command sent from the PLC consist of the following elements.

Number of Bytes	1	1	2	1		1		2	1	1
Number of BCD Digits	2	2	4	1	1	1	1	4	2	2
Command/Response element	Address number (ADR)	CPU number 01	Parameter number	0	0	R/W	+/-	Data	CR (0D)	LF (0A)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	

Can be changed only during a read operation.
A maximum of 64 data items

(1)Address Number (01 to 99)

Address numbers are used by the PLC to identify the M Series at the communication destination. (Identification numbers specific to individual M Series.)

(2)CPU Number

This is fixed to 01.

(3)Parameter Number

This is 4-digit BCD data of a D register number with its leading character D removed.
I relays cannot be specified.

See Also

Chapter 6 for more information on D registers.

(4)0

This is fixed to 0.

(5)0

This is fixed to 0.

(6)R/W

0: Read
1: Write

(7)+/-

0: Positive data (+) 1: Negative data (-)

(8)Data

For read operation, this is the number of data items to be read.
For write operation, it is the setting data.

(9)CR and LF

These control codes indicate the end of a command. The corresponding control character strings for CR and LF are 0D and 0A in hexadecimal in ASCII code, respectively.

4.2.2 Reading Parameters

Shown below are the configurations of commands and responses when parameters in the M Series are read by the PLC. (The maximum number of data items to be read is 64.)

- **Command/Response**

Number of Bytes	1	1	2	1		1		2	1	1
Number of BCD Digits	2	2	4	1	1	1	1	4	2	2
Command element	Address number (ADR)	CPU number 01	Parameter number	0	0	0	0	Number of read data (n)	CR (0D)	LF (0A)

Number of Bytes	1	1	2	1		1		2	1		1		2
Number of BCD Digits	2	2	4	1	1	1	1	4	1	1	1	1	4
Response element	Address number (ADR)	CPU number 01	Parameter number	0	0	0	+/-	dddd1	0	0	0	+/-	dddd2

Data of parameter number (a) | Data of parameter number (b)

• • •	1		1		2	1	1
	1	1	1	1	4	2	2
• • •	0	0	0	+/-	ddddn	CR (0D)	LF (0A)

Data of parameter number (n)

- **Example:**

  Reading the input value (D0003) of the M Series with address number 01.

  [Command]
  0101<u>0003</u>000000010D0A

  The input value 500 (BCD code) is returned with respect to the above command (50.0 is expressed as 500).

  [Response]
  0101000300<u>0005</u>000D0A

4.2.3 Writing Parameters

Shown below are the configurations of commands and responses when the parameters are written into the M Series from the PLC.

- **Command/Response**

Number of Bytes	1	1	2	1		1		2	1	1
Number of BCD Digits	2	2	4	1	1	1	1	4	2	2
Command element	Address number (ADR)	CPU number 01	Parameter number	0	0	1	+/-	dddd	CR (0D)	LF (0A)

Number of Bytes	1	1	2	1		1		2	1	1
Number of BCD Digits	2	2	4	1	1	1	1	4	2	2
Response element	Address number (ADR)	CPU number 01	Parameter number	0	0	1	+/-	dddd	CR (0D)	LF (0A)

- **Example:**

  Writing 200 into the alarm-1 setpoint (D0101) of the M Series with address number 01.

  [Command]
  0101010101002000D0A

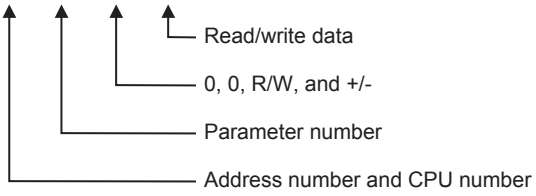
  The alarm-1 setpoint 200 (BCD code) is returned with respect to the above command (20.0 is expressed as 200).

  [Response]
  0101010101002000D0A

4.2.4 Response Error Codes

Data that the master station (PLC) will receive in the event of an error and the description of errors are given in the table below.

0101/0103/0000/0001/CR/LF



Note: Slashes (/) in the following send and receive data examples are used for explanatory purposes only, and are not part of the actual data string.

Table 4-2 List of Error Codes

Description of Error	Example of Data Sent by Master Station	Data Received by Master Station
A non-existent parameter was set.	0101/0451/0000/0001/CR/LF	0101/0451/0000/FFFF/CR/LF ↑ FFFF is returned.
Characters other than a BCD code (0 to 9) were used other than in an address number. * This excludes LF (0A).	0101/0420/0000/000B/CR/LF 0101/0420/000B/0000/CR/LF 0101/0420/0B00/0000/CR/LF 0101/042B/0000/0000/CR/LF	0101/FFFF/FFFF/FFFF/CR/LF
An LF code (0A) was used other than in an address number.	0101/0420/0000/000A/CR/LF 0101/0420/000A/0000/CR/LF 0101/0420/0A00/0000/CR/LF 0101/040A/0000/0000/CR/LF	No response
An address differed from the address numbers of the M Series. * In the example at right, none of the address numbers exist.	0103/0420/0000/0000/CR/LF 0001/0420/0000/0000/CR/LF 3301/0420/0000/0000/CR/LF	No response
The command length (length of the send data) is incorrect. * The command length, including CR and LF, must be 10 bytes.	0101/0420/0000/00/CR/LF 0101/0420/0/CR/LF 0101/0/CR/LF	No response
A timeout occurred during communication. * Timeout is 2 seconds.	0101/012	No response
The buffer overflowed. * This error occurs when the buffer overflow exceeds 368 bytes.	–	No response
A framing error or a parity error occurred.	–	No response

Note

If a parameter not existing in the D register table is read, an error will not occur. In this case, 0 will be returned instead.

Blank

5.1 Overview

The use of MODBUS communication enables the M Series to communicate with a PC. In this communication, you can use a PC to read/write data from/into D registers, which are internal registers of the M Series.

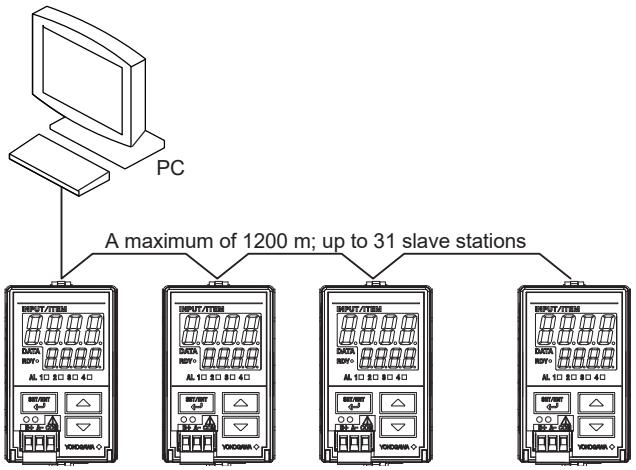


Figure 5-1 Example of Connection for MODBUS Communication

Hereafter, PCs are generically called “higher-level devices.”

See Also

Chapter 6 for information on the D registers.

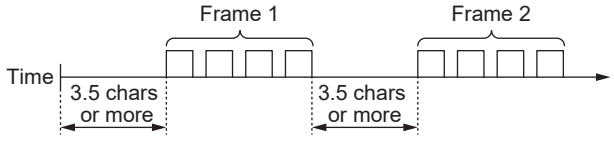
For the MODBUS communication of the M Series, two transmission modes are supported: ASCII mode and RTU mode (binary system).

Table 5-1 ASCII and RTU Modes

Item	ASCII Mode	RTU Mode
Number of data bits	7 bits (ASCII)	8 bits (binary)
Message start mark	: (colon)	Not necessary
Message end mark	CR+LF	Not necessary
Message length (*1)	2N+1	N
Data time intervals	1 second or less	24 bit time or less (*2)
Error detection	Longitudinal redundancy check: LRC	Cyclic redundancy check: CRC-16

*1: When the message length in the RTU mode is assumed to be “N.”
*2: When the baud rate is 9600 bps, 1÷9600×24 seconds or less applies.

Detection of Message Frame Termination in RTU Mode



Note

When the write data to D registers is outside the valid range, the response is returned as “normal.”

5.1.1 Configuration of Message

Messages sent from a higher-level device to the M Series consist of the following elements.

Element	Start of Message Mark	Address Number (ADR)	Function Code	Data	Error Check	End of Message Mark
Number of bytes in RTU mode	None	1	1	2n	2	None
Number of bytes in ASCII mode	1	2	2	4n	2	2
	(1)	(2)	(3)	(4)	(5)	(6)

(1) Start of Message Mark

This mark indicates the start of a message. Note that only ASCII mode requires a colon (:).

(2) Address Number (01 to 99)

Address numbers are used by a higher-level device to identify the M Series at the communication destination. (Identification numbers specific to individual M Series, which is expressed in hexadecimal in the message.)

(3) Function Code (See subsection 5.2.1, “List of Function Codes.”)

This specifies a command (function code) from the higher-level device.

(4) Data

This specifies D register numbers, the number of D registers, parameter values, or others in accordance with the function code. (It is expressed in hexadecimal in the message.)

(5) Error Check

In RTU mode : Carried out by the cyclic redundancy check (CRC-16) system.
In ASCII mode : Carried out by the longitudinal redundancy check (LRC) system.

(6) End of Message Mark

This mark indicates the end of a message. Note that only ASCII mode requires CR + LF.

5.1.2 Specifying D Registers

When you use a commercially available SCADA or the like or a user-created communication program, you must be careful when specifying D register numbers contained in messages because in both cases, you cannot use the original D register numbers as they are.

1) When using a commercially available SCADA or the like, specify D register numbers by changing them into reference numbers. To change them into a reference number, replace the D register number's leading character "D" with "4."

2) In a user-created communication program, specify a D register using the hexadecimal number of the value obtained by subtracting "40001" from the D register's reference number. (Specify this hexadecimal number.)

Example:

Specifying a value (alarm-1 setpoint [D0101])

1) For a messages using commercially available SCADA or the like, specify reference number "40101."

2) For a messages in a user-created communication program, specify "0064," the hexadecimal number of "100 ," which is obtained by subtracting 40001 from the reference number.

5.1.3 Error Check

The error checking of the ASCII mode is different from the RTU mode.

ASCII mode

In the ASCII mode, error checking is performed by the longitudinal redundancy check (LRC).
Each individual byte from the communication address up to the final data (excluding ":", "CR" and "LF") is added, and the 2's complement of the result becomes LRC.
Ignore the uppermost carry during addition.

Example:

How to calculate the LRC in the case of command [:]110307E10004[LRC][CR] [LF] for reading four values continuously from D register D0218 of the controller at communication address 17.

(1)Communication address 17 is expressed as "0x11" in Hex.
D00201 is "0x00C8". This is the number "200" (number obtained by subtracting 40001 from reference No. 400201) expressed in Hex. When this is converted to 1-byte Hex data, this becomes "11,03,00,C8,00,04".
(In Modbus/ASCII messages, "11" is ASCII code "H' 31, H' 31", which comprises two bytes.)

(2)This 1-byte Hex data is added one byte at a time as follows:
→ 11+03+00+C8+00+04 = E0

(3)2's complement of the lowermost 1 byte of the result of addition is "20".
11100000 (0xE0) → 00011111 (complement) +1=00100000 (20)

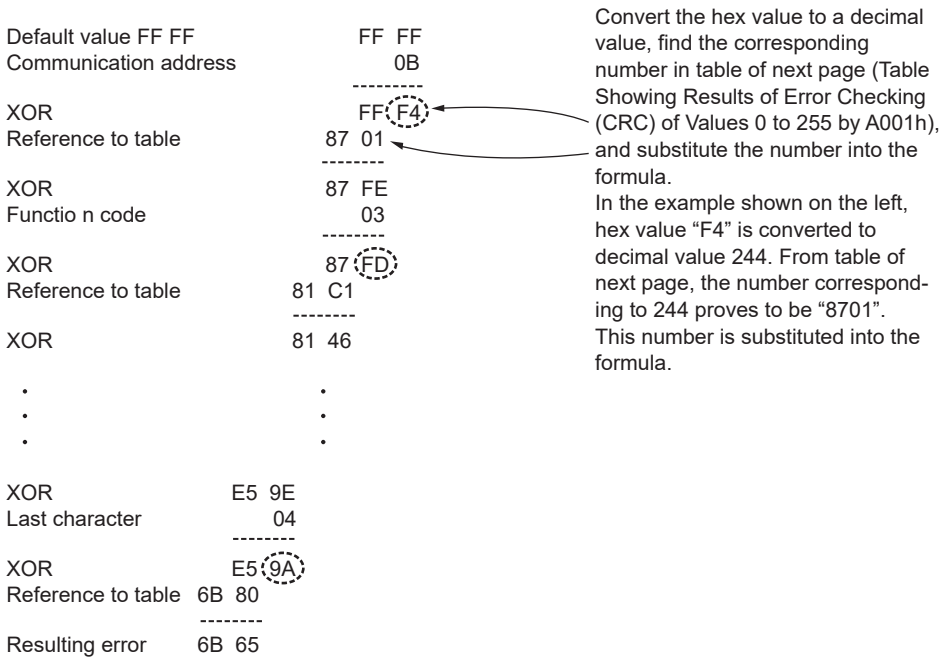
RTU Mode

In the RTU mode, error checking is performed by the cyclic redundancy check (CRC-16). Of all message blocks (from communication address through to final data), eight bits (excluding start bit, stop bit and parity bit) are aligned serially, and the remainder (16 bits) when the result is divided by predetermined binary 17 bits becomes the CRC-16.

Example (CRC-16 calculation example)

When reading four data from D register D2018 by function code 03 (read status of multiple D registers) from the slave at communication address 11 (0Bh).
"0B03002A0004" is sent as the send command.

(1)Default is FFFF. This is XORed (exclusive ORed) with the 1st byte (= slave address 11).
(2)The lower byte of the result is referenced, and the value corresponding to that value in the following table is obtained. In this case, the 244th value in the table is referenced to obtain 8701h as the result is F4h.
(3)The upper byte of the result of the XOR in (1) is XORed with the result of (2).
(4)The result (remainder) of (3) is taken as the next default, and the same operation is performed on the 2nd byte (=function code 03).



(5)From here on, steps (1) to (4) are repeated to calculate up to the final "04".
(6)The upper and lower bytes of the result of calculation "6B65" are inverted, and "656B" is appended to the final.

0B03002A0004**656B**

Showing Results of Error Checking (CRC) of Values 0 to 255 by A001h

Number	0	1	2	3	4	5	6	7
Result	0	C0C1	C181	140	C301	03C0	280	C241
Number	8	9	10	11	12	13	14	15
Result	C601	06C0	780	C741	500	C5C1	C481	440
Number	16	17	18	19	20	21	22	23
Result	CC01	0CC0	0D80	CD41	0F00	CFC1	CE81	0
Number	24	25	26	27	28	29	30	31
Result	0A00	CAC1	CB81	0B40	C901	09C0	880	C841
Number	32	33	34	35	36	37	38	39
Result	D801	18C0	1980	D941	1B00	DBC1	DA81	1A40
Number	40	41	42	43	44	45	46	47
Result	1	43800	DF81	1F40	DD01	1DC0	1C80	DC41
Number	48	49	50	51	52	53	54	55
Result	1400	D4C1	D581	1540	D701	17C0	1680	D641
Number	56	57	58	59	60	61	62	63
Result	D201	12C0	1380	D341	1100	D1C1	D081	1040
Number	64	65	66	67	68	69	70	71
Result	F001	30C0	3180	F141	3300	F3C1	F281	3240
Number	72	73	74	75	76	77	78	79
Result	3600	F6C1	F781	3740	F501	35C0	3480	F441
Number	80	81	82	83	84	85	86	87
Result	3C00	FCC1	FD81	3D40	FF01	3FC0	3E80	FE41
Number	88	89	90	91	92	93	94	95
Result	FA01	3AC0	3B80	FB41	3900	F9C1	F881	3840
Number	96	97	98	99	100	101	102	103
Result	2800	E8C1	E981	2940	EB01	2BC0	2A80	EA41
Number	104	105	106	107	108	109	110	111
Result	EE01	2EC0	2F80	EF41	2D00	EDC1	EC81	2C40
Number	112	113	114	115	116	117	118	119
Result	E401	24C0	2580	E541	2700	E7C1	E681	2640
Number	120	121	122	123	124	125	126	127
Result	2200	E2C1	E381	2340	E101	21C0	2080	E041
Number	128	129	130	131	132	133	134	135
Result	A001	60C0	6180	A141	6300	A3C1	A281	6240
Number	136	137	138	139	140	141	142	143
Result	6600	A6C1	A781	6740	A501	65C0	6480	A441
Number	144	145	146	147	148	149	150	151
Result	6C00	ACC1	AD81	6D40	AF01	6FC0	6E+80	AE41
Number	152	153	154	155	156	157	158	159
Result	AA01	6AC0	6B80	AB41	6900	A9C1	A881	6840
Number	160	161	162	163	164	165	166	167
Result	7800	B8C1	B981	7940	BB01	7BC0	7A80	BA41
Number	168	169	170	171	172	173	174	175
Result	BE01	7EC0	7F80	BF41	7D00	BDC1	BC81	7C40
Number	176	177	178	179	180	181	182	183
Result	B401	74C0	7580	B541	7700	B7C1	B681	7640
Number	184	185	186	187	188	189	190	191
Result	7200	B2C1	B381	7340	B101	71C0	7080	B041
Number	192	193	194	195	196	197	198	199
Result	5000	90C1	9181	5140	9301	53C0	5280	9241
Number	200	201	202	203	204	205	206	207
Result	9601	56C0	5780	9741	5500	95C1	9481	5440
Number	208	209	210	211	212	213	214	215
Result	9C01	5CC0	5D80	9D41	5F00	9FC1	9E81	5E40
Number	216	217	218	219	220	221	222	223
Result	5A00	9AC1	9B81	5B40	9901	59C0	5880	9841
Number	224	225	226	227	228	229	230	231
Result	8801	48C0	4980	8941	4B00	8BC1	8A81	4A40
Number	232	233	234	235	236	237	238	239
Result	4	8EC1	8F81	4F40	8D01	4DC0	4C80	8C41
Number	240	241	242	243	244	245	246	247
Result	4400	84C1	8581	4540	8701	47C0	4680	8641
Number	248	249	250	251	252	253	254	255
Result	8201	42C0	4380	8341	4100	81C1	8081	4040

5.1.4 Configuration of Responses

If the instruction message from the host computer is normal and the address is for itself, the M series moves to the process execution phase after it judges that the received content is normal. The M series then parses the content of the instruction message and executes processing.
However, it does not execute processing if the content of the instruction message is in error. In this case, the M series either ignores received content, or generates a response message to inform the host computer that the received content is in error.
After executing the requested processing when the received content is normal, the M series generates a response message appended with an error check corresponding to the instruction function code, and sends this message to the host computer.

Response in a normal state

In the case of the loopback function and write function on a single D register / I relay, the M series returns the same response message as the instruction message.
In the case of a write function on multiple D registers / I relays, the M series returns part of the instruction message as the response message.
In the case of the read function, the M series appends the address No. and function code with the data that was read, and returns this as the response message.

Response in an error state

When a communication error (framing error, parity error, inter-character timer timeout, or receiving frame over-length) occurs, the M series does not return a message.
When the message contains an inconsistency other than a communication error, the M series does not perform any processing, and returns the following message.

Element	Start of Message Mark	Address Number (ADR)	Function Code (*1)	Data	Error check	Message end mark
Number of bytes in RTU mode	None	1	1	1	2	None
Number of bytes in ASCII mode	1	2	2	2	2	2

*1: The value of “function code (Hex) + 0x80” is set in the function code.
The following shows the details of the error code.

Error code	Meaning	Cause
01	Function code error	The function code does not exist.
02	D register No. error	A No. outside the range has been specified.
03	Number of D resisters	A number of registers outside the range has been specified.

Even if continuous D registers specified by a read function include unused registers, no error is generated and the M series returns “0” as the value.
The M series returns error code “02” or “03” when the start address of continuously specified addresses is in the range, and the continuously specified addresses become out of range as a result of the number of specified addresses (according to function code).
When there is no response even after a message is sent:

- When a transmission error (overrun, framing, parity, LRC or CRC-16 error) is detected
- When the address in the instruction message is wrong
- When the inter-character timer timeout occurs
- When the communication address is “00” or “F9” (broadcast specification)
- When a receive buffer overflow (buffer size: 368 bytes) has occurred

Note: As a measure for the above, execute time-out processing by the communication function or communication program on the host computer.

5.2 Function Codes

5.2.1 List of Function Codes

Function codes are command words used by the higher-level device to obtain the D register data of the M Series.

Table 5-2 List of Function Codes

Code Number	Function	Description
03	Reads data from multiple registers.	Capable of reading data from a maximum of 64 successive registers.
06	Writes data into a register.	Capable of writing data into one register.
08	Performs loop back test.	Used to check the connection for communication.
16	Writes data into multiple registers.	Capable of writing data into a maximum of 64 successive registers.

- The write function codes will not write into read-only or disabled registers.
- Broadcast addressing is possible with function codes 06 and 16 only. (Also in this case, read-only or disabled registers will not be written into.)

03 Reads data from multiple D registers

- **Function**

  Reads the contents of a sequence of contiguous D registers by the specified number of D registers, starting at a specified D register number.
  - The maximum number of D registers to be read at a time is 64.
  - For the format of response in the event of failure, see subsection 5.2.2.

- **Message (for normal operation)**

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (03)	D-Register Start Number	Number of D Registers
Number of bytes in RTU mode	None	1	1	2	2
Number of bytes in ASCII mode	1	2	2	4	4

Message (continued)

Error Check	End of Message Mark (CR+LF)
2	None
2	2

- **Response (for normal operation)**

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (03)	Byte Count	Contents of D Register
Number of bytes in RTU mode	None	1	1	1	2
Number of bytes in ASCII mode	1	2	2	2	4

Response (continued)

• • •	Contents of D Register	Error Check	End of Message Mark (CR+LF)
• • •	2	2	None
• • •	4	2	2

- **Example:**

  Reading the statuses of alarm-1 and alarm-2 setpoints of the M Series with address number 01.
  The following message reads two successive D registers starting at alarm-1 setpoint (D0101) of address number 01 in the ASCII mode.

  [Message]

  : 01030064000296[CR][LF]
  ↑
  Start of message mark

  “01”: address number 01, “03”: function code 03, “0064”: D-register start number 0101, “0002”: number of D registers 2, and “96”: error check

  Note: The numbers in quotation marks are hexadecimal.

  The following response is returned with respect to the above message.

  [Response]

  : 010304<u>0001</u> <u>0000</u>F7[CR][LF]
  Alarm-1 setpoint is 1. ↑ ↑ Alarm-2 setpoint is 0.

06 Writes data into a D register

- **Function**

  Writes data into a specified D register.
  - The maximum number of D registers to be written into at a time is 1.
  - For the format of response in the event of failure, see subsection 5.2.2.
  - Broadcast addressing is possible by setting 00 in the address number.

- **Message (for normal operation)**

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (06)	D-Register Number (Upper Digit)	D-Register Number (Lower Digit)
Number of bytes in RTU mode	None	1	1	1	1
Number of bytes in ASCII mode	1	2	2	2	2

Message (continued)

Write Data (Upper Digit)	Write Data (Lower Digit)	Error Check	End of Message Mark (CR+LF)
1	1	2	None
2	2	2	2

- **Response (for normal operation)**

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (06)	D-Register Number (Upper Digit)	D-Register Number (Lower Digit)
Number of bytes in RTU mode	None	1	1	1	1
Number of bytes in ASCII mode	1	2	2	2	2

Response (continued)

Write Data (Upper Digit)	Write Data (Lower Digit)	Error Check	End of Message Mark (CR+LF)
1	1	2	None
2	2	2	2

- **Example:**

  Setting 70.00 into the alarms-1 setpoint of the M Series with address number 01. The following message writes 70.00 into the alarms-1 setpoint (D0101) of address number 01 in the ASCII mode.

  [Message]

  : 010600641B5822[CR][LF]
  ↑
  └ Start of message mark

  “01”: address number 01, “06”: function code 06, “0064”: D-register number 0101, “1B58”: data 70.00, and “22”: error check

  Note: The numbers in quotation marks are hexadecimal.

  The following response is returned with respect to the above message.

  [Response]

  : 010600641B5822[CR][LF]
  ↑
  └ Alarm-1 setpoint is 70.00.

08 Performs loop back test

- **Function**

  This function code is used to check the connection for communication.
  - For the format of response in the event of failure, see subsection 5.2.2.
  - The element marked with * is “00” (fixed).
  - Any value can be selected for send data.

- **Message (for normal operation)**

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (08)	00* 0000	Send Data (any)
Number of bytes in RTU mode	None	1	1	2	2
Number of bytes in ASCII mode	1	2	2	4	4

Message (continued)

Error Check	End of Message Mark (CR+LF)
2	None
2	2

- **Response (for normal operation)**

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (08)	00 0000	Same as send data
Number of bytes in RTU mode	None	1	1	2	2
Number of bytes in ASCII mode	1	2	2	4	4

Response (continued)

Error Check	End of Message Mark (CR+LF)
2	None
2	2

- **Example:**

  Sending data 1234 (HEX) to the M Series with address number 01 to check connection for communication.
  The following message sends 1234 (HEX) to address number 01 in the ASCII mode.

  [Message]

  : 010800001234B1[CR][LF]
  ↑
  └ Start of message mark

  When the connection for communication is normal, the response whose configuration is the same as that of the message is returned with respect to the above message.

  [Response]

  : 010800001234B1[CR][LF]

16 Writes data into multiple D registers

- **Function**

  Writes data into a sequence of contiguous D registers by the specified number of D registers, starting at a specified D register number.
  - The maximum number of D registers to be written into at a time is 32.
  - For the format of response in the event of failure, see subsection 5.2.2.
  - Broadcast addressing is possible by setting 00 in the address number.

- **Message (for normal operation)**

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (10)	D-Register Start Number (Upper Digit)	D-Register Start Number (Lower Digit)
Number of bytes in RTU mode	None	1	1	1	1
Number of bytes in ASCII mode	1	2	2	2	2

Message (continued)

Number of D Registers (Upper Digit)	Number of D Registers (Lower Digit)	Byte Count	Data (Upper Digit)	Data (Lower Digit)	• • •	Error Check	End of Message Mark (CR+LF)
1	1	1	1	1	• • •	2	None
2	2	2	2	2	• • •	2	2

- **Response (for normal operation)**

Element	Start of Message Mark (:)	Address Number (ADR)	Function Code (10)	D-Register Start Number (Upper Digit)	D-Register Start Number (Lower Digit)
Number of bytes in RTU mode	None	1	1	1	1
Number of bytes in ASCII mode	1	2	2	2	2

Response (continued)

Number of D Registers (Upper Digit)	Number of D Registers (Lower Digit)	Error Check	End of Message Mark (CR+LF)
1	1	2	None
2	2	2	2

- **Example:**

  Setting 200, 10 and 3 into the alarms-1 setpoint, alarm-2 setpoint and alarm-3 setpoint of the M Series with address number 02, respectively.
  The following message writes 200, 10 and 3 in this order in the ASCII mode, starting at the alarm-1 setpoint (D0101) of address number 02 .

  [Message]

  : 0210006400030600C8000A0003AC[CR][LF]
  ↑ Start of message mark

  “02”: address number 02, “10”: function code 16, “0064”: D-register start number 0101, “0003”: number of D registers 3, “06”: byte count, “00C8”: alarm-1 setpoint 200, “000A”: alarm-2 setpoint 10, “0003”: alarm-3 setpoint 3, and “AC”: error check

  Note: The numbers in quotation marks are hexadecimal.

  The following response is returned with respect to the above message.

  [Response]

  : 021000640003 87[CR][LF]
  ↑ The number of registers is 3.

5.2.2 Response Error Codes

- **Message Format in the Event of Error**

  If there are any inconsistencies other than communication errors in a message, the M Series does nothing, but returns the following message.

Element	Address Number (ADR)	Function Code (*1)	Error Code	Error Check	[CR] [LF]
Number of bytes in RTU mode	1	1	1	2	None
Number of bytes in ASCII mode	2	2	2	2	2

*1: In this case, a value of [function code (hexadecimal number) + number 80 (hexadecimal number)] is set.

- **Response Error Codes**

Table 5-3 List of Error Codes

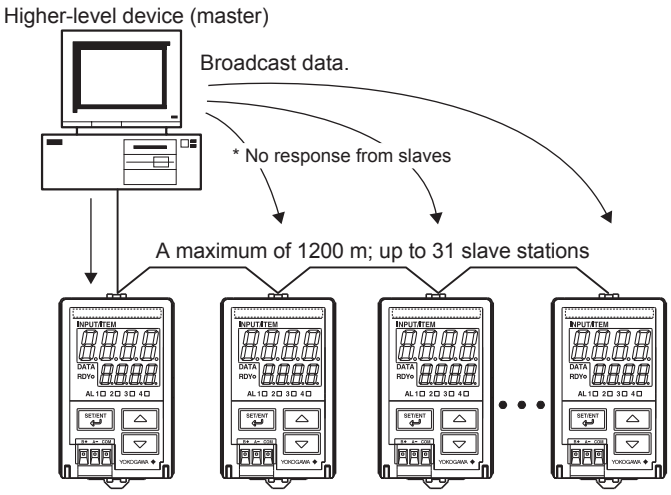
Error Code	Meaning	Cause
01	Function code error	No such function code exists.
02	D-register number error	Specified D register number is out of the range.
03	D-register count error	Specified number of D registers is out of the range.

- **Even when a message is sent, no response returns if:**
  - Retransmission error (overrun, framing, parity, LRC, or CRC-16 error) was detected.
  - Address in a command message is incorrect.
  - Interval between data composing a message was 2 seconds or more.
  - CRC-16 or LRC values are incorrect.
  - Broadcase is specified (address number: 00).

Note: As a countermeasure, provide a timeout process in the communication functions of a higher-level device or in the communication program.

5.2.3 Specifying Broadcast

Broadcast addressing allows the corresponding multiple M Series to receive the command.
(1) To use this function, specify 00 in the address number.
(2) Broadcast addressing works independently of the address number.
(3) Broadcast addressing is only applicable to write commands.
(4) No response is returned if broadcast addressing is used.



For the M Series communication, D registers are used.

Blank

6.1 Overview of D Registers

This section describes the functions and usage of D registers.

The D registers store the input and output values, statuses and others that are handled by the M Series. By connecting M Series to higher-level device capable of PC link communication, Ladder communication or MODBUS communication, you can readily use these internal data items by reading from or writing into the D registers.

6.2 Interpretation of D Register Map Table

This section explains how to read D Register Map tables in this chapter. The num- bers listed in the leftmost column are D register numbers ((1) below). The five-digit numbers in the next column are reference numbers used for MODBUS communication ((2) below). The numbers in the column third from left are register numbers in hexadecimal used in MODBUS communication programs ((3) below).

D-Register Data Area				
D-Reg No.	**Ref No.**	**H No.**	**Description**	**R/W**
D0001	40001	0000	Status	R

(1) D register number
(2) Reference number (for MODBUS communication)
(3) Hex number (for MODBUS communication)
Permission of read/write by communication
: Indicates that the number of writing actions is limited to 100,000.

6.3 D Register Map Table

Note

- Before changing parameter settings, refer to “PARAMETER SETTING ORDER AND PRECAUTIONS” in the MVHK, MVRK, and MVTK User’s Manual.
- Parameters that are not displayed can not be written.
- Do not turn off the M series while changing parameters.

D-Register Data Area				
D-Reg No.	Ref No.	H No.	Description	R/W
D0001	40001	0000	Status	R
D0002	40002	0001	Alarm status	R
D0003	40003	0002	Input value (display value)	R
D0004	40004	0003	Input unit	R
D0005 to D0100				
D0101	40101	0064	Alarm-1 setpoint (A1)	R/W
D0102	40102	0065	Alarm-2 setpoint (A2)	R/W
D0103	40103	0066	Alarm-3 setpoint (A3)	R/W
D0104	40104	0067	Alarm-4 setpoint (A4)	R/W
D0105	40105	0068	Alarm-1 action (AL1)	R/W
D0106	40106	0069	Alarm-2 action (AL2)	R/W
D0107	40107	006A	Alarm-3 action (AL3)	R/W
D0108	40108	006B	Alarm-4 action (AL4)	R/W
D0109	40109	006C	Alarm-1 hysteresis (HY1)	R/W
D0110	40110	006D	Alarm-2 hysteresis (HY2)	R/W
D0111	40111	006E	Alarm-3 hysteresis (HY3)	R/W
D0112	40112	006F	Alarm-4 hysteresis (HY4)	R/W
D0113	40113	0070	Alarm ON delay (OND)	R/W
D0114	40114	0071	Alarm OFF delay (OFD)	R/W
D0115	40115	0072	Setpoint (SP)	R/W
D0116	40116	0073	Keylock (LOC)	R/W
D0117	40117	0074	PV, Deviation high-limit alarm	R/W
D0118	40118	0075	PV, Deviation low-limit alarm	R/W
D0119				
D0120	40120	0077	Alarm 1 ON delay (ON1)	R/W
D0121	40121	0078	Alarm 2 ON delay (ON2)	R/W
D0122 to D0123				
D0124	40124	007B	Alarm 1 OFF delay (OF1)	R/W
D0125	40125	007C	Alarm 2 OFF delay (OF2)	R/W
D0126 to D0200				
D0201	40201	00C8	Bias (BS)	R/W
D0202	40202	00C9	Economical mode (ECO)	R/W
D0203	40203	00CA	Burnout action (BSL)	R/W
D0204	40204	00CB	Wiring resistance correction (WIR)	R
D0205	40205	00CC	RJC sensor (RJC)	R/W
D0206 to D0209				
D0210	40210	00D1	Communication protocol (PSL)	R/W
D0211	40211	00D2	Address number (ADR)	R/W
D0212	40212	00D3	Baud rate (BPS)	R/W
D0213	40213	00D4	Parity (PRI)	R/W
D0214	40214	00D5	Stop bit (STP)	R/W
D0215	40215	00D6	Data length (DLN)	R/W
D0216 to D0300				
D0301	40301	012C	Range code number (IN)	R/W
D0302	40302	012D	Maximum measured input value (RH)	R/W
D0303	40303	012E	Minimum measrued input value (RL)	R/W
D0304	40304	012F	Decimal point position of scaling value (SDP)	R/W

Continue to the next page

D-Register Data Area				
D-Reg No.	Ref No.	H No.	Description	R/W
D0305	40305	0130	Maximum scaling value (SH)	R/W
D0306	40306	0131	Minimum scaling value (SL)	R/W
D0307 to D0308				
D0309	40309	0134	Input adjustment point LOW (BL)	R
D0310	40310	0135	Input adjustment LOW (AL)	R
D0311	40311	0136	Input adjustment point HIGH (BH)	R
D0312	40312	0137	Input adjustment HIGH (AH)	R
D0313 to D0400				
D0401 to D0450	40401 to 40450	0190 to 01C1	User area *1	R/W

*1: The user area applies to some devices such as graphic panels.
: The number of writing actions is limited to 100,000.

6.3.1 Contents of D Registers

- **D0001: Bit configuration of status**

The D0001 register represents errors and parameter data by a combination of bits in the register.

In the table below, if any of the events shown occurs, the corresponding bit is set to “1.” The bit remains set to “0” if the event has not occurred yet. Note that blank fields indicate bits not used, which are in “0.”

Bit	Description
0	Alarm-1 status
1	Alarm-2 status
2	
3	
4	Input exceeding high limit
5	Input falling below low limit
6	Burnout
7	
8	
9	EEP sum error
10	
11	AD error
12	
13	RJC error
14	EEP error
15	

- **D0002: Bit configuration of alarm status**

Bit	Description
0	Alarm-1 status
1	Alarm-2 status
2	
3	
4	Alarm-3 status
5	Alarm-4 status
6 to 15	

- **D0003: INPUT (Input value: display value)**

- **D0004: IN UNIT (Input unit)**

D0004 value	Unit	Model
H’0000	No unit	MVHK
H’0003	degC	MVTK, MVRK
H’0004	K	MVTK, MVRK

Blank

Blank

7.1 Status

This chapter describes the functions and usage of the I relays.
The I relays store information on errors, alarm statuses and others of the M Series. The higher-level device can read data from I relays or write data into I relays using PC link communication.

The following table shows how the I relays are classified.

I-Relay No.	Type of Status	Description
1 to 16	ON/OFF	Error information (same contents as those of D0001)
17 to 32		Alarm status (same contents as those of D0002)
33 to 64		User area (that is used in some devices such as graphic panels)

Note

- The I relays numbered 1 to 32 store ON/OFF statuses. Generally, this area can be accessed to read the ON/OFF statuses.
- When specifying an I relay number via communication, begin the number with an upper-case letter I. For example, type I0001 to specify the alarm-1 status (I relay number: 1).
- No data may be written into or read from data storage areas with blank fields in the table below. If you attempt to do so, the M Series may fail to operate normally.

I-Relay Area	
I-Relay No.	**Description**
1	Alarm-1 status
2	Alarm-2 status
3	
4	
5	Input exceeding high limit
6	Input falling below low limit
7	Burnout
8	
9	EEP sum error
10	
11	AD error
12	
13	
14	RJC error
15	EEP error
16	
17	Alarm-1 status
18	Alarm-2 status
19	
20	
21	Alarm-3 status
22	Alarm-4 status
23 to 32	
33 to 64	User area

Blank

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