User's
Manual

M Series
Digital Limit Alarms
Communication Functions

IM 77J04J11-01E

YOKOGAWA
Yokogawa Electric Corporation

IM 77J04J11-01E
1st Edition

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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.

Documentation Conventions

■ Symbols

The following symbols are used in this manual.

● Symbols Used in the Main Text

CAUTION

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.

■ Regarding Protection, Safety, and Prohibition Against Unauthorized Modification

(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.

M Series Digital Limit Alarms Communication Functions

IM 77J04J11-01E 1st Edition

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1. Setup

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.

1.1 Setup Procedure

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.)

↓

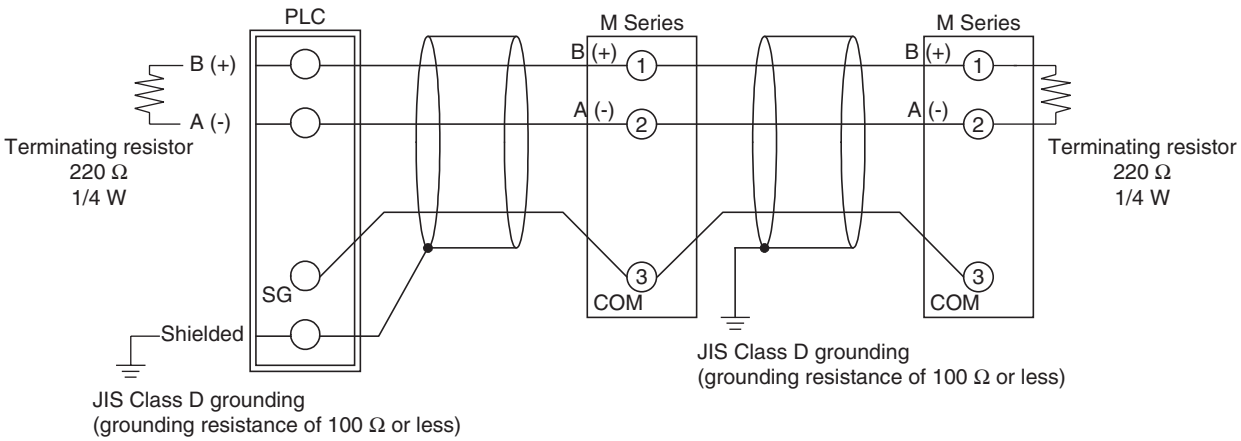
Connect a higher-level device and a M Series. (See the connection diagram below.)

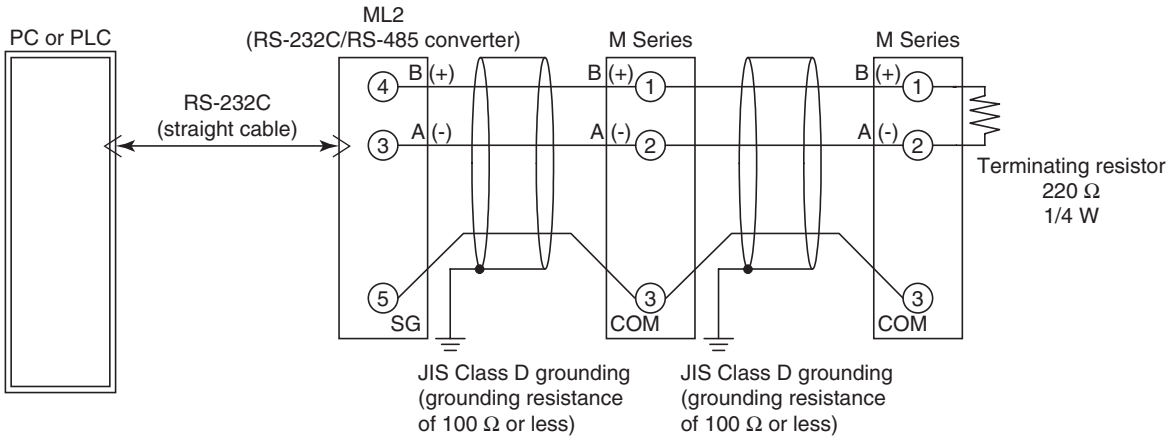
↓

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.

CAUTION

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) 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.

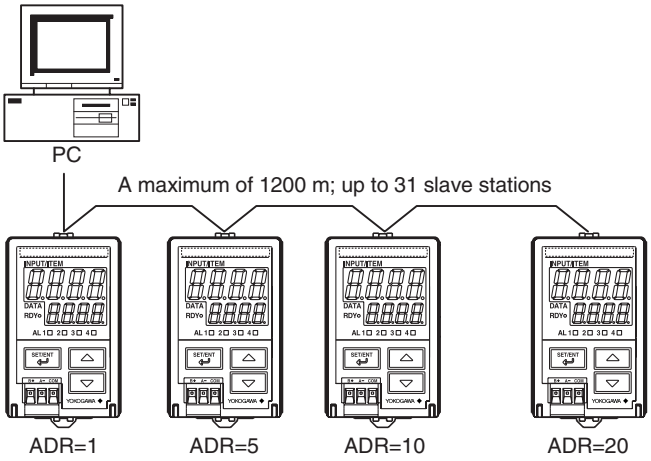
● Protocol selection (PSL)

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. 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	Two-piece connector on the front panel: 1, 2, 3
Communication Protocol Specifications	PC link communication without checksum PC link communication with checksum MODBUS communication (ASCII mode) MODBUS communication (RTU mode) Ladder communication
Maximum Baud Rate	9600 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)

2.1 RS-485 Communication Specifications

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

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3. PC Link Communication

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 communication, 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.

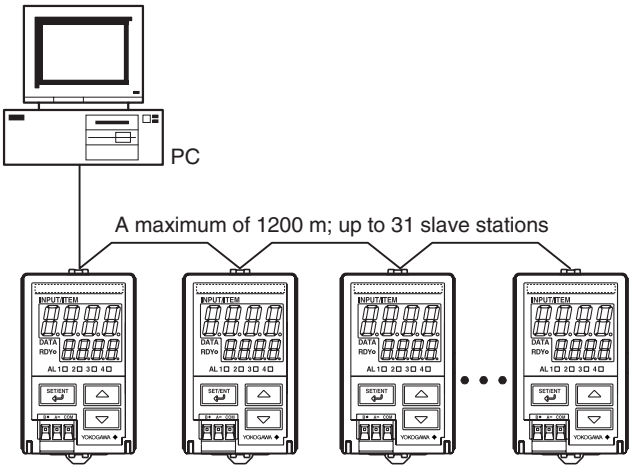


Figure 3-1 Example of Connection for PC Link Communication

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	Address number (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.

CAUTION

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 number (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]01010BRR02I0001,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.

3.1.4 Specifying Broadcast

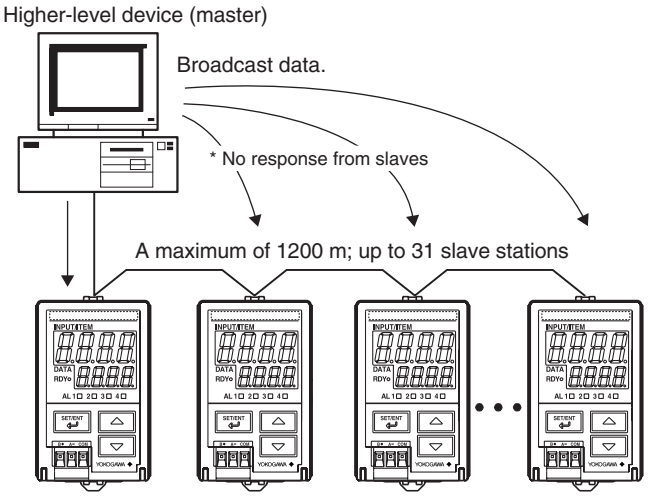
Broadcast addressing allows the corresponding multiple M Series to receive the command.

(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.

(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]01010BRMA3[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]0101OK01F401F4FC[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]0101 0WRME8[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

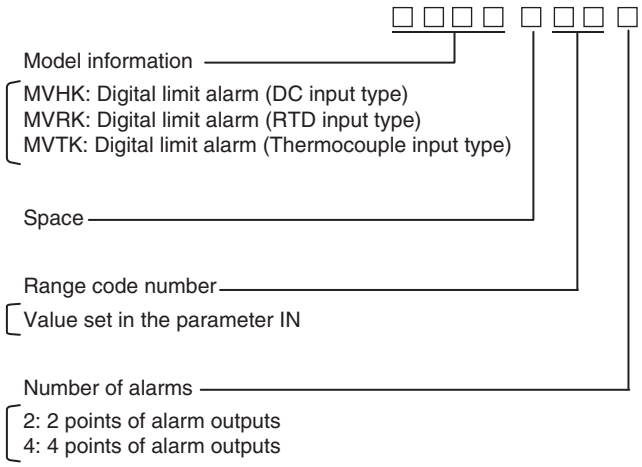
Number of Bytes	1	2	2	2	8	8	4	4
Response element	STX	Address number (ADR)	CPU number 01	OK	□□□□□□□□ (Note 1)	Version Revision (Note 2)	Start register specified for readout refreshing *	Number of registers specified for readout refreshing *

Response (continued)

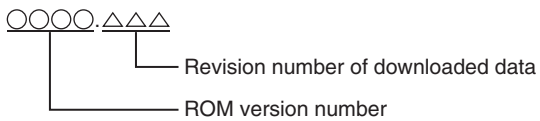
4	4	2	1	1
Start register specified for write refreshing *	Number of registers specified for write refreshing *	Checksum	ETX	CR

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 Example of Communication Program Created Using Visual Basic

This subsection shows a sample program created using Microsoft Visual Basic 6.0.

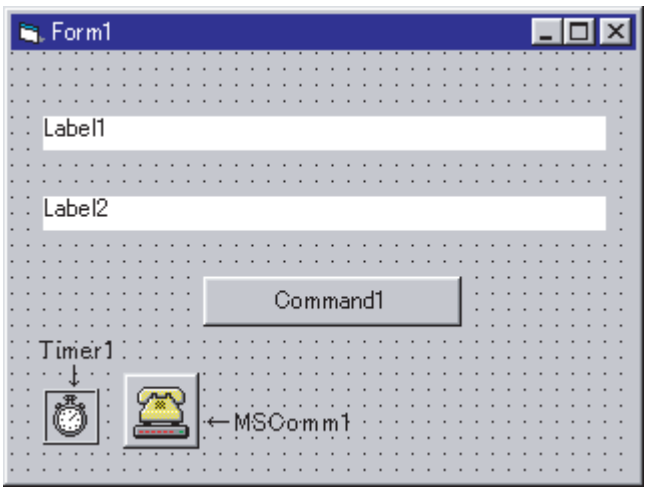
Operation verification environment: PC/AT compatible machine + Windows NT 4.0 (SP4), Windows 95

PC/AT is a product of IBM Corporation.
Visual Basic is a registered trademark of Microsoft Corporation.

See Also

MSDN and commercially available documentation for information on Visual Basic programming.

The sample program reads the contents of D register D0002 using the PC link communication protocol. When you press the Command button, the commands sent and responses received will be displayed in a form. If no response is received, a timeout will occur.




```
'=========================================================
' Program name: Sample
'
' RS-485 communication program for M series
'
'============================== YOKOGAWA Electric Corporation ===
'
'Definition of public variables
Public fSend As Boolean           'Sending flag
Public strSend As String          'Character string sent
Public strBuf1 As String          'Character (1 byte) received
Public strReceive As String       'Character string received

'When the Command button is pressed,
Private Sub Command1_Click()

  strSend = "01010WRDD0002,01"    'Character string to be sent
                                 '[stx]01010WRDD0002,01[etx][cr]
```

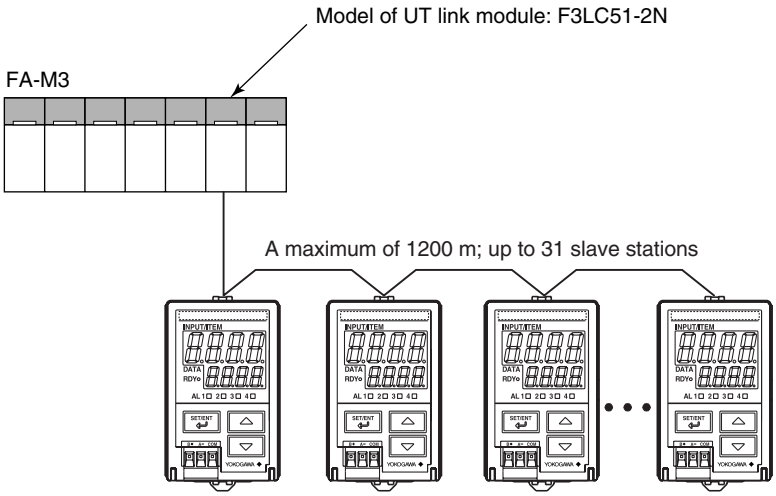
```
  Label1.Caption = "[stx]" + strSend + "[etx][cr]"
  Label2.Caption = ""

  MSComm1.PortOpen = True          'Open port
  Timer1.Enabled = True            'Start timer for detecting timeout
  Command1.Enabled = False         'Disable the Command button temporarily
  fSend = True                     'Set sending flag

  'Send
  MSComm1.Output = Chr(&H2) + strSend + Chr(&H3) + Chr(&HD)
                                   'Send with stx, etx, and cr added

  Do                               'Loop until sending flag becomes false
    If DoEvents() = 0 Then         '
    End If                         '
  Loop Until fSend = False         '

  Timer1.Enabled = False           'Stop Timer 1
  MSComm1.PortOpen = False         'Close port

  Label2.Caption = strReceive      'Display received character string in Label 2
  Command1.Enabled = True          'Enable the Command button

End Sub

--------------------------------------------------------------------------------

'At start of program
Private Sub Form_Load()

  Form1.Caption = "Communication Sample"

  'Set up timer for detecting timeout
  Timer1.Enabled = False
  Timer1.Interval = 2000
                                   'Regard as being 2 seconds
  'Initialize MSComm control
  MSComm1.CommPort = 1             'COM1
  MSComm1.InputLen = 1             'Size of receiving buffer
  MSComm1.InputMode = comInputModeText       'Receiving mode
  MSComm1.RThreshold = 1           'MSComm1_OnComm interrupt processing starts
                                   'each time 1 byte is received
  MSComm1.Settings = "9600,e,8,1" 'Communication conditions: 9600 bps; Parity,
                                   'even; Data length, 8 bits; Stop bit, 1 bit

  'Command button control
  Command1.Caption = "Send"
```

```
  'Initialize label control that displays character strings sent and received
  Label1.Caption = ""
  Label2.Caption = ""

End Sub

--------------------------------------------------------------------------------

'This processing starts each time 1 byte is received
Private Sub MSComm1_OnComm()
Dim strBuf0 As String

  Select Case MSComm1.CommEvent
    Case comEvReceive
      strBuf0 = MSComm1.Input     '
      Select Case strBuf0         'Case classification based on 1 byte received
      Case Chr(2)                 'When it is stx
        strBuf1 = "[stx]"
      Case Chr(3)                 'When it is etx
        strBuf1 = strBuf1 & "[etx]"
      Case Chr(13)                'When it is cr
        strBuf1 = strBuf1 & "[cr]"
        'This is provided as a measure against the fact that a command sent may
        'be seen as response depending on a combination with communication
        'converter.

        If strBuf1 = Label1.Caption Then
          strBuf1 = ""
        Else
          strReceive = strBuf1    'Completion of character string received
          fSend = False           'Receiving is regarded as being ended
        End If
      Case Else                   'When it is not stx, etx, or cr
        strBuf1 = strBuf1 & strBuf0
      End Select
  Case Else
  End Select

End Sub

--------------------------------------------------------------------------------

'Timeout
Private Sub Timer1_Timer()
```

```
    strReceive = "Time Out!"
    fSend = False                    'Receiving is regarded as being ended

End Sub
```

3.3.2 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

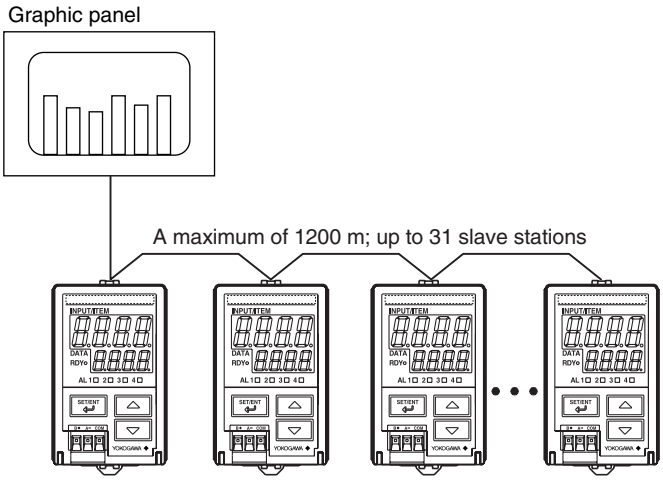
The devices mentioned here are D registers and I relays. For more information on D registers and I relays, see Chapters 6 and 7.

3. Command communication

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

3.3.3 Communication with Touch Panel

Communication with a touch panel is achieved using the PC link communication protocol. Set the communication conditions of the M Series identical to those of the touch panel.



For more information, refer to the user's manual of the touch panel to be connected.

	Model	Name	Remarks
Yokogawa	TOP75T	Touch operation panel (large)	10-inch TFT color LCD
	TOP72S	Touch operation panel (medium)	5-inch STN color LCD
Digital's Pro-face	GP70 Series	Graphic operation panel	(*1)
	GP-J Series	High-speed graphic operation panel	
	GP-230 Series	Medium-size graphic operation panel	
	GP-430 Series	High-speed, advanced graphic operation panels	
	GP-530 Series		

Note 1: For Digital's graphic panels, contact Digital Corp. directly.
Note 2: The system data area should be assigned to D0450.
*1: Display devices differ depending on the model.

4. Ladder Communication

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).

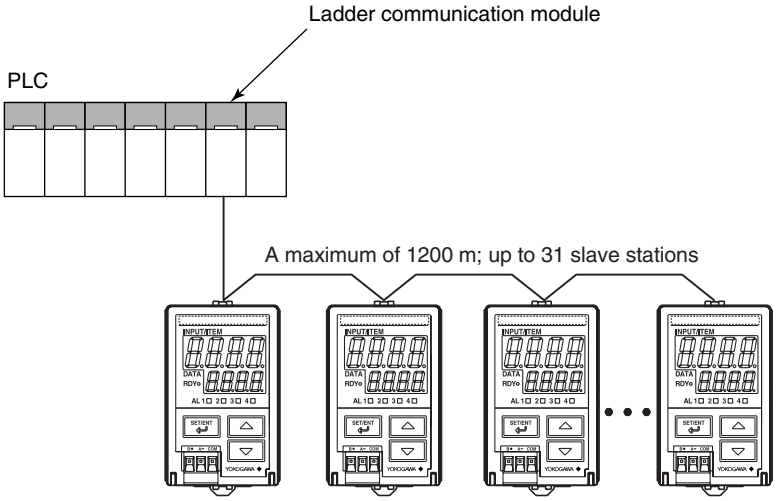


Figure 4-1 Example of Connection for Ladder Communication

● Connecting the M Series to a PLC of another company

When the M Series are connected to a PLC manufactured by Mitsubishi Electric (MELSEC-A 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 commands 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]

0101000300000<u>5000</u>D0A

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]

0101010100100200 0D0A

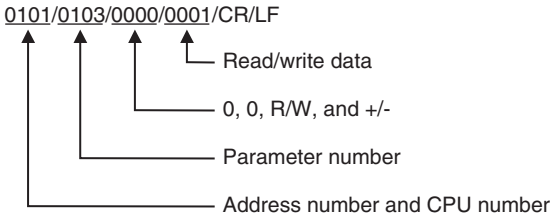
The alarm-1 setpoint 200 (BCD code) is returned with respect to the above command (20.0 is expressed as 200).

[Response]

0101010100100200 0D0A

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.



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

CAUTION

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.

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5. MODBUS Communication

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.

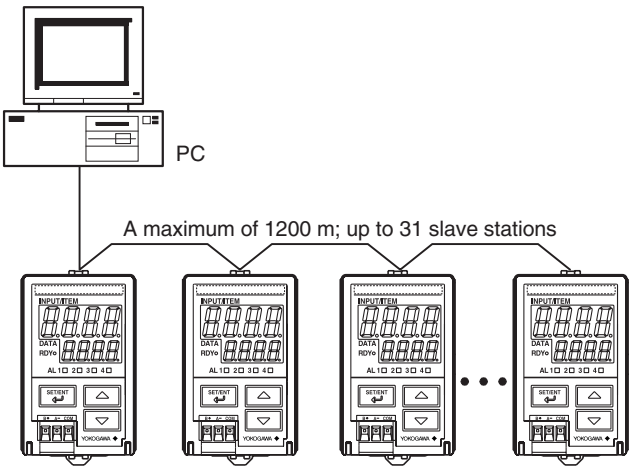


Figure 5-1 Example of Connection for MODBUS Communication

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.

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

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.

5.2 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]

: 02100064000306 00C8 000A 0003AC[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]

: 0210006400 0387[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

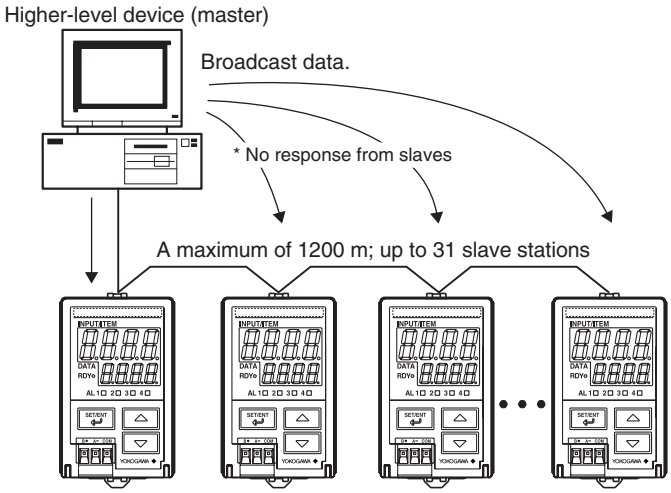
Broadcast addressing allows the corresponding multiple M Series to receive the command.

(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.

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6. Functions and Usage of D Registers

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 numbers 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

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 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
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: User area applies when a graphic panel manufactured by Digital Corp. is used.

: 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	Parameter error
11	
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

7. Functions and Usage of I Relays

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.

7.1 Status

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)

CAUTION

- 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	
10	EEP sum error
11	Parameter 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

Appendix Table of ASCII Codes (Alphanumeric Codes)

In order to implement PC link communication, create a transmission/receiving program by referring to the Table of ASCII Codes below.

b8	b7	b6	b5	b4	b3	b2	b1		0	1	2	3	4	5	6	7
				0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
				0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
				0	0	1	0	2	STX	DC2	“	2	B	R	b	r
				0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
				0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
				0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
				0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
				0	1	1	1	7	BEL	ETB	‘	7	G	W	g	w
				1	0	0	0	8	BS	CAN	(	8	H	X	h	x
				1	0	0	1	9	HT	EM	)	9	I	Y	i	y
				1	0	1	0	A	LF	SUB	*	:	J	Z	j	z
				1	0	1	1	B	VT	ESC	+	;	K	[	k	{
				1	1	0	0	C	FF	FS	,	<	L	\	l	|
				1	1	0	1	D	CR	GS	-	=	M	]	m	}
				1	1	1	0	E	SO	RS	.	>	N	•	n	~
				1	1	1	1	F	SI	US	/	?	O	_	o	DEL

Control code — Character code

Note: SP($20): space
DEL($7F): control code

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