

Programmable Controller

**MELSEC iQ-R**  
series

**MELSEC iQ-R MODBUS/TCP Reference Manual**

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# SAFETY PRECAUTIONS

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(Read these precautions before using this product.)

Before using MELSEC iQ-R series programmable controllers, please read the manuals for the product and the relevant manuals introduced in those manuals carefully, and pay full attention to safety to handle the product correctly.

Make sure that the end users read this manual and then keep the manual in a safe place for future reference.

## CONDITIONS OF USE FOR THE PRODUCT

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(1) Mitsubishi programmable controller ("the PRODUCT") shall be used in conditions;

i) where any problem, fault or failure occurring in the PRODUCT, if any, shall not lead to any major or serious accident; and

ii) where the backup and fail-safe function are systematically or automatically provided outside of the PRODUCT for the case of any problem, fault or failure occurring in the PRODUCT.

(2) The PRODUCT has been designed and manufactured for the purpose of being used in general industries.

MITSUBISHI SHALL HAVE NO RESPONSIBILITY OR LIABILITY (INCLUDING, BUT NOT LIMITED TO ANY AND ALL RESPONSIBILITY OR LIABILITY BASED ON CONTRACT, WARRANTY, TORT, PRODUCT LIABILITY) FOR ANY INJURY OR DEATH TO PERSONS OR LOSS OR DAMAGE TO PROPERTY CAUSED BY the PRODUCT THAT ARE OPERATED OR USED IN APPLICATION NOT INTENDED OR EXCLUDED BY INSTRUCTIONS, PRECAUTIONS, OR WARNING CONTAINED IN MITSUBISHI'S USER, INSTRUCTION AND/OR SAFETY MANUALS, TECHNICAL BULLETINS AND GUIDELINES FOR the PRODUCT.

("Prohibited Application")

Prohibited Applications include, but not limited to, the use of the PRODUCT in;

- Nuclear Power Plants and any other power plants operated by Power companies, and/or any other cases in which the public could be affected if any problem or fault occurs in the PRODUCT.
- Railway companies or Public service purposes, and/or any other cases in which establishment of a special quality assurance system is required by the Purchaser or End User.
- Aircraft or Aerospace, Medical applications, Train equipment, transport equipment such as Elevator and Escalator, Incineration and Fuel devices, Vehicles, Manned transportation, Equipment for Recreation and Amusement, and Safety devices, handling of Nuclear or Hazardous Materials or Chemicals, Mining and Drilling, and/or other applications where there is a significant risk of injury to the public or property.

Notwithstanding the above restrictions, Mitsubishi may in its sole discretion, authorize use of the PRODUCT in one or more of the Prohibited Applications, provided that the usage of the PRODUCT is limited only for the specific applications agreed to by Mitsubishi and provided further that no special quality assurance or fail-safe, redundant or other safety features which exceed the general specifications of the PRODUCTS are required. For details, please contact the Mitsubishi representative in your region.

# INTRODUCTION

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Thank you for purchasing the Mitsubishi Electric MELSEC iQ-R series programmable controllers.

This manual describes the frame specifications and MODBUS standard functions of MODBUS/TCP.

Before using this product, please read this manual and the relevant manuals carefully and develop familiarity with the functions and performance of the MELSEC iQ-R series programmable controller to handle the product correctly.

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# TERMS

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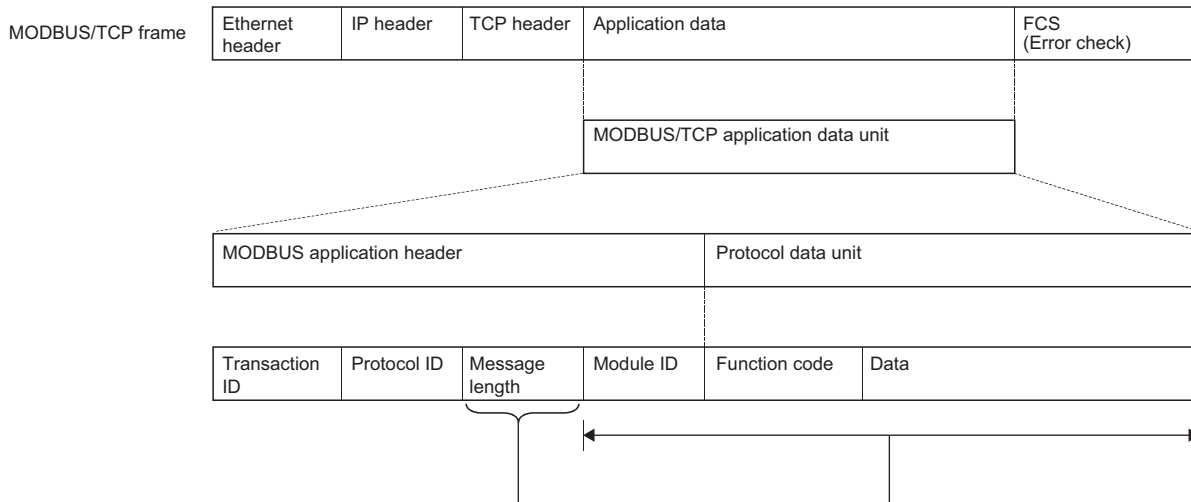
Unless otherwise specified, this manual uses the following terms.

Term	Description
FC	An abbreviation of function code
Master	A name for the side that requests function execution
MODBUS device	A device used in communications via the MODBUS protocol
Request message	A message that requests function execution to slaves. In the MODBUS protocol, the master requests function execution to the slaves.
Response message	A message that returns execution results of functions from a slave to the master
SC	An abbreviation of sub code
Slave	A name for the side that processes execution requests from the master and returns the execution results
Slave function	A function that communicates with the MODBUS-compliant master device as the MODBUS slave

# 1 MODBUS/TCP PROTOCOL FRAME SPECIFICATIONS

## 1.1 Frame Specifications

This section describes the frame specifications of the MODBUS/TCP protocol.



Area name		Area size	Description
MODBUS application header	Communication ID	2 bytes	Used by the master to match response messages from slaves.
	Protocol ID	2 bytes	Indicates the protocol of the protocol data unit. For MODBUS/TCP, 0 is stored.
	Message length	2 bytes	Stores the message size in bytes. The stored message length indicates the length of the message in areas subsequent to this area.
	Module ID	1 byte	Used when specifying slaves connected to other lines, such as with the MODBUS Serial protocol.
Protocol data unit	Function code	1 byte	Specifies the content of the processing instructed from the master to a slave.
	Data	1 to 252 bytes	<ul style="list-style-type: none"> <li>■When request message is sent from the master to a slave Stores the request content of the processing.</li> <li>■When response message is sent from a slave to the master Stores the execution result of the processing.</li> </ul>

# 1.2 Protocol Data Unit Formats Grouped by Function

This section describes the protocol data unit formats of the MODBUS standard functions.

## When the device number is specified within the message

When specifying the device number within the message, specify "device number - 1".

However, this instruction is not applicable to the file number and the device number specified for reading or writing extended file register.

**Ex.**

When the status of input 32 (100032) is read by input reading (function code: 02H)

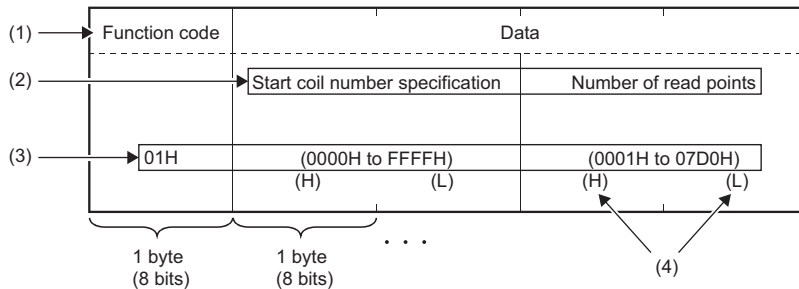
Function code	Data	
	Start input number specification	Number of read points
02H	001FH (1) (H) (L)	0001H (H) (L)

(1) When reading the status of input 32 (100032), specify 31 (001FH) for the start input number.

The device number stored in the response message is "the device number of the device that actually performed reading/writing - 1".

## Descriptions of request message and response message formats

This section describes descriptions of the request message and response message formats of the MODBUS standard functions.



(1) Area name

(2) Frame description

(3) For request message format: Setting range

For response message format: Value stored in the response message

(4) When one piece of data consists of two bytes, the upper byte (eight bits) is (H) and the lower byte (eight bits) is (L).

### Response message format

The format of the response message sent from a slave to the master varies depending on whether the processing performed by the slave completed successfully or completed with an error.

In the MODBUS standard function, the formats when completed successfully and completed with an error are described in the response message format.

## Storage locations of abnormal response code and error code

When processing on a slave is completed with an error, an abnormal response code is sent to the master.

For details on abnormal response codes, refer to the following.

☞ Page 21 ABNORMAL RESPONSE CODES

Abnormal response codes are also stored in the buffer memory of Ethernet-equipped modules.

The detailed cause is detected as an error by Ethernet-equipped modules.

For details on the buffer memory and errors of Ethernet-equipped modules, refer to the following.

📖 MELSEC iQ-R Ethernet User's Manual (Application)



# 2 MODBUS STANDARD FUNCTIONS

This chapter describes the MODBUS standard functions supported by Ethernet-equipped modules.

## 2.1 MODBUS Standard Function List

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This section lists the MODBUS standard functions.

Function code (FC)	Sub code (SC)	Function name	Reference
01H	—	Coil reading	Page 8 Coil reading (FC: 01H)
02H	—	Input reading	Page 9 Input reading (FC: 02H)
03H	—	Holding register reading	Page 10 Holding register reading (FC: 03H)
04H	—	Input register reading	Page 11 Input register reading (FC: 04H)
05H	—	One coil writing	Page 12 One coil writing (FC: 05H)
06H	—	One register writing	Page 13 One register writing (FC: 06H)
0FH	—	Multiple coil writing	Page 14 Multiple coil writing (FC: 0FH)
10H	—	Multiple register writing	Page 15 Multiple register writing (FC: 10H)
14H	06H	Extended file register reading	Page 16 Extended file register reading (FC: 14H) (SC: 06H)
15H	06H	Extended file register writing	Page 18 Extended file register writing (FC: 15H) (SC: 06H)
16H	—	Holding register mask writing	Page 19 Holding register mask writing (FC: 16H)
17H	—	Multiple register reading/writing	Page 20 Multiple register reading/writing (FC: 17H)

## 2.2 MODBUS Standard Function Details

### Coil reading (FC: 01H)

#### Operation description

Reads the status (ON/OFF) of one or multiple coils.

#### Request message format (from master to slave)

Function code	Data	
01H	Start coil number specification (0000H to FFFFH) (H) (L)	Number of read points (0001H to 07D0H) (H) (L)

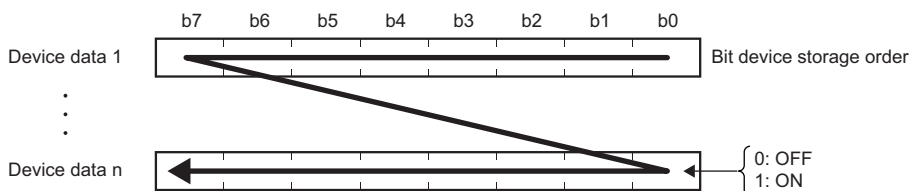
#### Response message format (from slave to master)

##### ■When completed successfully

Function code	Data		
01H	Number of read bytes n	Device data 1	Device data n

Number of read bytes n

##### • Device data 1 to n



- The read coil status is stored in the order of lower bit → higher bit.
- If the number of read points is not a multiple of eight, the remaining bits are all set to 0.

##### ■When completed with an error

Function code	Data
81H	Exception code

# Input reading (FC: 02H)

## Operation description

Reads the status (ON/OFF) of one or multiple inputs.

## Request message format (from master to slave)

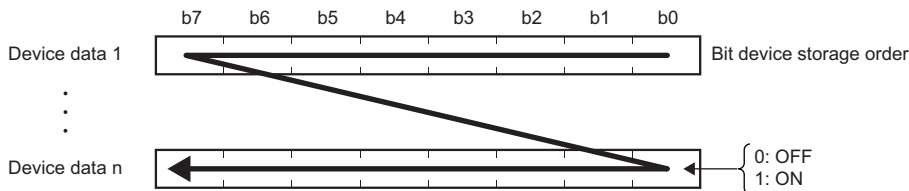
Function code	Data	
02H	Start input number specification	Number of read points
	(0000H to FFFFH) (H) (L)	(0001H to 07D0H) (H) (L)

## Response message format (from slave to master)

### ■When completed successfully

Function code	Data			
02H	Number of read bytes n	Device data 1	...	Device data n
	Number of read bytes n			

#### • Device data 1 to n



- The read input status is stored in the order of lower bit → higher bit.
- If the number of read points is not a multiple of eight, the remaining bits are all set to 0.

### ■When completed with an error

Function code	Data
82H	Exception code

# Holding register reading (FC: 03H)

## Operation description

Reads one or multiple holding register values.

## Request message format (from master to slave)

Function code	Data	
03H	Start holding register number specification	Number of read points
	(0000H to FFFFH) (H) (L)	(0001H to 007DH) (H) (L)

## Response message format (from slave to master)

### ■When completed successfully

Function code	Data			
03H	Number of read bytes n×2	Device data 1	...	Device data n
		(H) (L)		(H) (L)

• For example, when n = 4, the number of read bytes is  $4 \times 2 = 8$ .

### ■When completed with an error

Function code	Data
83H	Exception code

# Input register reading (FC: 04H)

## Operation description

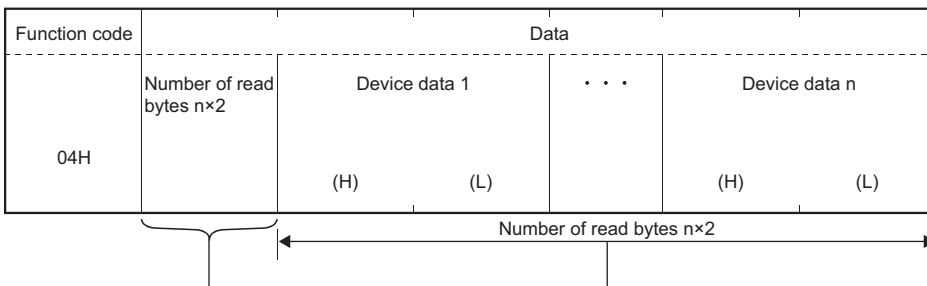
Reads one or multiple input register values.

## Request message format (from master to slave)

Function code	Data	
04H	Start input register number specification	Number of read points
	(0000H to FFFFH) (H) (L)	(0001H to 007DH) (H) (L)

## Response message format (from slave to master)

### When completed successfully



• For example, when n = 4, the number of read bytes is 4 × 2 = 8.

### When completed with an error

Function code	Data
84H	Exception code

## One coil writing (FC: 05H)

### Operation description

Writes a value (ON/OFF) to one coil.

### Request message format (from master to slave)

Function code	Data	
05H	Coil number specification	ON/OFF specification
	(0000H to FFFFH) (H) (L)	$\left\{ \begin{array}{l} \text{FF00H: ON} \\ \text{0000H: OFF} \end{array} \right\}$ (H) (L)

### Response message format (from slave to master)

#### ■When completed successfully

The slave returns the request message received from the master as-is.

#### ■When completed with an error

Function code	Data
85H	Exception code

# One register writing (FC: 06H)

## Operation description

Writes a value to one holding register area.

## Request message format (from master to slave)

Function code	Data	
06H	Holding register number specification	Write data
	(0000H to FFFFH) (H) (L)	(0000H to FFFFH) (H) (L)

## Response message format (from slave to master)

### ■When completed successfully

The slave returns the request message received from the master as-is.

### ■When completed with an error

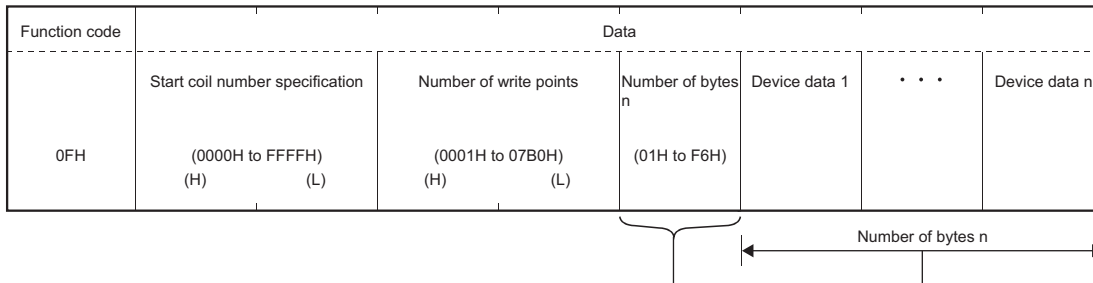
Function code	Data
86H	Exception code

# Multiple coil writing (FC: 0FH)

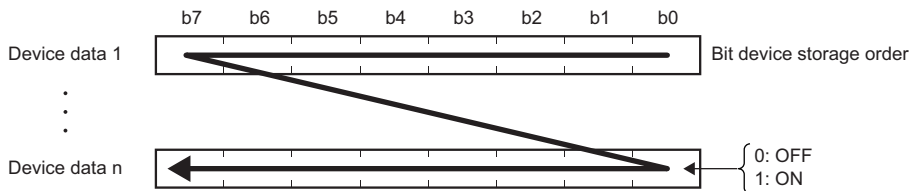
## Operation description

Writes values (ON/OFF) to multiple coils.

## Request message format (from master to slave)



- Device data 1 to n



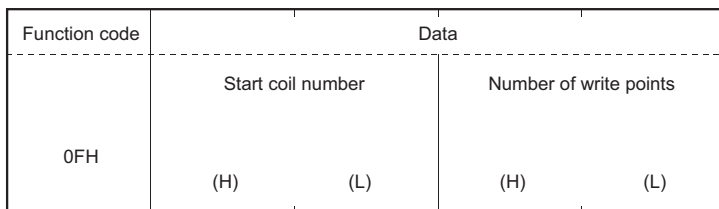
- The values (ON/OFF) stored in device data 1 to n are written to the coils in the order of lower bit → higher bit of the device data.

### Point

Ensure that the specified number of write points matches the number of bits specified with the number of bytes.  
For example, when the specified number of write points is 16, set the number of bytes to 2 bytes (= 16 bits).

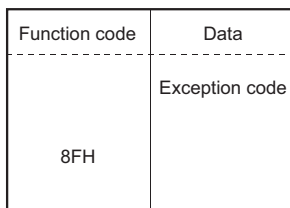
## Response message format (from slave to master)

### When completed successfully



- Start coil number: Stores the same value as the start coil number of the request message.
- Number of write points: Stores the same value as the number of write points of the request message.

### When completed with an error



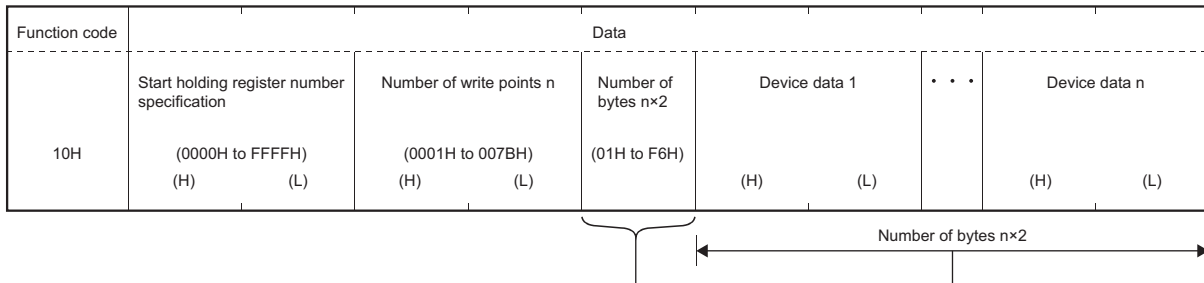


# Multiple register writing (FC: 10H)

## Operation description

Writes values to multiple holding register areas.

## Request message format (from master to slave)



**Point**

Ensure that the specified number of write points matches the number of bits specified with the number of bytes.

## Response message format (from slave to master)

### ■When completed successfully

Function code	Data			
10H	Start holding register number		Number of write points	
	(H) (L)	(H) (L)	(H) (L)	(H) (L)

- Start holding register number: Stores the same value as the start holding register number of the request message.
- Number of write points: Stores the same value as the number of write points of the request message.

### ■When completed with an error

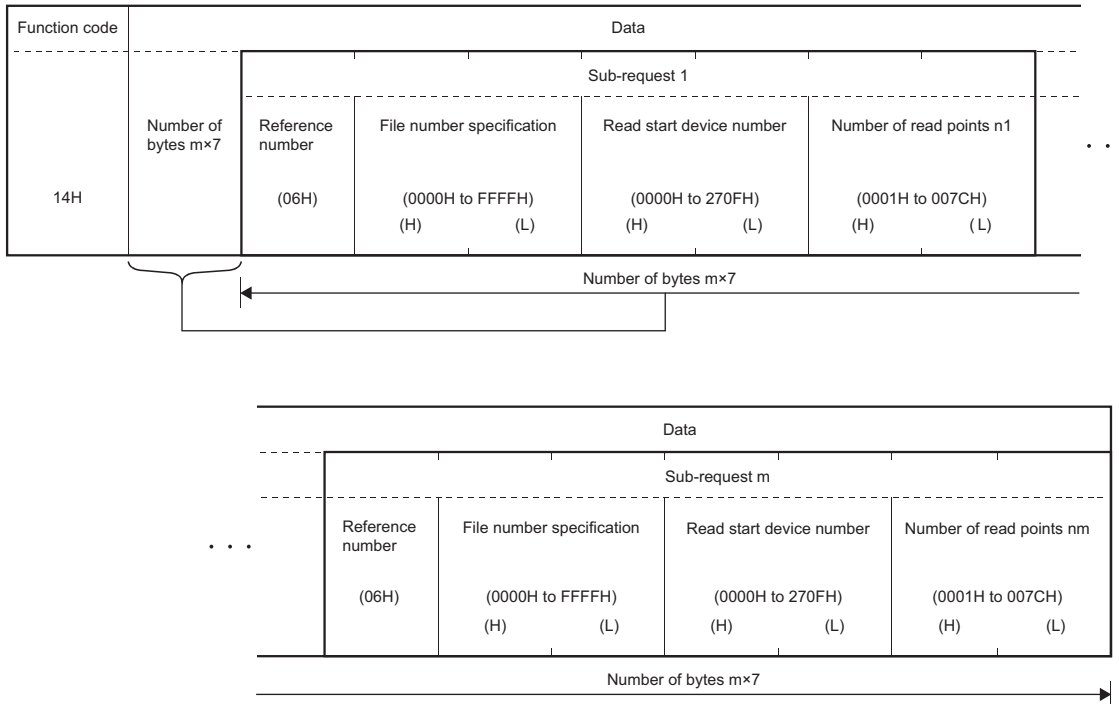
Function code	Data
90H	Exception code

# Extended file register reading (FC: 14H) (SC: 06H)

## Operation description

Reads the values of multiple extended file register areas.

## Request message format (from master to slave)



- File number specification: The upper limit of the file numbers that can be received by an Ethernet-equipped module is the file register size of the mounted CPU module.

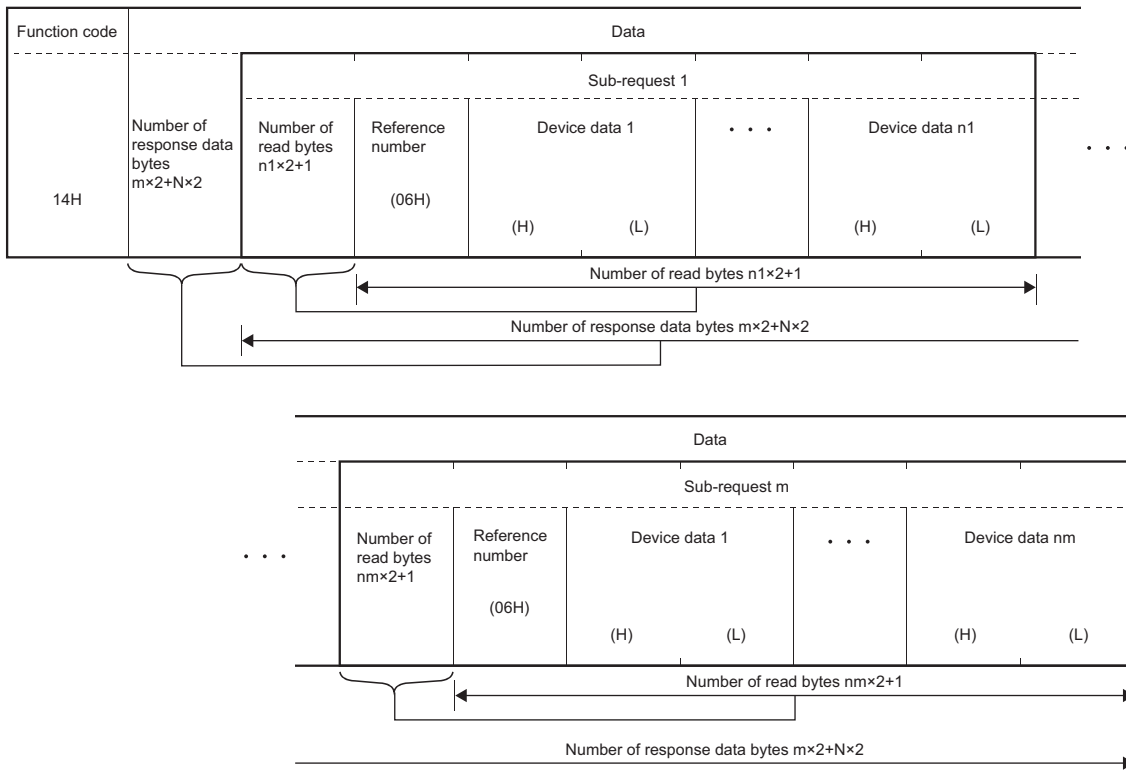
### Point

- Specify the number of sub requests, m, so that the size of the protocol data unit of the request message does not exceed 253 bytes. The request message will be discarded if the following condition is not met.  
[Conditional formula]  $253 \geq 2 + (m \times 7)$
- Specify the total number of read points of each sub request, N ( $n1 + \dots + nm$ ), so that the size of the protocol data unit of the response message does not exceed 253 bytes. The slave will return an abnormal response if the following condition is not met.  
[Conditional formula]  $253 \geq 2 + (m \times 2) + (N \times 2)$

## Response message format (from slave to master)

### ■ When completed successfully

N shown below is the total of the device data ( $n_1 + \dots + n_m$ ).



### ■ When completed with an error

Function code	Data
94H	Exception code

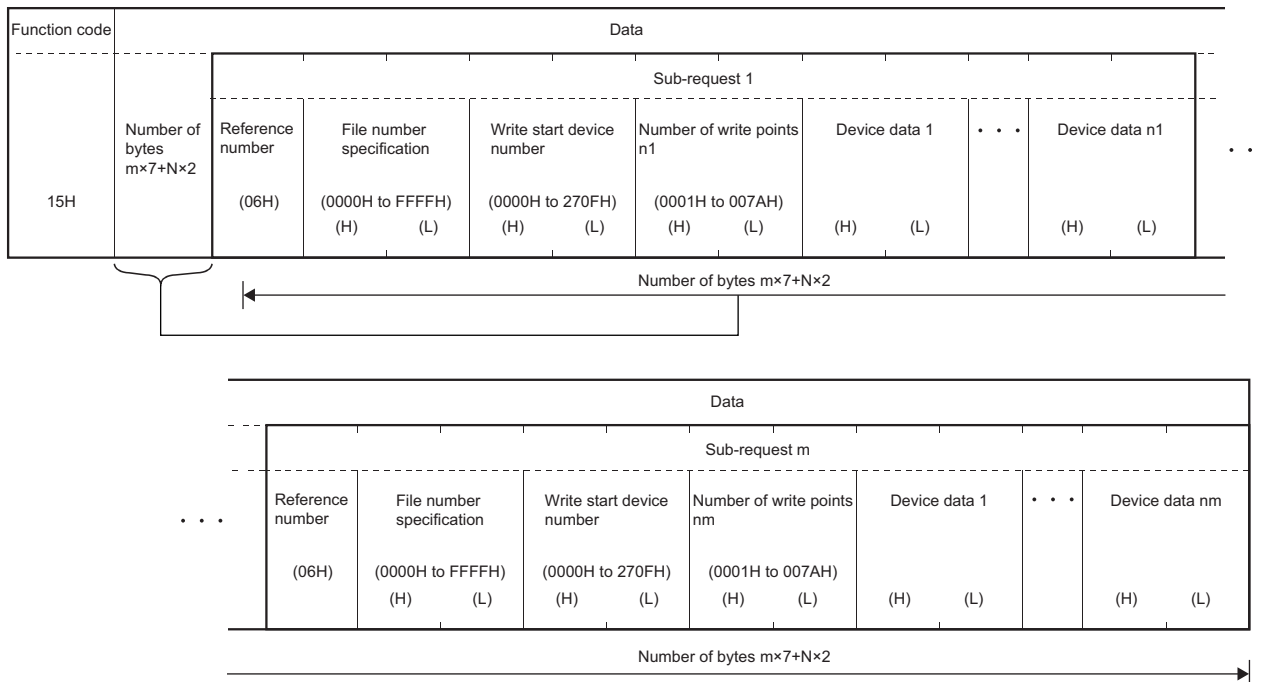
# Extended file register writing (FC: 15H) (SC: 06H)

## Operation description

Writes a value to one extended file register area or values to multiple extended file register areas.

## Request message format (from master to slave)

N shown below is the total of the device data ( $n1 + \dots + nm$ ).



- File number specification: The upper limit of the file numbers that can be received by an Ethernet-equipped module is the file register size of the mounted CPU module.

### Point

Specify the number of sub requests,  $m$ , and the total number of write points of each sub request,  $N$  ( $n1 + \dots + nm$ ), so that the size of the protocol data unit of the request message does not exceed 253 bytes. The request message will be discarded if the following condition is not met.

$$[Conditional\ formula] \quad 253 \geq 2 + (m \times 7) + (N \times 2)$$

## Response message format (from slave to master)

### ■When completed successfully

The slave returns the request message received from the master as-is.

### ■When completed with an error

Function code	Data
95H	Exception code

## Holding register mask writing (FC: 16H)

### Operation description

Writes the masked value obtained by performing AND and OR operations on the value stored in one holding register area. The value is written to the holding register as shown below.

Write value = (current value of target register  $\wedge$  AND mask value)  $\vee$  (OR mask value  $\wedge$  AND mask value)

If the OR mask value is 0000H, only the AND processing of the AND mask value will be performed.

If the AND mask value is 0000H, the OR mask value will be the write value.

### Request message format (from master to slave)

Function code	Data		
16H	Target holding register number (0000H to FFFFH) (H) (L)	AND mask value (0000H to FFFFH) (H) (L)	OR mask value (0000H to FFFFH) (H) (L)

### Response message format (from slave to master)

#### ■When completed successfully

The slave returns the request message received from the master as-is.

#### ■When completed with an error

Function code	Data
96H	Exception code

#### Point

With this function, the value stored in the holding register is read from the slave, the AND/OR processing is performed on the master, and then the mask value is written to the holding register on the slave. Therefore, if the holding register value is changed during AND/OR processing, the changed value will be overwritten.

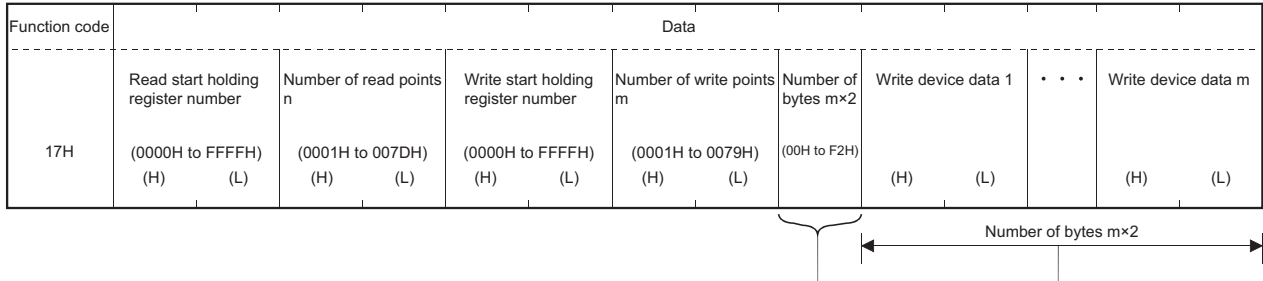
# Multiple register reading/writing (FC: 17H)

## Operation description

Reads/writes data from/to multiple holding register areas.

During the processing, writing is performed first, followed by reading.

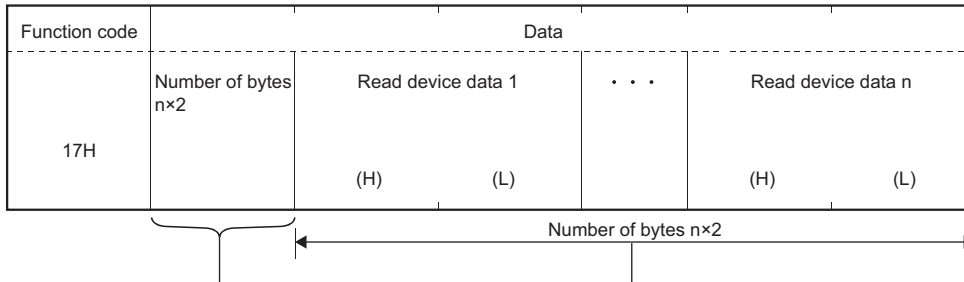
## Request message format (from master to slave)



Ensure that the specified number of write points matches the number of bits specified with the number of bytes.

## Response message format (from slave to master)

### ■When completed successfully



### ■When completed with an error

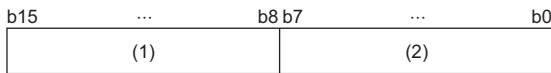
Function code	Data
97H	Exception code

# 3 ABNORMAL RESPONSE CODES

Abnormal response codes are error codes that are common to the MODBUS protocol and are stored in the response message when a slave returns an abnormal response for the request message from the master.

When the master receives an abnormal response code from a slave, perform actions according to the description in this chapter.

The response message format when processing completed with an error is shown below.



(1) Abnormal response function code

(2) Abnormal response code

## Abnormal response function code list

This section lists the abnormal response function codes that are stored in the upper byte of the response message format.

Abnormal response function code	Function name	Details
81H	Coil reading	Coil reading completed with an error.
82H	Input reading	Input reading completed with an error.
83H	Holding register reading	Holding register reading completed with an error.
84H	Input register reading	Input register reading completed with an error.
85H	One coil writing	Coil writing completed with an error.
86H	One register writing	Holding register writing completed with an error.
8FH	Multiple coil writing	Multiple coil writing completed with an error.
90H	Multiple register writing	Holding register writing completed with an error at multiple points.
94H	Extended file register reading	Extended file register reading completed with an error.
95H	Extended file register writing	Extended file register writing completed with an error.
96H	Holding register mask writing	Holding register mask writing completed with an error.
97H	Multiple register reading/writing	Register reading/writing completed with an error at multiple points.

## Abnormal response code list

This section lists the abnormal response codes that are stored in the lower byte of the response message format.

Abnormal response code	Error name	Error definition and cause	Action
01H	Function code error	The slave received an unsupported function code.	Check the function codes that are supported by the slave, and then check the request message sent from the master.
02H	Device address error	The specified MODBUS device address is incorrect.	Check the types and sizes of the MODBUS devices that are supported by the slave, and then check the address specification of the request message sent from the master.
03H	Data error	The content of the protocol data unit of the request message is abnormal.	Revise the data unit of the request message sent from the master.
04H	Processing failure	Processing was not possible because of an error that occurred during request message processing on the slave.	Eliminate the error factor that has occurred on the slave. If an Ethernet-equipped module is issuing this code, use the module diagnostics or a similar method to identify the problem from the error that is occurring, and then perform the appropriate actions.
06H	Slave busy	The slave cannot execute the processing of the request message because it is executing other processing.	Retry at a later time. If an Ethernet-equipped module is issuing this code, revise the settings so that the number of request messages that can be received at the same time is 64 or less.





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# MEMO

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# REVISIONS

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\*The manual number is given on the bottom left of the back cover.

Print date	*Manual number	Revision
October 2018	BCN-P5999-1060-A	First edition

Japanese manual number: BCN-P5999-1059-A

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# WARRANTY

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Please confirm the following product warranty details before using this product.

## **1. Gratis Warranty Term and Gratis Warranty Range**

If any faults or defects (hereinafter "Failure") found to be the responsibility of Mitsubishi occurs during use of the product within the gratis warranty term, the product shall be repaired at no cost via the sales representative or Mitsubishi Service Company.

However, if repairs are required onsite at domestic or overseas location, expenses to send an engineer will be solely at the customer's discretion. Mitsubishi shall not be held responsible for any re-commissioning, maintenance, or testing on-site that involves replacement of the failed module.

[Gratis Warranty Term]

The gratis warranty term of the product shall be for one year after the date of purchase or delivery to a designated place. Note that after manufacture and shipment from Mitsubishi, the maximum distribution period shall be six (6) months, and the longest gratis warranty term after manufacturing shall be eighteen (18) months. The gratis warranty term of repair parts shall not exceed the gratis warranty term before repairs.

[Gratis Warranty Range]

- (1) The range shall be limited to normal use within the usage state, usage methods and usage environment, etc., which follow the conditions and precautions, etc., given in the instruction manual, user's manual and caution labels on the product.
- (2) Even within the gratis warranty term, repairs shall be charged for in the following cases.
  1. Failure occurring from inappropriate storage or handling, carelessness or negligence by the user. Failure caused by the user's hardware or software design.
  2. Failure caused by unapproved modifications, etc., to the product by the user.
  3. When the Mitsubishi product is assembled into a user's device, Failure that could have been avoided if functions or structures, judged as necessary in the legal safety measures the user's device is subject to or as necessary by industry standards, had been provided.
  4. Failure that could have been avoided if consumable parts (battery, backlight, fuse, etc.) designated in the instruction manual had been correctly serviced or replaced.
  5. Failure caused by external irresistible forces such as fires or abnormal voltages, and Failure caused by force majeure such as earthquakes, lightning, wind and water damage.
  6. Failure caused by reasons unpredictable by scientific technology standards at time of shipment from Mitsubishi.
  7. Any other failure found not to be the responsibility of Mitsubishi or that admitted not to be so by the user.

## **2. Onerous repair term after discontinuation of production**

- (1) Mitsubishi shall accept onerous product repairs for seven (7) years after production of the product is discontinued. Discontinuation of production shall be notified with Mitsubishi Technical Bulletins, etc.
- (2) Product supply (including repair parts) is not available after production is discontinued.

## **3. Overseas service**

Overseas, repairs shall be accepted by Mitsubishi's local overseas FA Center. Note that the repair conditions at each FA Center may differ.

## **4. Exclusion of loss in opportunity and secondary loss from warranty liability**

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:

- (1) Damages caused by any cause found not to be the responsibility of Mitsubishi.
- (2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.
- (3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.
- (4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

## **5. Changes in product specifications**

The specifications given in the catalogs, manuals or technical documents are subject to change without prior notice.

# TRADEMARKS

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The company names, system names and product names mentioned in this manual are either registered trademarks or trademarks of their respective companies.

In some cases, trademark symbols such as <sup>™</sup> or <sup>®</sup> are not specified in this manual.



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Specifications subject to change without notice.