User's Manual

FA-M3V VITESSE™

Modbus Interface Module

IM 34M06H42-01E

Applicable Modules:

Model Code	Model Name
F3LC31-2F	Modbus Interface Module

YOKOGAWA
Yokogawa Electric Corporation

IM 34M06H42-01E
1st Edition

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Applicable Product

- **Range-free Controller FA-M3**

  - Model : F3LC31-2F
  - Name : Modbus Interface Module

The document number for this manual is given below.

Refer to the document number in all communications, including when purchasing additional copies of this manual.

- Document No.: IM 34M06H42-01E

Precautions

■ About This Manual

- This Manual should be passed on to the end user.
- This manual is an essential part of the product; keep it in a safe place for future reference.
- This product is designed to be used by a person with specialized knowledge.
- Before using the product, read this manual thoroughly to have a clear understanding of the product.
- This manual explains the functions of this product, but there is no guarantee that they will suit the particular purpose of the user.
- Under absolutely no circumstances may the contents of this manual be transcribed or copied, in part or in whole, without permission.
- The contents of this manual are subject to change without prior notice.
- Every effort has been made to ensure accuracy in the preparation of this manual. However, should any errors or omissions come to the attention of the user, please contact the nearest Yokogawa Electric representative or sales office.

■ Safety Symbols

- **”Handle with care.”** This symbol on the product indicates that the operator must follow the instructions laid out in this user's manual to avoid the risk of personnel injuries, fatalities, or damage to the instrument.

- **Protective Conductor Terminal**

  This terminal is to prevent electric shock. Before using the instrument, connect to the Protective earth (Comply with the regulation of each country.), and route the line through the shortest path possible.

- **Functional Earth Terminal**

  This terminal is for stable operation. Before using the instrument, be sure to ground this terminal.

- **Alternating current.** Indicates alternating current.

- **Direct current.** Indicates direct current.

The following symbols are used only in the user's manual.

WARNING

- Draws attention to information essential to prevent electrical shock or other dangers that may result in injury or the loss of life.

CAUTION

- Draws attention to information essential to prevent hardware damage, software damage or system failure.

NOTE

- Draws attention to information essential to the understanding of operation and functions.

■ Safety Precautions when Using/Maintaining the Product

- For the protection and safe use of the product and the system controlled by it, be sure to follow the instructions and precautions on safety stated in this manual whenever handling the product. Take special note that if you handle the product in a manner other than prescribed in these instructions, the protection feature of the product may be damaged or impaired. In such cases, Yokogawa cannot guarantee the quality, performance, function and safety of the product.
- When installing protection and/or safety circuits such as lightning protection devices and equipment for the product and control system as well as designing or installing separate protection and/or safety circuits for fool-proof design and fail-safe design of processes and lines using the product and the system controlled by it, the user should implement it using devices and equipment, additional to this product.
- If component parts or consumable are to be replaced, be sure to use parts specified by the company.
- This product is not designed or manufactured to be used in critical applications which directly affect or threaten human lives and safety — such as nuclear power equipment, devices using radioactivity, railway facilities, aviation equipment, shipboard equipment, aviation facilities or medical equipment. If so used, it is the user's responsibility to include in the system additional equipment and devices that ensure personnel safety.
- Do not attempt to modify the product.
- To avoid electrical shock, turn off the power before wiring.
- This product is classified as Class A for use in industrial environments. If used in a residential environment, it may cause electromagnetic interference (EMI).

  In such situations, it is the user's responsibility to adopt the necessary measures against EMI.

■ Exemption from Responsibility

- Yokogawa Electric Corporation (hereinafter simply referred to as Yokogawa Electric) makes no warranties regarding the product except those stated in the WARRANTY that is provided separately.
- Yokogawa Electric 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.

■ Software Supplied by the Company

- Yokogawa Electric makes no other warranties expressed or implied except as provided in its warranty clause for software supplied by the company.
- Use the software with one computer only. You must purchase another copy of the software for use with each additional computer.
- Copying the software for any purposes other than backup is strictly prohibited.
- Store the original media that contain the software in a safe place.
- Reverse engineering, such as decompiling of the software, is strictly prohibited.
- Under absolutely no circumstances may the software supplied by Yokogawa Electric be transferred, exchanged, or sublet or leased, in part or as a whole, for use by any third party without prior permission by Yokogawa Electric.

■ General Requirements for Using the FA-M3 / e-RT3 Controller

● Set the product in a location that fulfills the following requirements:

- INDOOR USE ONLY
- This product is an open equipment. The product must be installed in a metallic panel enclosure with an impact rating IK08 or more.
- Where the product will not be exposed to direct sunlight, and where the operating surrounding air temperature is from 0°C to 55°C (32°F to 131°F).

  There are modules that must be used in an environment where the operating surrounding air temperature is in a range smaller than 0°C to 55°C (32°F to 131°F). Refer to “Hardware Manual” (IM 34M06C11-01E) or the applicable user's manual. In case of attaching such a module, the entire system's operating surrounding air temperature is limited to the module's individual operating surrounding air temperature.
- Where the relative humidity is from 10 to 90%.

  In places where there is a chance of condensation, use a space heater or the like to constantly keep the product warm and prevent condensation.
- For use in Pollution Degree 2 Environment.
- Where there are no corrosive or flammable gases.
- Where the product will not be exposed to mechanical vibration or shock that exceed specifications.
- Where there is no chance the product may be exposed to radioactivity.

● Use the correct types of wire for external wiring:

- USE COPPER CONDUCTORS ONLY.
- Use conductors with temperature rating above 75°C.

● Securely tighten screws:

- Securely tighten module mounting screws and terminal screws to avoid problems such as faulty operation.
- Tighten terminal block screws with the correct tightening torque as given in this manual. Refer to the “Hardware Manual” (IM 34M06C11-01E) or the applicable user's manual for the appropriate tightening torque.

● Securely lock connecting cables:

- Securely lock the connectors of cables, and check them thoroughly before turning on the power.

● Interlock with emergency-stop circuitry using external relays:

- Equipment incorporating the FA-M3 / e-RT3 controller must be furnished with emergency-stop circuitry that uses external relays. This circuitry should be set up to interlock correctly with controller status (stop/run).

● Ground for low impedance:

- For safety reasons, connect the [FG] grounding terminal to a protective earth (Comply with the regulation of each country.). For compliance to CE Marking, use braided or other wires that can ensure low impedance even at high frequencies for grounding.

- **Configure and route cables with noise control considerations:**
  - Perform installation and wiring that segregates system parts that may likely become noise sources and system parts that are susceptible to noise. Segregation can be achieved by measures such as segregating by distance, installing a filter or segregating the grounding system.

- **Configure for CE Marking Conformance:**
  - For compliance to CE Marking, perform installation and cable routing according to the description on compliance to CE Marking in the “Hardware Manual” (IM 34M06C11-01E).
  - The list of CE conforming models is available in Appendix A2. of “Hardware Manual”.

- **Keep spare parts on hand:**
  - We recommend that you stock up on maintenance parts, including spare modules, in advance.
  - Preventive maintenance (replacement of the module) is required for using the module beyond 10 years.

- **Discharge static electricity before touching the system:**
  - Because static charge can accumulate in dry conditions, first touch grounded metal to discharge any static electricity before touching the system.

- **Wipe off dirt with a soft cloth:**
  - Gently wipe off dirt on the product's surfaces with a soft cloth.
  - If you soak the cloth in water or a neutral detergent, tightly wring it out before wiping the product. Letting water enter the module interior can cause malfunctions.
  - Do not use volatile solvents such as benzine or paint thinner or chemicals for cleaning, as they may cause deformity, discoloration, or malfunctioning.

- **Avoid storing the FA-M3 /e-RT3 controller in places with high temperature or humidity:**
  - Since the CPU module has a built-in battery, avoid storage in places with high temperature or humidity.
  - Since the service life of the battery is drastically reduced by exposure to high temperatures, take special care (storage surrounding air temperature should be from -20°C to 75°C).
  - There is a built-in lithium battery in a Sequence CPU module which serves as backup power supply for programs, device information and configuration information.

    The service life of this battery is more than 10 years in standby mode at room temperature. Take note that the service life of the battery may be shortened when installed or stored at locations of extreme low or high temperatures. Therefore, we recommend that modules with built-in batteries be stored at room temperature.

- **Always turn off the power before installing or removing modules:**
  - Failing to turn off the power supply when installing or removing modules, may result in damage.

- **Do not touch components in the module:**
  - In some modules you can remove the right-side cover and install ROM packs or change switch settings. While doing this, do not touch any components on the printed-circuit board, otherwise components may be damaged and modules may fail to work.

- **Do not use unused terminals:**
  - Do not connect wires to unused terminals on a terminal block or in a connector. Doing so may adversely affect the functions of the module.
- **Use the following power source:**
  - Use only F3PU□□-□□ as the power supply module.
  - If using this product as a UL-approved product, for the external power supply, use a limited voltage / current circuit power source or a Class 2 power source.
  - If using this product as a CE-complied product, for the external power supply, use a SELV and limited-energy circuit separated by reinforced insulation or double insulation from hazardous voltage.
- **Refer to the user's manual before connecting wires:**
  - Refer to the “Hardware Manual” (IM 34M06C11-01E) or the applicable user’s manual for the external wiring drawing.
  - Refer to “A3.6.5 Connecting Output Devices” in the “Hardware Manual” before connecting the wiring for the output signal.
  - Refer to “A3.5.4 Grounding Procedure” in the “Hardware Manual” for attaching the grounding wiring.
- **Authorized Representative:**
  - The Authorized Representative for this product in the EEA is:

    Yokogawa Europe B. V.

    Euroweg 2, 3825 HD Amersfoort, The Netherlands

■ General Requirements for Using the FA-M3 Slave Units (TAH Series)

● Connect YHLS cable to SHIELD terminal:

- Connect the DRAIN line of the YHLS cable to the SHIELD terminal of the YHLS master module securely. Failing to do so may affect the performance of the YHLS system.

● Do not touch components in the unit:

- Do not remove the back cover of the unit. Doing so may cause a failure.

■ Waste Electrical and Electronic Equipment

Waste Electrical and Electronic Equipment (WEEE), Directive
(This directive is only valid in the EU.)

This product complies with the WEEE Directive marking requirement.
The marking indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category

With reference to the equipment types in the WEEE directive, this product is classified as a “Monitoring and Control instruments”.

When disposing of products in the EU, contact your local Yokogawa Europe B. V. office.

Do not dispose of this product in domestic household waste.

■ How to dispose the batteries

This is an explanation about the new EU Battery Directive. This directive is only valid in the EU.

Batteries are included in some modules of this product. The procedure is different when the user can remove or cannot remove.

①Batteries the user can remove

The battery of F3RP6☐ and F3RP7☐ can be removed by yourself.
When you remove the battery from F3RP6☐ and F3RP7☐ and dispose it, discard them in accordance with domestic law concerning disposal. See the User's Manual of F3RP6☐ and F3RP7☐ for the removal procedure. Take a right action on waste batteries, because the collection system in the EU on waste batteries are regulated. If you don't remove the battery from this product, please see ②.

②Batteries the user cannot remove

Dispose the battery together with this product.
When you dispose this product in the EU, contact your local Yokogawa Europe B.V.office.
Do not dispose them as domestic household waste.

Battery category: Lithium battery

Note: With reference to Annex II of the new EU Battery Directive, the above symbol indicates obligatory separate collection.

Introduction

■ Overview of the Manual

This is the user's manual of the Modbus Interface Module for the range-free controller “FA-M3”.

■ Other User’s Manuals

The manual(s) to be read depends on the CPU module to be used. You should read the latest versions of the following manuals, as required.

- **For F3SP71, F3SP76 functions:**
  - Sequence CPU Instruction Manual – Functions (for F3SP71-4N/4S, F3SP76-7N/7S) (IM 34M06P15-01E)
  - Sequence CPU – Network Functions (for F3SP71-4N/4S, F3SP76-7N/7S) (IM 34M06P15-02E)
- **For F3SP66, F3SP67 functions:**
  - Sequence CPU – Functions (for F3SP66-4S, F3SP67-6S) (IM 34M06P14-01E)
  - Sequence CPU – Network Functions (for F3SP66-4S, F3SP67-6S) (IM 34M06P14-02E)
- **For F3SP22, F3SP28, F3SP38, F3SP53, F3SP58, F3SP59 functions:**
  - Sequence CPU Instruction Manual – Functions (for F3SP22-0S, F3SP28-3N/3S, F3SP38-6N/6S, F3SP53-4H/4S, F3SP58-6H/6S, F3SP59-7S) (IM 34M06P13-01E)
- **For sequence CPU instructions:**
  - Sequence CPU Instruction Manual – Instructions (IM 34M06P12-03E)
- **For ladder programming:**
  - FA-M3 Programing Tool WideField3 (Introduction and Troubleshooting) (IM 34M06Q16-01E)
  - FA-M3 Programing Tool WideField3 Offline (IM 34M06Q16-02E)
  - FA-M3 Programing Tool WideField3 Online (IM 34M06Q16-03E)
  - FA-M3 Programing Tool WideField3 Script (IM 34M06Q16-04E)
- **Common for all sequence CPU modules**

  For the FA-M3 specifications and configurations*1, installation and wiring, test run, maintenance, and module installation limits for the whole system:

  *1: Refer to the relevant product manuals for specifications except for power supply modules, base modules, input/output modules, cables and terminal units.

  - Hardware Manual (IM 34M06C11-01E)

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■ Copyrights

■ Trademarks

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The trade names and company names referred to in this manual are either trademarks or registered trademarks of their respective companies.

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FA-M3
Modbus Interface Module

IM 34M06H42-01E 1st Edition

CONTENTS

1. Overview

F3LC31-2F Modbus Interface Module (hereafter called “the module”) is a communication module used in Modbus protocol communications.

1.1 What is Modbus?

Modbus is a general-purpose, open network protocol for communications among heterogeneous systems.
A Modbus communication consists of a single master and slaves. Slaves, each with a station address, connect to the master.

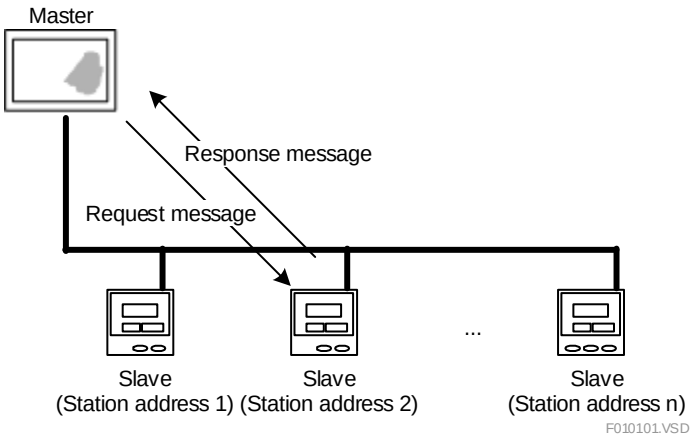

Figure 1.1 Modbus Communication Architecture

The master sends a request message to a slave. The slave processes the request message and returns a response message. This request/response interaction enables the master to access data from the slave.
To access data in Modbus communications, Modbus devices are used. There are four types of Modbus devices: coils, discrete inputs, input registers, and holding registers.

For details on the Modbus communication, refer to Chapter 3.

1.2 What the Module Can Do

This section describes Modbus functions that the module provides.

1.2.1 Master Function

With the master function, you can set the module as the master and connect it to slaves. The module can send request messages to read or write data from Modbus devices of the slaves.

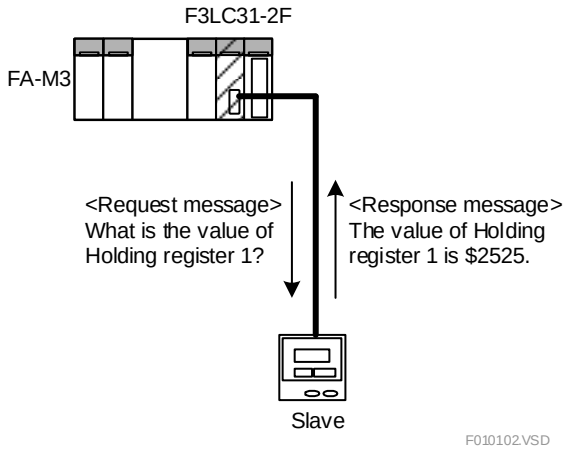

Figure 1.2 Master Function

The master uses the function codes to specify the Modbus device to access. For details on the function codes that the module supports, refer to Chapter 3.

For details on the master function, refer to Chapter 4.

1.2.2 Slave Function

With the slave function, you can set the module as a slave and connect it to the master. When the master sends request messages, the module returns response messages.

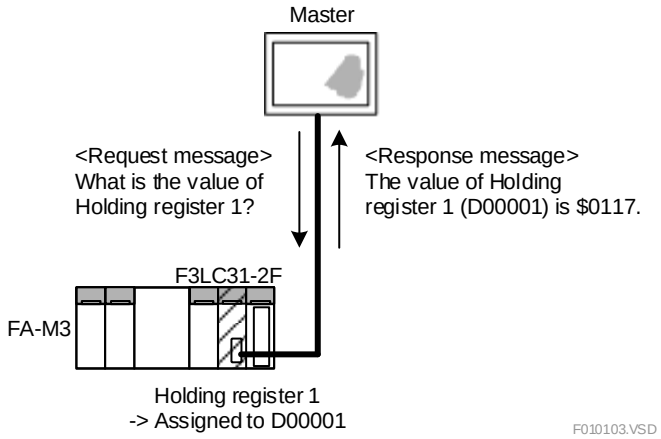

Figure 1.3 Slave Function

This request/response interaction enables read/write access to devices (such as Data registers and Internal relays) of the FA-M3 CPU module.
With the slave function, Modbus devices can be assigned to any devices of the CPU module. The master equipment can directly access devices of the FA-M3 CPU module.

For details on the slave function, refer to Chapter 5.

Note

The main CPU (CPU1) is the only CPU module that can be accessed with the slave function. The multi-slave function (in the following section) supports multi-CPU systems. For details, refer to Chapter 6 in this manual.

1.2.3 Multi-Slave Function

The module provides the multi-slave function as an extended function of the slave function. Multiple station addresses can be set to the module, allowing the module to communicate as multiple slaves. Each station address has a Modbus device. Up to eight station addresses can be set.
In addition, this function supports multi-CPU systems. Thus, CPU modules other than CPU1 can be accessed.

For details on the multi-slave function, refer to Chapter 6.

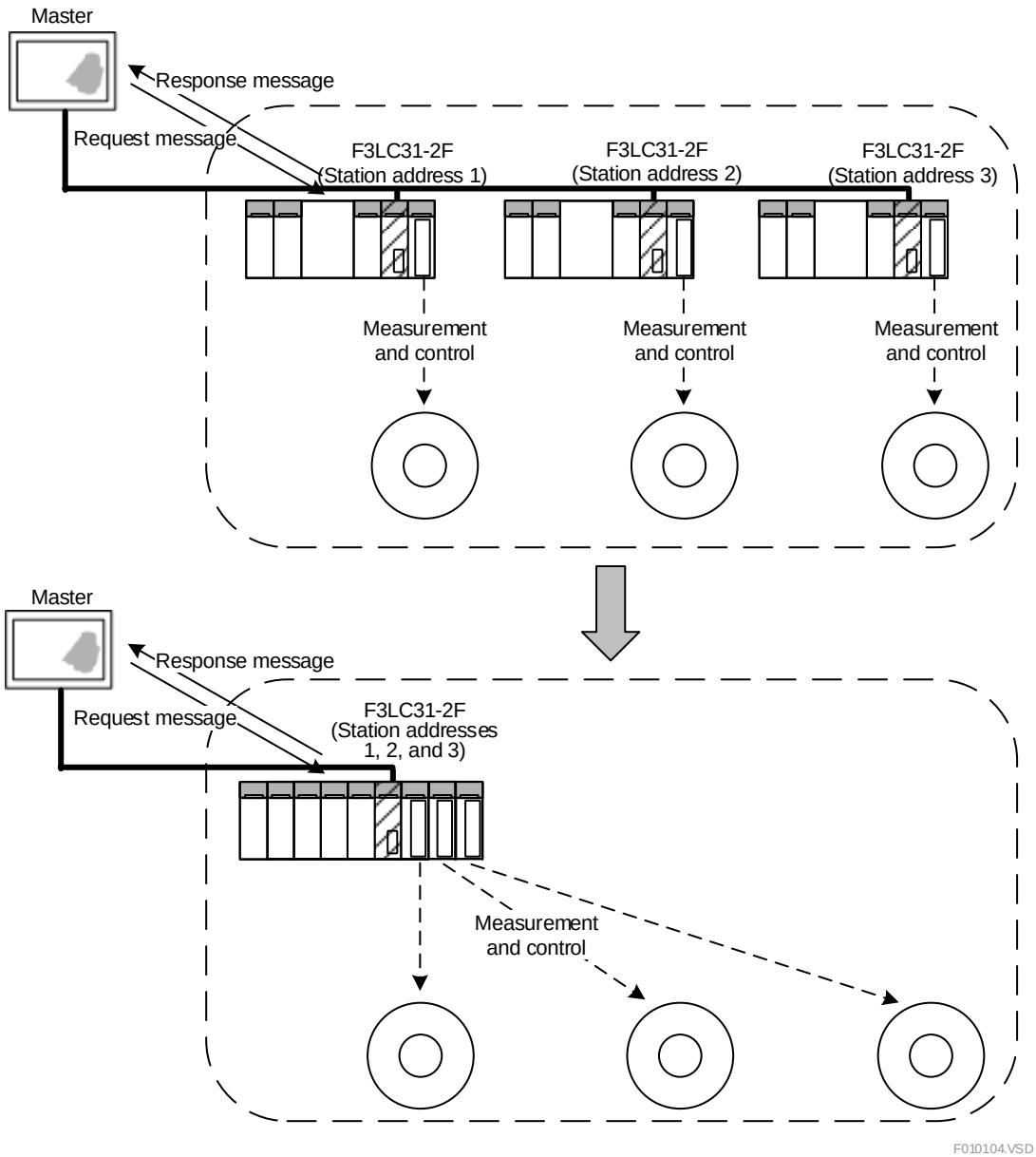

Figure 1.4 Multi-Slave Function

2. Module Specifications

2.1 Specifications

■ Model Name and Suffix Code

Table 2.1 Model Name and Suffix Code

Model	Suffix Code	Style Code	Option Code	Description
F3LC31	-2F	.....	.....	Modbus RTU/ASCII 1 port

■ Supported CPU Modules

Any CPU module can use this module.

■ General Specifications

Table 2.2 General Specifications

Item	Specifications
Maximum number of installed modules*1	F3SP05, F3SP08, F3SP20, F3SP21 ：2 modules F3SP22,F3SP25,F3SP28,F3SP30,F3SP35, F3SP38,F3SP53,F3SP58,F3SP59,F3SP66, F3SP67, F3SP71,F3SP76,F3BP20,F3BP30 ：6 modules
Operating ambient temperature range	0 to 55°C
Operating ambient humidity range	10 to 90%RH (No condensation)
Usage atmosphere	No corrosive or flammable gas and no thick dust
Storage ambient temperature range	-20 to 75°C
Storage ambient humidity range	10 to 90%RH (No condensation)
Noise immunity	Tested using a noise simulator with a noise voltage of 1,500 Vp-p, pulse width of 1 μs, rise time of 1 ns, and repetition frequency of 25 to 60 Hz
Vibration resistance	Amplitude: 0.075 mm (10 to 57 Hz) Acceleration: 9.8 m/s^2 (1 G) (57 to 150 Hz) Sweep cycle: 10 times (3 times in each of 3 directions)
Shock resistance	Acceleration: 147 m/s^2 (15 G) (3 times in each of 3 directions)
Consumption current (5 V DC)	290 mA
External dimensions	28.9 (W) x 100 (H) x 83.2 (D) mm (Excluding protrusions)
Weight	130 g

*1: The total installation numbers of PC link, multi-link, Ethernet, modem, GP-IB communication (when the slave mode is selected), NX, FL-net, and Ethernet/IP memory card modules

■ Function Specifications

Table 2.3 Function Specifications

Item			Specifications	
			Master	Slave
Interface			Conforms to EIA RS-422/485	
Number of ports			1 port (isolated)	
Connector			Terminal block	
Transmission speed			300, 600, 1200, 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600, or 115200 bps	
Transmission distance			1,200 m max.	
Data format	Character length		7 / 8 bit	
	Stop bit length		1 / 2 bit	
	Parity bit		None/even/odd	
Transmission mode			Modbus RTU / Modbus ASCII	
Error check			CRC-16 (RTU) / LRC-8 (ASCII)	
Supported function codes (✓: Supported, ×: Not supported)		01($01)	✓	✓
		02($02)	✓	✓
		03($03)	✓	✓
		04($04)	✓	✓
		05($05)	✓	✓
		06($06)	✓	✓
		07($07)	✓	✓
		08($08)	×	×
		11($0B)	×	×
		12($0C)	×	×
		15($0F)	✓	✓
		16($10)	✓	✓
		17($11)	×	×
		20($14)	×	×
		21($15)	×	×
		22($16)	×	×
		23($17)	✓	✓
		24($18)	×	×
		43($2B)	×	×
Station address			--	1 to 247

2.2 Components and Their Functions

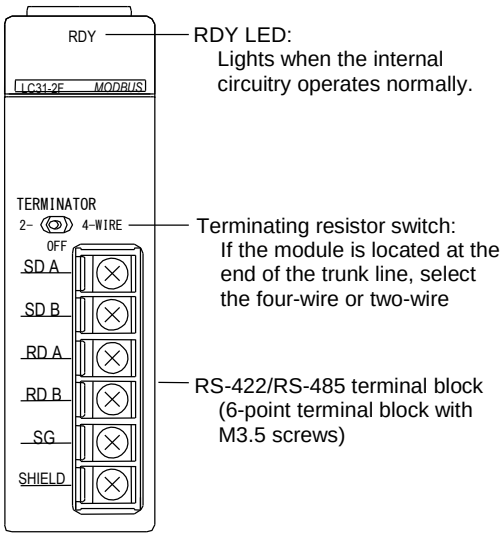

Figure 2.1 Front Face of the Modbus Interface Module

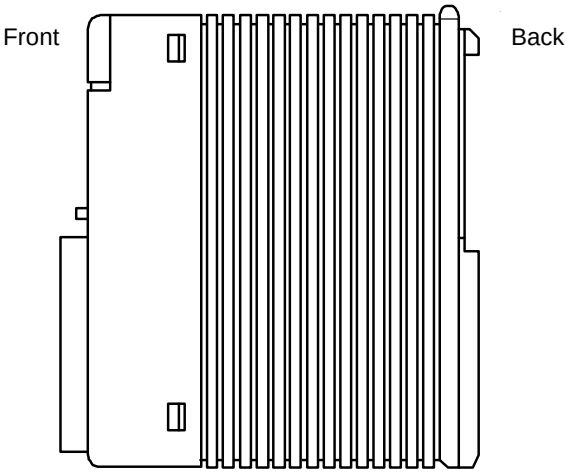

Figure 2.2 Right Side of the Modbus Interface Module

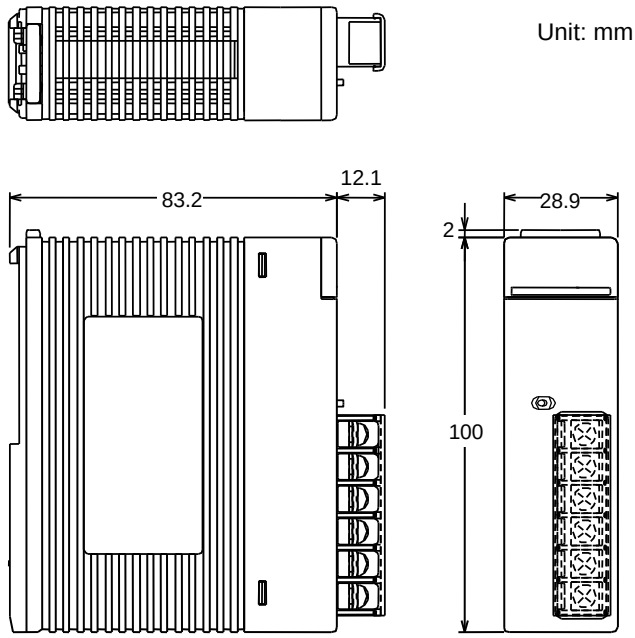

Figure 2.3 External Dimensions

2.3 Connecting to External Equipment

■ RS-422-A/RS-485 Terminal Block

The module has a 6-point terminal block with M3.5 screws as shown below.

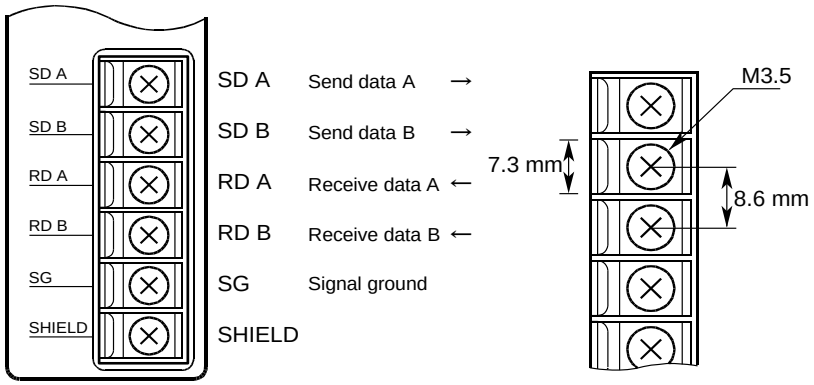

Figure 2.4 Terminal Block of the Module

Table 2.4 Wire and Crimp-On Terminals

Wire type	Shielded twisted-pair wire
Wire temperature rating	75°C or higher
Wire connection method	Use crimp-on terminals

Crimp-on terminals and applicable wire	**Manufacturer**	**Model**	**Applicable wire**
	J.S.T. Mfg. Co., Ltd.	V1.25-M3	AWG22 to 18 (0.33 to 0.82 mm^2) (Copper wire)
	Nippon Tanshi Co., Ltd.	RAV1.25-3.5	
	J.S.T. Mfg. Co., Ltd.	V1.25-M4	
	J.S.T. Mfg. Co., Ltd.	V2-M4	AWG16 to 14 (1.3 to 2.1 mm^2) (Copper wire)
Applicable tightening torque	0.8 N·m		

■ Terminating Resistor

The module has a built-in terminating resistor.
Set the switch to 4-WIRE if the module connects to equipment with a four-wire system, and set the switch to 2-WIRE if connecting with a two-wire system.
Make sure to set the terminating resistor selector switch to OFF if the module is not located at the end of the trunk line.

Figure 2.5 Terminating Resistor Selector Switch of the Module

Note

The terminating resistance value is 220 Ω for both four-wire and two-wire systems.

■ Wiring for the Master Function

● Four-Wire System

The module is depicted as the master in the following figure. The wires intersect between the master and slaves.

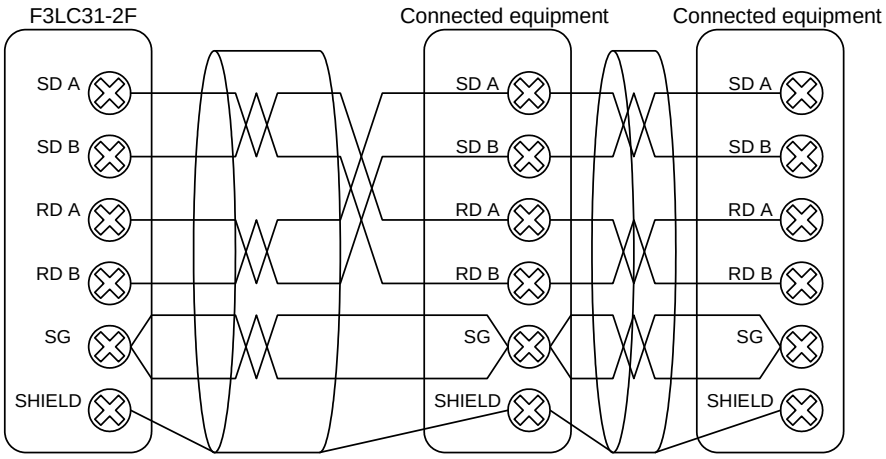

Figure 2.6 Four-Wire System (Master)

● Two-Wire System

When wiring with a two-wire system, short-circuit SD A-RD A and SD B-RD B of the module.

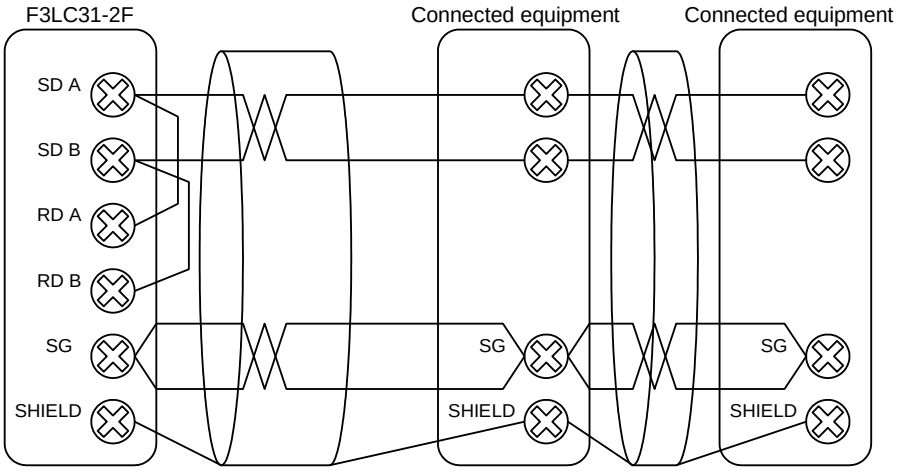

Figure 2.7 Two-Wire System (Master)

■ Wiring for the Slave Function

● Four-Wire System

The module is depicted as a slave in the following figure. The wires intersect between the master and slaves.

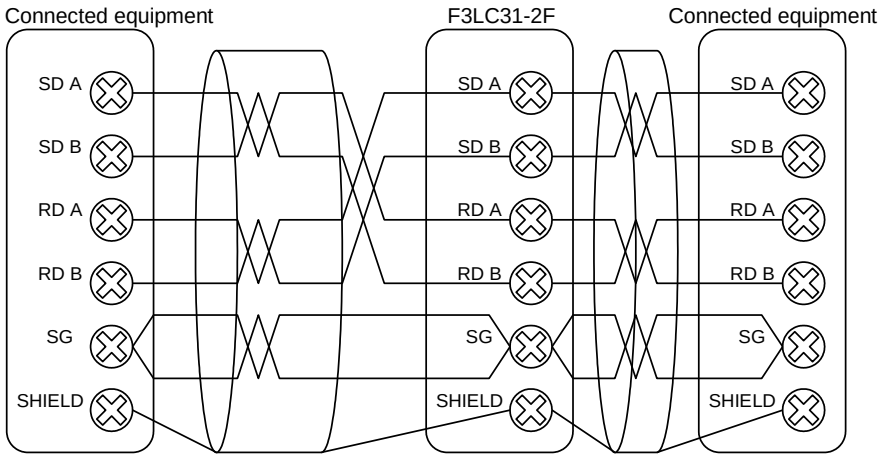

Figure 2.8 Four-Wire System (Slave)

● Two-Wire System

When wiring with a two-wire system, short-circuit SD A-RD A and SD B-RD B of the module.

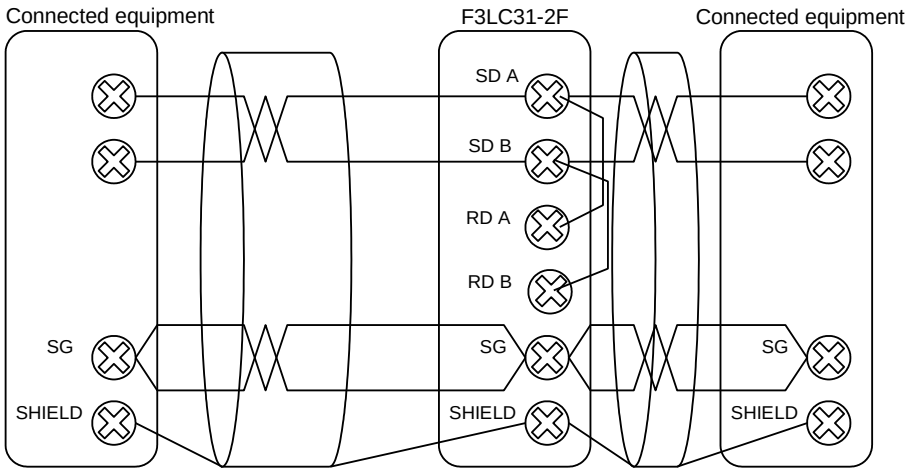

Figure 2.9 Two-Wire System (Slave)

2.4 Input/Output Relays and Registers

■ Input and Output Relays

Table 2.5 shows input and output relays supported by the module.
The module does not support interruption handling.
Note that relays that are not defined in Table 2.5 cannot be used.
□□□ in X□□□** and Y□□□** in Table 2.5 denotes the unit number (0 to 7) and slot number (1 to 16) that indicate where the module is installed.
(Example: X□□□01 relay with the module installed at Unit 0 and Slot 5 is X00501)

Table 2.5 Input and Output Relays

Input relay	Name	M	S
X□□□01	Ready	✓	✓
X□□□02		--	--
X□□□03		--	--
X□□□04		--	--
X□□□05		--	--
X□□□06		--	--
X□□□07		--	--
X□□□08		--	--
X□□□09	Setting Completed	✓	✓
X□□□10	Setting Error	✓	✓
X□□□11	Setting Success	✓	✓
X□□□12		--	--
X□□□13		--	--
X□□□14		--	--
X□□□15		--	--
X□□□16	Master Mode	✓	✓
X□□□17	Response Received	✓	--
X□□□18	Request Error	✓	--
X□□□19		--	--
X□□□20		--	--
X□□□21		--	--
X□□□22		--	--
X□□□23		--	--
X□□□24		--	--
X□□□25		--	--
X□□□26		--	--
X□□□27		--	--
X□□□28		--	--
X□□□29		--	--
X□□□30		--	--
X□□□31		--	--
X□□□32		--	--

Output relay	Name	M	S
Y□□□33		--	--
Y□□□34		--	--
Y□□□35		--	--
Y□□□36		--	--
Y□□□37		--	--
Y□□□38		--	--
Y□□□39		--	--
Y□□□40		--	--
Y□□□41	Setting Request	✓	✓
Y□□□42		--	--
Y□□□43		--	--
Y□□□44		--	--
Y□□□45		--	--
Y□□□46		--	--
Y□□□47		--	--
Y□□□48		--	--
Y□□□49	Request Sent	✓	--
Y□□□50		--	--
Y□□□51		--	--
Y□□□52		--	--
Y□□□53		--	--
Y□□□54		--	--
Y□□□55		--	--
Y□□□56		--	--
Y□□□57		--	--
Y□□□58		--	--
Y□□□59		--	--
Y□□□60		--	--
Y□□□61		--	--
Y□□□62		--	--
Y□□□63		--	--
Y□□□64		--	--

M: Master setting ✓: Valid --: Not used
S: Slave setting ✓: Valid --: Not used

■ Registers

Table 2.6 Registers

Data position number	Name			M	S
1 to 2	Reserved			--	--
3	Setting error code			✓	✓
4	Send error code			✓	--
5 to 8	Reserved			--	--
9	Station address			✓	✓
10	Communication setting parameters			✓	✓
11	Delay between frames			--	✓
12 to 16	Reserved			--	--
17	Slave #1 station address and CPU number			--	✓
18	Slave #2 station address and CPU number				
19	Slave #3 station address and CPU number				
20	Slave #4 station address and CPU number				
21	Slave #5 station address and CPU number				
22	Slave #6 station address and CPU number				
23	Slave #7 station address and CPU number				
24	Slave #8 station address and CPU number				
25 to 32	Reserved			--	--
33	Slave device assignment	Coil Device type		--	✓
34		Reserved			
35		Coil Head device number			
36					
37		Discrete input Device type			
38		Reserved			
39		Discrete input Head device number			
40					
41		Input register Device type			
42		Reserved			
43		Input register Head device number			
44					
45		Holding register Device type			
46		Reserved			
47		Holding register Head device number			
48					
49 to 128	Reserved			--	--
129	Multi-slave device assignment	#1	Coil Device type	--	✓
130			Reserved		
131			Coil Head device number		
132					
133			Discrete input Device type		
134			Reserved		
135			Discrete input Head device number		
136					
137			Input register Device type		
138			Reserved		
139			Input register Head device number		
140					
141			Holding register Device type		
142			Reserved		
143			Holding register Head device number		
144					
145		#2	Coil Device type	--	✓
146			Reserved		
147			Coil Head device numberment		
148					
149			Discrete input Device type		
150			Reserved		
151			Discrete input Head device number		
152					
153			Input register Device type		

Data position number	Name			M	S
154			Reserved		
155			Input register Head device number		
156					
157			Holding register Device type		
158			Reserved		
159			Holding register Head device number		
160					
161			Coil Device type		
162			Reserved		
163			Coil Head device number		
164					
165			Discrete input Device type		
166			Reserved		
167			Discrete input Head device number		
168					
169		#3	Input register Device type	--	✓
170			Reserved		
171			Input register Head device number		
172					
173			Holding register Device type		
174			Reserved		
175			Holding register Head device number		
176					
177			Coil Device type		
178			Reserved		
179			Coil Head device number		
180					
181			Discrete input Device type		
182			Reserved		
183			Discrete input Head device number		
184					
185		#4	Input register Device type	--	✓
186			Reserved		
187			Input register Head device number		
188					
189			Holding register Device type		
190			Reserved		
191			Holding register Head device number		
192					
193			Coil Device type		
194			Reserved		
195			Coil Head device number		
196					
197			Discrete input Device type		
198			Reserved		
199			Discrete input Head device number		
200					
201		#5	Input register Device type	--	✓
202			Reserved		
203			Input register Head device number		
204					
205			Holding register Device type		
206			Reserved		
207			Holding register Head device number		
208					
209			Coil Device type		
210			Reserved		
211			Coil Head device number		
212					
213			Discrete input Device type		
214			Reserved		
215		#6	Discrete input Head device number	--	✓
216					
217			Input register Device type		
218			Reserved		
219			Input register Head device number		
220					

Data position number	Name			M	S
221			Holding register Device type		
222			Reserved		
223			Holding register Head device number		
224					
225		#7	Coil Device type	--	✓
226			Reserved		
227			Coil Head device number		
228					
229			Discrete input Device type		
230			Reserved		
231			Discrete input Head device number		
232					
233			Input register Device type		
234			Reserved		
235			Input register Head device number		
236					
237			Holding register Device type		
238			Reserved		
239			Holding register Head device number		
240					
241		#8	Coil Device type	--	✓
242			Reserved		
243			Coil Head device number		
244					
245			Discrete input Device type		
246			Reserved		
247			Discrete input Head device number		
248					
249			Input register Device type		
250			Reserved		
251			Input register Head device number		
252					
253			Holding register Device type		
254			Reserved		
255			Holding register Head device number		
256					
257 to 1280	Reserved			--	--
1281	Destination station address			✓	--
1282 to 1287	Reserved			--	--
1288	Response wait time (timeout)			✓	--
1289 to 1414	Request parameters			✓	--
1415 to 1536	Reserved			--	--
1537 to 1662	Response parameters			✓	--

M: Master setting ✓: Valid --: Not used
S: Slave setting ✓: Valid --: Not used

2.5 Attaching/Detaching the Module

■ Attaching the Module

Figure 2.10 shows how to attach the module to the base module. First hook the anchor slot at the bottom of the module to be attached onto the anchor pin on the bottom of the base module. Push the top of the module toward the base module until the anchor/release button clicks into place.

CAUTION

Always switch off the power before attaching or detaching the module.

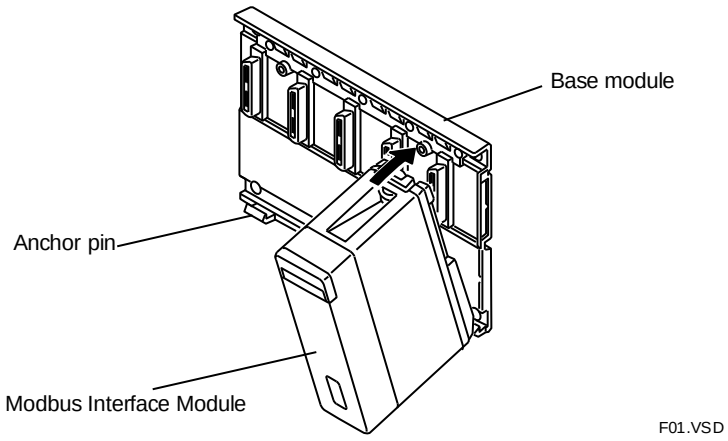

Figure 2.10 Attaching the Module

CAUTION

Do not bend the connector on the rear of the module by force during the above operation. If the module is pushed with improper force, the connector may bend, causing an error.

■ Detaching the Module

To remove the module from the base module, reverse the above operation. Press the anchor/release button on the top of the module to unlock it and tilt the module away from the base module.

■ Attaching the Module in Intense Vibration Environments

If the module is used in intense vibration environments, fasten the module with a screw. Use a screw listed in the table below. Insert the screw into the screw hole on top of the module and tighten it with a Phillips screwdriver.

Required Screw
Binding head machine screw M4 of 12 to 15 mm long (washer screw of 14-15 mm long)

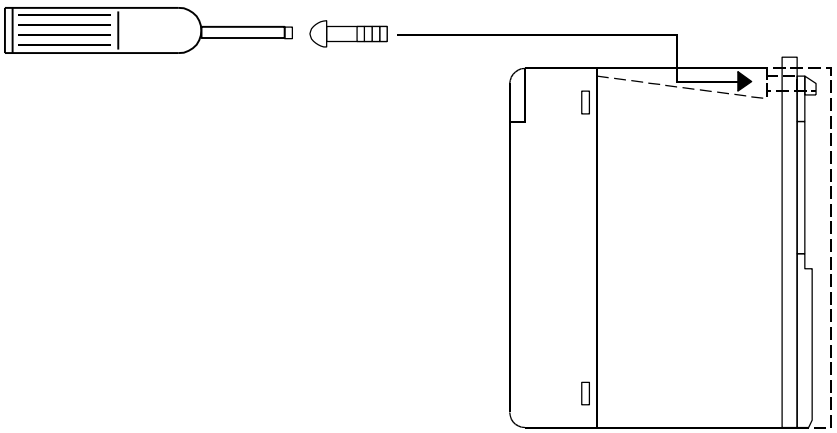

Figure 2.11 Securing the Module Using a Screw

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3. Modbus Communication

This chapter describes the master and slaves, and request and response messages, of which Modbus communications consist.

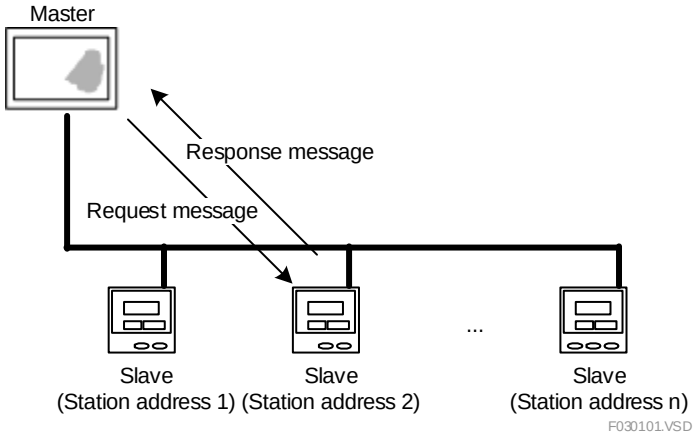


Figure 3.1 Modbus Communication Architecture

3.1 Master and Slaves

A Modbus communication consists of a single master and slaves.
The master sends a request message to a slave. The slave processes the request message and returns a response message. This request/response interaction enables the master to access data from the slave.

■ Station Address

Slaves, each with a station address, connect to the master. The master selects station addresses to specify the slaves to which it sends request messages.

■ Modbus Devices

The master uses Modbus devices to access data of slaves. There are four types of Modbus devices: coils, discrete inputs, input registers, and holding registers. Modbus devices are defined as shown in the following table.

Table 3.1 List of Modbus Devices

Modbus device	Unit/Read or Write	Number of points	Number
Coils	1 bit/Read and Write	65,536	1 to 65536
Discrete inputs	1 bit/Read	65,536	1 to 65536
Input registers	16 bits/Read	65,536	1 to 65536
Holding registers	16 bits/Read and Write	65,536	1 to 65536

3.2 Request and Response Messages

A request message is a message that the master sends to slaves. A response message is a message that slaves return to the master.

■ Modbus Frame

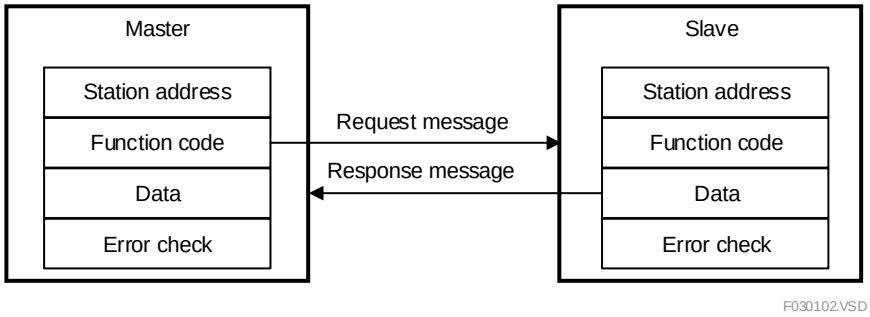


Figure 3.2 Modbus Frames

Request and response messages are transmitted in the form of Modbus frames. Modbus frame consists of a station address, function code, parameters, and error check. Each function is coded as a function code based on the feature of the Modbus frame and the type of data. The error check is used to validate the entire message.

Table 3.2 Modbus Frame Data

Name	Description	
	Sending as the master	**Sending as a slave**
Station address	0: Broadcast 1 to 247: Destination station address	Its own station address
Function code	The code of the function that the slave is to perform	The function code received. The most significant bit turns on upon an error response.
Data	Parameters required to perform the function	Function execution result Error code when an error occurs
Error check	The check code to validate the message. When unmatched, the message is discarded.	

■ RTU Mode

There are two types of serial communication transmission modes for Modbus frames: the RTU (Remote Terminal Unit) mode and the ASCII mode.
In the RTU mode, 8-bit binary data is transmitted. The transmission efficiency is higher than the ASCII mode, because the character length is half that of it.

● Character Format

In the RTU mode, a character consists of 11 bits.
The character format with parity is shown as below.

- Start bit: 1 bit
- Data length: 8 bits
- Parity: 1 bit
- Stop bit: 1 bit

Start bit	1	2	3	4	5	6	7	8	Parity	Stop bit

Figure 3.3 RTU Character Format(With Parity)

Without parity, two stop bits are used.

- Start bit: 1 bit
- Data length: 8 bits
- Parity: None
- Stop bit: 2 bits

Start bit	1	2	3	4	5	6	7	8	Stop bit	Stop bit

Figure 3.4 RTU Character Format (Without Parity)

● RTU Message Frame

Start	Station address	Function code	Parameters	CRC
(A silent interval of at least 3.5 character times)	1 character	1 character	0 to 252 characters	2 characters

CRC calculation range

Figure 3.5 RTU Message Frame

- Start

In the RTU mode, each frame is transmitted after a silent interval of at least 3.5 character times.

- CRC

In the RTU mode, messages include an error check field based on a CRC method. The CRC consists of a 16-bit binary value. The sender calculates the CRC. The receiver re-calculates the CRC during receiving data and compares the calculated result with the received CRC value. If those two values do not match, an error occurs.

■ ASCII Mode

In the ASCII mode, 8-bit binary data is transmitted as two ASCII characters. With the ASCII mode, the module can be connected to equipment not supporting the RTU mode. The transmission efficiency is lower than the RTU mode, because the character length is double.

● Character Format

In the ASCII mode, a character consists of 10 bits.
The bit configuration for a character with parity is shown as below.

- Start bit: 1 bit
- Data length: 7 bits
- Parity: 1 bit
- Stop bit: 1 bit

Figure 3.6 ASCII Character Format (With Parity)

Without parity, two stop bits are used.

- Start bit: 1 bit
- Data length: 7 bits
- Parity: None
- Stop bit: 2 bits

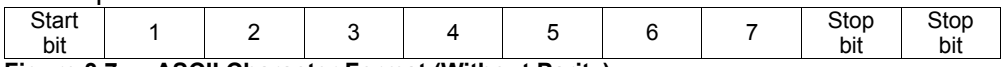


Figure 3.7 ASCII Character Format (Without Parity)

● ASCII Message Frame

Start character	Station address	Function code	Parameters	LRC	End character
: (1 character)	2 characters	2 characters	0 to 2 x 252 characters	2 characters	CRLF (2 characters)

LRC calculation range

Figure 3.8 ASCII Message Frame

- Start character

In the ASCII mode, each frame starts with a colon ":" ($3A).

- End character

In the ASCII mode, each frame ends with CRLF ($0D0A).

- LRC

In the ASCII mode, messages include an error check field based on an LRC method. The LRC is generated as an 8-bit binary value and transmitted as two ASCII characters. The sender calculates the LRC. The receiver calculates the LRC during receiving data and compares the calculated result with the received LRC value. If those two values do not match, an error occurs.

■ Function Codes

The master uses the function codes to specify the function that the slave is to perform. The module supports the function codes shown in the table below.

Table 3.3 Supported Function Codes

Function code	Name	Description	Supported? ✓: Yes ×: No
01($01)	Read Coils	Reads up to 2,000 consecutive coils	✓
02($02)	Read Discrete Inputs	Reads up to 2,000 consecutive inputs	✓
03($03)	Read Holding Registers	Reads up to 125 consecutive holding registers	✓
04($04)	Read Input Registers	Reads up to 125 consecutive input registers	✓
05($05)	Write Single Coil	Writes a value to one coil	✓
06($06)	Write Single Register	Writes a value to one register	✓
07($07)	Read Exception Status	Reads exception status	✓
08($08)	Diagnostics	Perform diagnostics on Modbus communications	×
11($0B)	Get Communication Event Counter	Reads the slave's communication event counter	×
12($0C)	Get Communication Event Log	Reads the slave's communication event log	×
15($0F)	Write Multiple Coils	Writes values to up to 1,968 consecutive coils	✓
16($10)	Write Multiple Registers	Writes values to up to 123 consecutive registers	✓
17($11)	Report Slave ID	Reads the slave's information	×
20($14)	Read File Record	Reads up to 124 file records	×
21($15)	Write File Record	Writes values to up to 122 file records	×
22($16)	Mask Write Register	Masks the value stored in one register with AND or OR	×
23($17)	Read/Write Multiple Registers	Reads and writes values from and to multiple registers	✓
24($18)	Read FIFO Queue	Reads the FIFO table	×
43($2B)	Read Device Identification	Reads the device's ID	×

■ Formats for Each Function Code

Here are descriptions of the formats for function codes that the module supports.

● Read Coils ($01)

Reads the status (ON/OFF) of one or more coils.
Through a single request, 1 to 2,000 devices can be accessed.

Request message format (from the master to a slave)

Function code	Data	
$01	Head coil number ($0000 to $FFFF)	Number of read points ($0001 to $07D0)
1 byte	2 bytes	2 bytes

Response message format (from a slave to the master)

(When completed successfully)

Function code	Data			
$01	Number of read bytes n ($01 to $FA)	Device data 1	...	Device data n
1 byte	1 byte	1 byte		1 byte

(When completed with an error)

Function code	Data
$81	Error code
1 byte	1 byte

F030109.VSD

Figure 3.9 Read Coils ($01)

● Read Discrete Inputs ($02)

Reads the status (ON/OFF) of one or more discrete inputs.
Through a single request, 1 to 2,000 devices can be accessed.

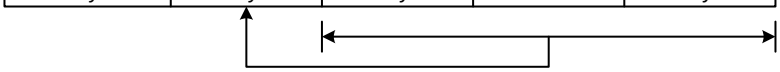
Request message format (from the master to a slave)

Function code	Data	
$02	Head input number ($0000 to $FFFF)	Number of read points ($0001 to $07D0)
1 byte	2 bytes	2 bytes

Response message format (from a slave to the master)

(When completed successfully)

Function code	Data			
$02	Number of read bytes n ($01 to $FA)	Device data 1	...	Device data n
1 byte	1 byte	1 byte		1 byte



(When completed with an error)

Function code	Data
$82	Error code
1 byte	1 byte

F030110.VSD

Figure 3.10 Read Discrete Inputs ($02)

● Read Holding Registers ($03)

Reads the value of one or more holding registers.
Through a single request, 1 to 125 devices can be accessed.

Request message format (from the master to a slave)

Function code	Data	
$03	Head holding register number ($0000 to $FFFF)	Number of read points ($0001 to $007D)
1 byte	2 bytes	2 bytes

Response message format (from a slave to the master)

(When completed successfully)

Function code	Data			
$03	Number of read bytes n x 2 ($02 to $FA)	Device data 1	...	Device data n
1 byte	1 byte	2 bytes		2 bytes

(When completed with an error)

Function code	Data
$83	Error code
1 byte	1 byte

F030111.VSD

Figure 3.11 Read Holding Registers ($03)

● Read Input Registers ($04)

Reads the value of one or more input registers.
Through a single request, 1 to 125 devices can be accessed.

Request message format (from the master to a slave)

Function code	Data	
$04	Head input register number ($0000 to $FFFF)	Number of read points ($0001 to $007D)
1 byte	2 bytes	2 bytes

Response message format (from a slave to the master)

(When completed successfully)

Function code	Data			
$04	Number of read bytes n x 2 ($02 to $FA)	Device data 1	...	Device data n
1 byte	1 byte	2 bytes		2 bytes

(When completed with an error)

Function code	Data
$84	Error code
1 byte	1 byte

F030112.VSD

Figure 3.12 Read Input Registers ($04)

● Write Single Coil ($05)

Writes a value (1/0) to one coil.
Through a single request, one device can be accessed.

Request message format (from the master to a slave)

Function code	Data	
$05	Coil number ($0000 to $FFFF)	Output value 1: $FF00 0: $0000
1 byte	2 bytes	2 bytes

Response message format (from a slave to the master)

(When completed successfully)

Function code	Data	
$05	Coil number (The same value as that of the request message)	Output value (The same value as that of the request message)
1 byte	2 bytes	2 bytes

The slave returns the request message received from the master without change.

(When completed with an error)

Function code	Data
$85	Error code
1 byte	1 byte

F030113.VSD

Figure 3.13 Write Single Coil ($05)

● Write Single Register ($06)

Writes a value to one holding register.
Through a single request, one device can be accessed.

Request message format (from the master to a slave)

Function code	Data	
$06	Holding register number ($0000 to $FFFF)	Write data ($0000 to $FFFF)
1 byte	2 bytes	2 bytes

Response message format (from a slave to the master)

(When completed successfully)

Function code	Data	
$06	Holding register number (The same value as that of the request message)	Write data (The same value as that of the request message)
1 byte	2 bytes	2 bytes

The slave returns the request message received from the master without change.

(When completed with an error)

Function code	Data
$86	Error code
1 byte	1 byte

F030114.VSD

Figure 3.14 Write Single Register ($06)

● Read Exception Status ($07)

Reads exception status. The exception status corresponds to the specifications of the slave equipment.

Request message format (from the master to a slave)

Function code
$07
1 byte

Response message format (from a slave to the master)

(When completed successfully)

Function code	Data
$07	Exception status ($00 to $FF)
1 byte	1 byte

(When completed with an error)

Function code	Data
$87	Error code
1 byte	1 byte

F030115.VSD

Figure 3.15 Read Exception Status ($07)

● Write Multiple Coils ($0F)

Writes a value (1/0) to multiple coils.
Through a single request, up to 1,968 devices can be accessed.

Request message format (from the master to a slave)

Function code	Data					
$0F	Head coil number ($0000 to $FFFF)	Number of write points ($0001 to $07B0)	Number of write bytes n ($01 to $F6)	Device data 1	···	Device data n
1 byte	2 bytes	2 bytes	1 byte	1 byte		1 byte

Response message format (from a slave to the master)

(When completed successfully)

Function code	Data	
$0F	Head coil number (The same value as that of the request message)	Number of write points (The same value as that of the request message)
1 byte	2 bytes	2 bytes

(When completed with an error)

Function code	Data
$8F	Error code
1 byte	1 byte

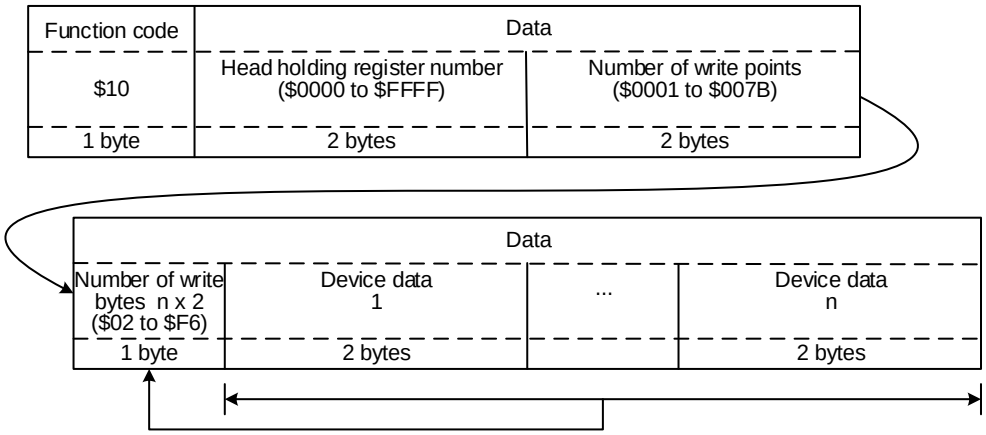
F030116.VSD

Figure 3.16 Write Multiple Coils ($0F)

● Write Multiple Registers ($10)

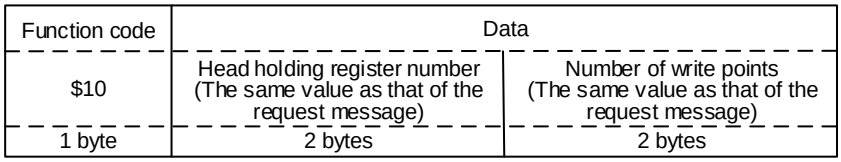
Writes values to multiple holding registers.
Through a single request, 1 to 123 devices can be accessed.

Request message format (from the master to a slave)

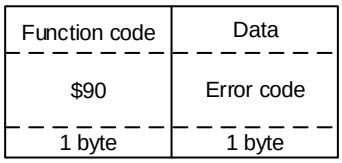


Response message format (from a slave to the master)

(When completed successfully)



(When completed with an error)



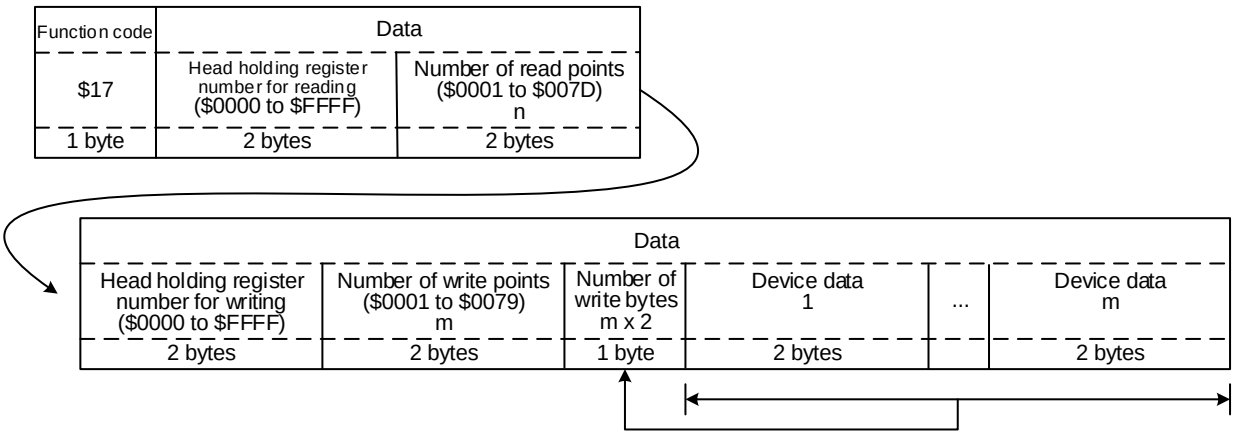
F030117.VSD

Figure 3.17 Write Multiple Registers ($10)

● Read/Write Multiple Registers ($17)

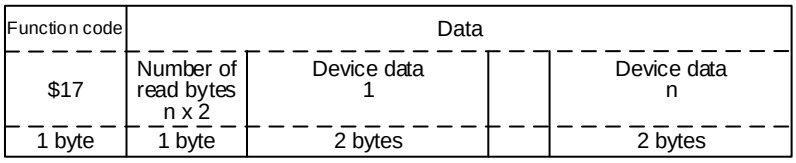
Reads and writes values from and to multiple holding registers. Read processing is performed after write processing.
Through a single request, 1 to 125 devices can be read from and 1 to 121 devices can be written to.

Request message format (from the master to a slave)

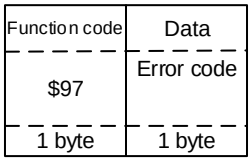


Response message format (from a slave to the master)

(When completed successfully)



(When completed with an error)



F030118.VSD

Figure 3.18 Read/Write Multiple Registers ($17)

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4. Master Function

With the master function, you can set the module as the master and connect it to slaves. The module can send request messages to read or write data from Modbus devices of the slaves.

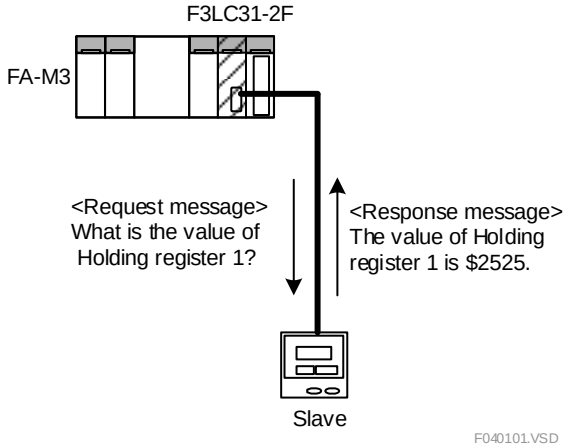


Figure 4.1 Master Function

■ Supported Function Codes

The module can access Modbus devices of slaves with the following function codes.

Table 4.1 Supported Function Codes

Function code	Name	Supported number of devices	Broadcast ✓: Supported ×: Not supported
01($01)	Read Coils	1 to 2,000	×
02($02)	Read Discrete Inputs	1 to 2,000	×
03($03)	Read Holding Registers	1 to 125	×
04($04)	Read Input Registers	1 to 125	×
05($05)	Write Single Coil	1	✓
06($06)	Write Single Register	1	✓
07($07)	Read Exception Status	--	×
15($0F)	Write Multiple Coils	1 to 1,968	✓
16($10)	Write Multiple Registers	1 to 123	✓
23($17)	Read/Write Multiple Registers	Read: 1 to 125 Write: 1 to 121	×

■ Broadcast Function

The module supports the broadcast function. With the broadcast function, the module can send a request to all connected slaves simultaneously.
When a request message is sent using the broadcast function, slaves do not respond.

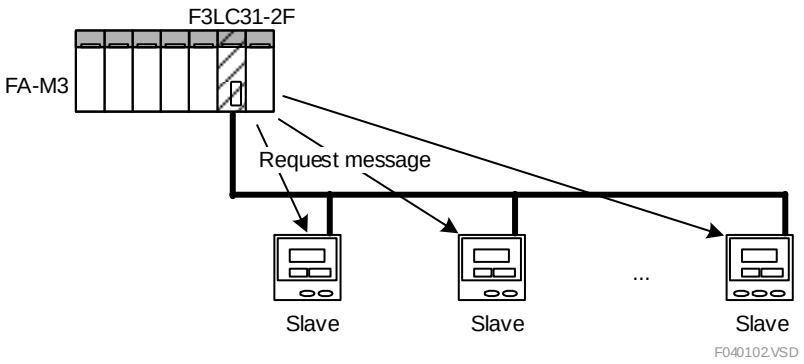


Figure 4.2 Broadcast Function

4.1 Input and Output Relays

This section describes relays used in the master function.

■ Output Relays

Table 4.2 Output Relays

Output relay number	Name	Overview of the action
Y□□□41	Setting Request	When this relay turns on after setting parameters are written, setting processing is performed. After setting processing is completed, X□□□09 turns on. If the setting is completed successfully, X□□□11 turns on. If an error is included in the settings, X□□□10 turns on. Keep the relay on during Modbus communications.
Y□□□49	Request Sent	When this relay turns on after request parameters are written, the request messages is sent. When the response message is received after the request message is sent, X□□□17 turns on. If the response message is not received successfully, X□□□18 turns on.

■ Input Relays

Table 4.3 Input Relays

Input relay number	Name	Overview of the action
X□□□01	Ready	Turns on when the module starts up successfully. All of the setting processing must be performed after this relay turns on.
X□□□09	Setting Completed	Turns on upon completion of the setting request. This relay turns off when Y□□□41 turns off.
X□□□10	Setting Error	Turns on if an error occurs when the setting request is processed. This relay turns off when Y□□□41 turns off.
X□□□11	Setting Success	Turns on when the setting request is processed successfully. This relay turns off when Y□□□41 turns off.
X□□□16	Master Mode	This relay is on when the master function is in operation. It is off when the slave function is in operation. This relay turns off when Y□□□41 turns off.
X□□□17	Response Received	Turns on when the response message is successfully received and the message is stored in the response parameter area. This relay turns off when Y□□□49 turns off.
X□□□18	Request Error	Turns on if an error is included in request data or the request message is not received successfully. This relay turns off when Y□□□49 turns off.

4.2 Registers

This section describes registers used in the master function.

■ List

Table 4.4 List of Registers

Data position number	Name	Description
3	Setting error code	Indicate wrong setting parameters
4	Send error code	Indicate wrong request/response parameters
9	Station address	Select the master function
10	Communication setting parameters	Set RS-485 communication parameters including the transmission mode
1281	Destination station address	0: Broadcast 1 to 247: Destination station address
1288	Response wait time	Specify the communication timeout setting 0 to 65535(ms)
1289 to 1414	Request parameters	Request parameters
1537 to 1662	Response parameters	Response parameters

● Setting Error Code

The Setting Error relay (X□□□10) turns on when a setting error occurs, and the corresponding error code is stored in Data position number #3. The error code is initialized to $0000 when the Setting Request relay (Y□□□41) turns off.
For details on troubleshooting the setting errors, refer to Section 7.3.

Table 4.5 Setting Error Codes

Error code	Description
$0000	Success
$0001	Station address error

● Send Error Code

The Request Error relay (X□□□18) turns on when a send error occurs, and the error code is stored in Data position number #4. The error code is initialized to $0000 when the Sending Request relay (Y□□□49) turns off.
For details on troubleshooting the send errors, refer to Section 7.4.

Table 4.6 Send Error Codes

Error code	Description
$0000	Success
$0301	Station address error
$0302	Function code error
$0303	Broadcast is not supported
$0304	Parameter error (count)
$0307	Communication timeout
$0308	Station address unmatched
$0309	Function code unmatched
$030A	CRC/LRC error
$030B	Not in the master mode

● Station Address

Data position number	Name	Description
9	Station address	0: Master function 1 to 247: Slave function $8000: Multi-slave function

To select the master function, set 0 to Data position number #9.

Communication Setting Parameters

You set RS-485 communication parameters. Set the parameters in Data position number #10. The communication parameters must match those of slaves.

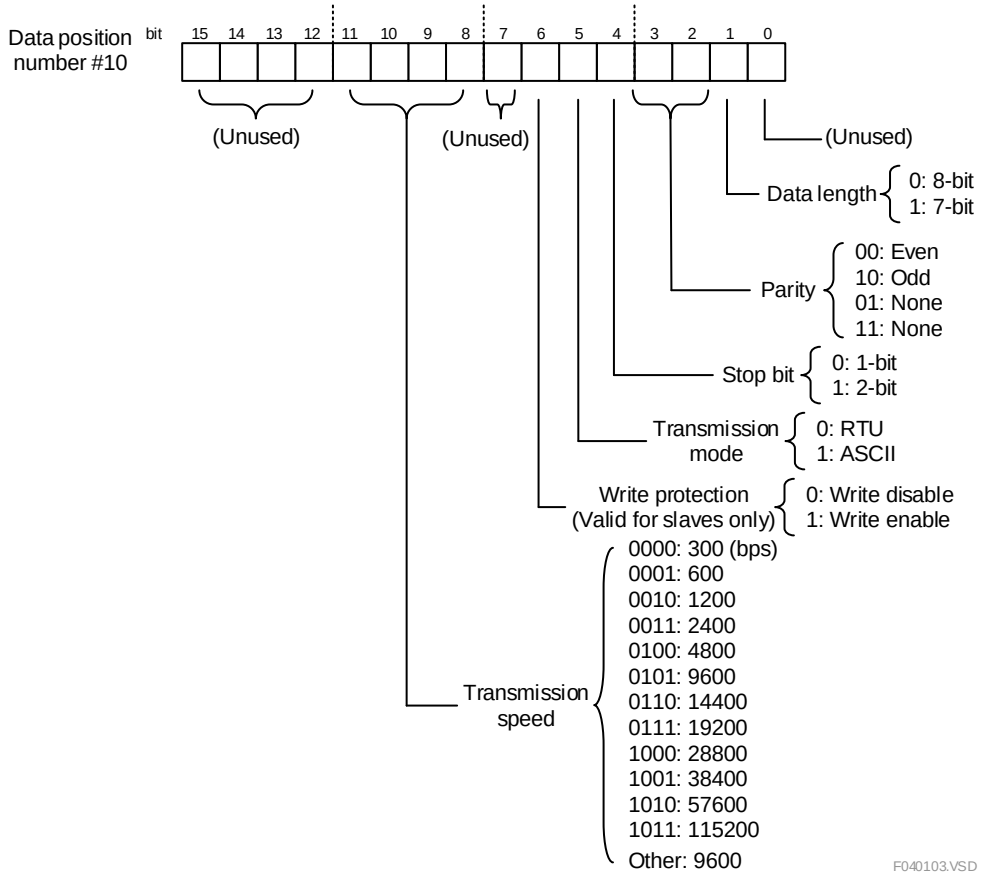


Figure 4.3 16-Bit Data in Communication Settings

Destination Station Address

Set the destination station address. The station address of the destination slave should be specified. Set 0 for a broadcast.

Response Wait Time

Set the wait time after sending a request message until a response is returned. If a response from the slave is not received after this time period, a send error (communication timeout) is issued.

The wait time can be set between 1 ms and 65,535 ms in 1 ms steps. The unit used for the value is ms.

Setting 0 means that the wait time is 5,000 ms.

4.3 Details of Request and Response Parameters

Here are the details of request and response parameters for each function code. The number of bytes and others are automatically calculated by the module. For details on the formats for function codes, refer to Chapter 3.

Note

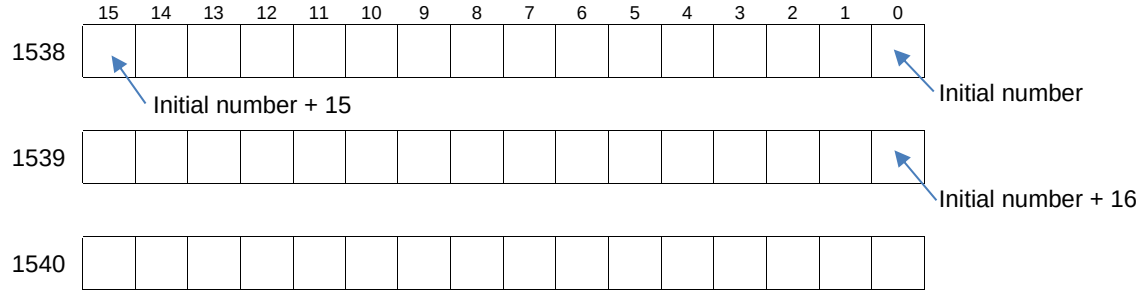
The Modbus device begins with 1, and the setting of head number begins with 0.
(Example) If you specify coil 1, the setting value of head coil number is 0.

● 1($01) Read Coils

Request parameters		
Data position number	Name	Value
1289	Function code	$0001
1290	Head coil number	$0000 to $FFFF
1291	The number of read points	1 to 2000

Response parameters		
Data position number	Name	Value
1537	Function code	$0001
1538 to 1662	Coils status	$0000 to $FFFF

Coils status

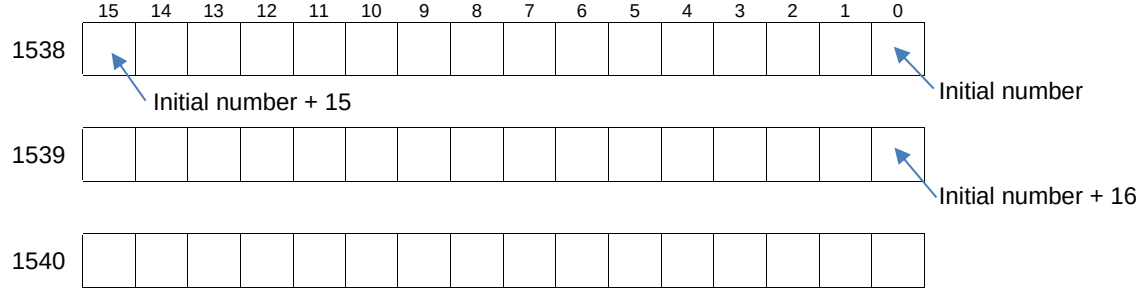


● 2($02) Read Discrete Inputs

Request parameters		
Data position number	Name	Value
1289	Function code	$0002
1290	Head discrete input number	$0000 to $FFFF
1291	The number of read points	1 to 2000

Response parameters		
Data position number	Name	Value
1537	Function code	$0002
1538 to 1662	Discrete input status	$0000 to $FFFF

Discrete input status



● 3($03) Read Holding Registers

Request parameters		
Data position number	Name	Value
1289	Function code	$0003
1290	Head holding register number	$0000 to $FFFF
1291	The number of read points	1 to 125

Response parameters		
Data position number	Name	Value
1537	Function code	$0003
1538 to 1662	Holding register value	$0000 to $FFFF

● 4($04) Read Input Registers

Request parameters		
Data position number	Name	Value
1289	Function code	$0004
1290	Head input register number	$0000 to $FFFF
1291	The number of read points	1 to 125

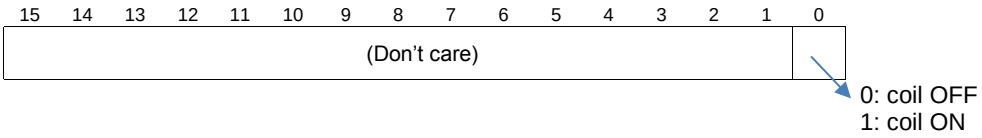
Response parameters		
Data position number	Name	Value
1537	Function code	$0004
1538 to 1662	Input register value	$0000 to $FFFF

● 5($05) Write Single Coil

Request parameters		
Data position number	Name	Value
1289	Function code	$0005
1290	Coil number	$0000 to $FFFF
1291	Output value	Refer to the following.

Response parameters		
Data position number	Name	Value
1537	Function code	$0005
1538	Coil number	$0000 to $FFFF
1539	Output value	Refer to the following.

Output value



● 6($06) Write Single Register

Request parameters		
Data position number	Name	Value
1289	Function code	$0006
1290	Holding register number	$0000 to $FFFF
1291	Register Value	$0000 to $FFFF

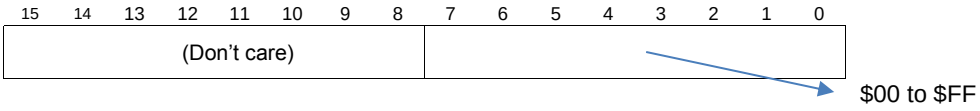
Response parameters		
Data position number	Name	Value
1537	Function code	$0006
1538	Holding register number	$0000 to $FFFF
1539	Register Value	$0000 to $FFFF

● 7($07) Read Exception Status

Request parameters		
Data position number	Name	Value
1289	Function code	$0007

Response parameters		
Data position number	Name	Value
1537	Function code	$0007
1538	Exception status	$0000 to $00FF

Exception status

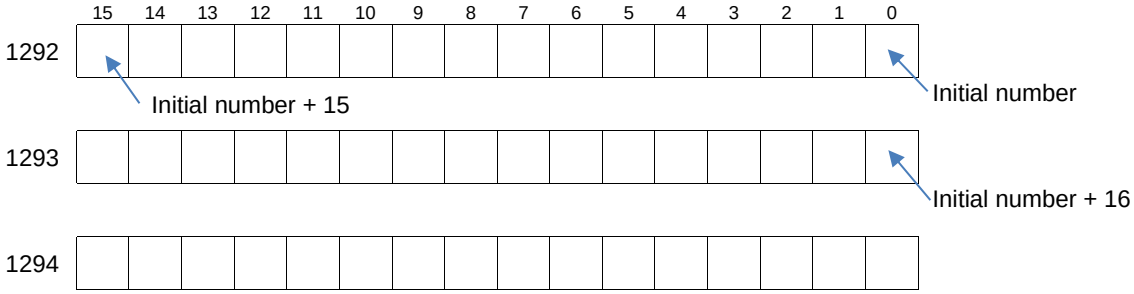


● 15($0F) Write Multiple Coils

Request parameters		
Data position number	Name	Value
1289	Function code	$000F
1290	Head coil number	$0000 to $FFFF
1291	The number of write points	1 to 1968
1292 to 1414	Outputs value	$0000 to $FFFF

Response parameters		
Data position number	Name	Value
1537	Function code	$000F
1538	Head coil number	$0000 to $FFFF
1539	The number of write points	1 to 1968

Output value



● 16($10) Write Multiple Registers

Request parameters		
Data position number	Name	Value
1289	Function code	$0010
1290	Head holding register number	$0000 to $FFFF
1291	The number of write points	1 to 123
1292 to 1414	Registers Value	$0000 to $FFFF

Response parameters		
Data position number	Name	Value
1537	Function code	$0010
1538	Head holding register number	$0000 to $FFFF
1539	The number of write points	1 to 123

● 23($17) Read/Write Multiple Registers

Request parameters		
Data position number	Name	Value
1289	Function code	$0017
1290	Head holding register number for reading	$0000 to $FFFF
1291	The number of read points	1 to 125
1292	Head holding register number for writing	$0000 to $FFFF
1293	The number of write points	1 to 121
1294 to 1414	Write Registers Value	$0000 to $FFFF

Response parameters		
Data position number	Name	Value
1537	Function code	$0017
1538 to 1662	Read register value	$0000 to $FFFF

● Error Response

Request parameters		
Data position number	Name	Value
1289	Function code	n

Response parameters		
Data position number	Name	Value
1537	Function code	n + $0080
1538	Response error code	Refer to the following table.

Table 4.7 Response Error Codes

Error code	Name	Description
$0001	Invalid function code	The function code is not supported
$0002	Invalid data address	The address is not supported
$0003	Invalid data value	The data is out of range
$0004	Unable to process	The function cannot be executed due to some reasons

The response error codes correspond to the specifications of the slave equipment. Refer to the manuals for the slave equipment.

4.4 How to Use

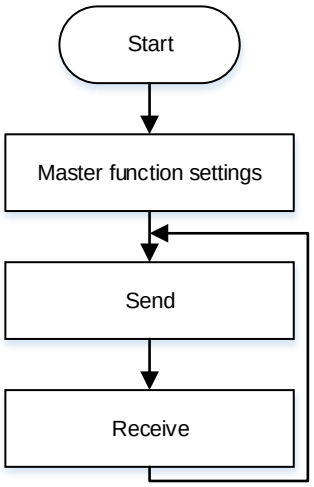


Figure 4.4 Master Function Routine

A user program of the master function is divided into two parts. In the Master function setting, the program specifies settings for the master function and sets the communication parameters. In the sending and receiving, the program sends request messages and checks if response messages are received.

■ Master Function Settings

● Procedure

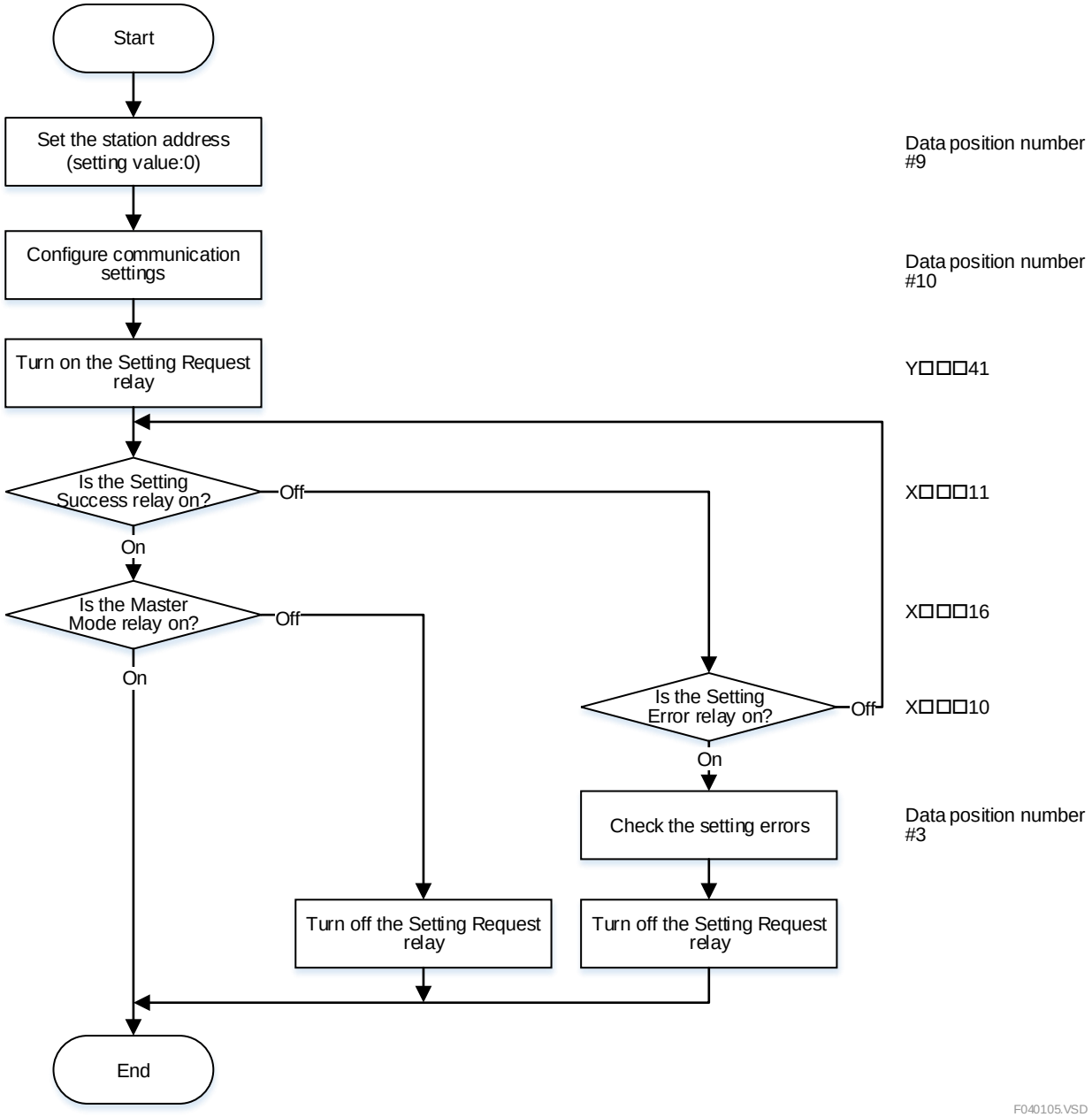


Figure 4.5 Master Function Settings

Programming

Table 4.8 shows the setting parameters for the master function.

Table 4.8 Example of Setting Values

Data position number	Name	Setting value	Remarks
9	Station address	0	Master function
10	Communication setting parameters	$0900	Transmission speed: 38400 bps Write protection: (not valid) Transmission mode: RTU Stop bit: 1 bit Parity: Even Data length: 8-bit

Set the station address to 0 to select the master function.
Store the communication parameters to set RS-485 communication conditions.
After setting the parameters, turn on the Setting Request relay.

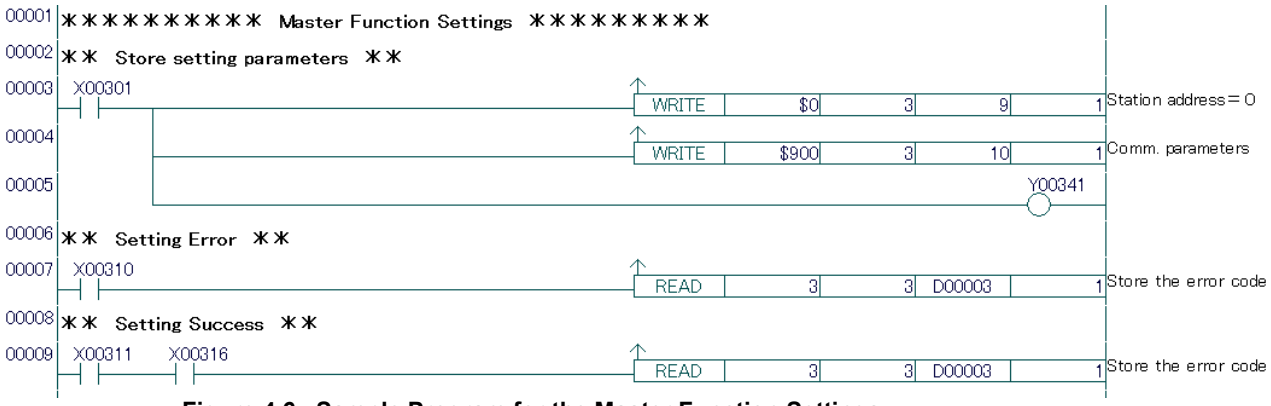


Figure 4.6 Sample Program for the Master Function Settings

■ Sending and Receiving

● Procedure

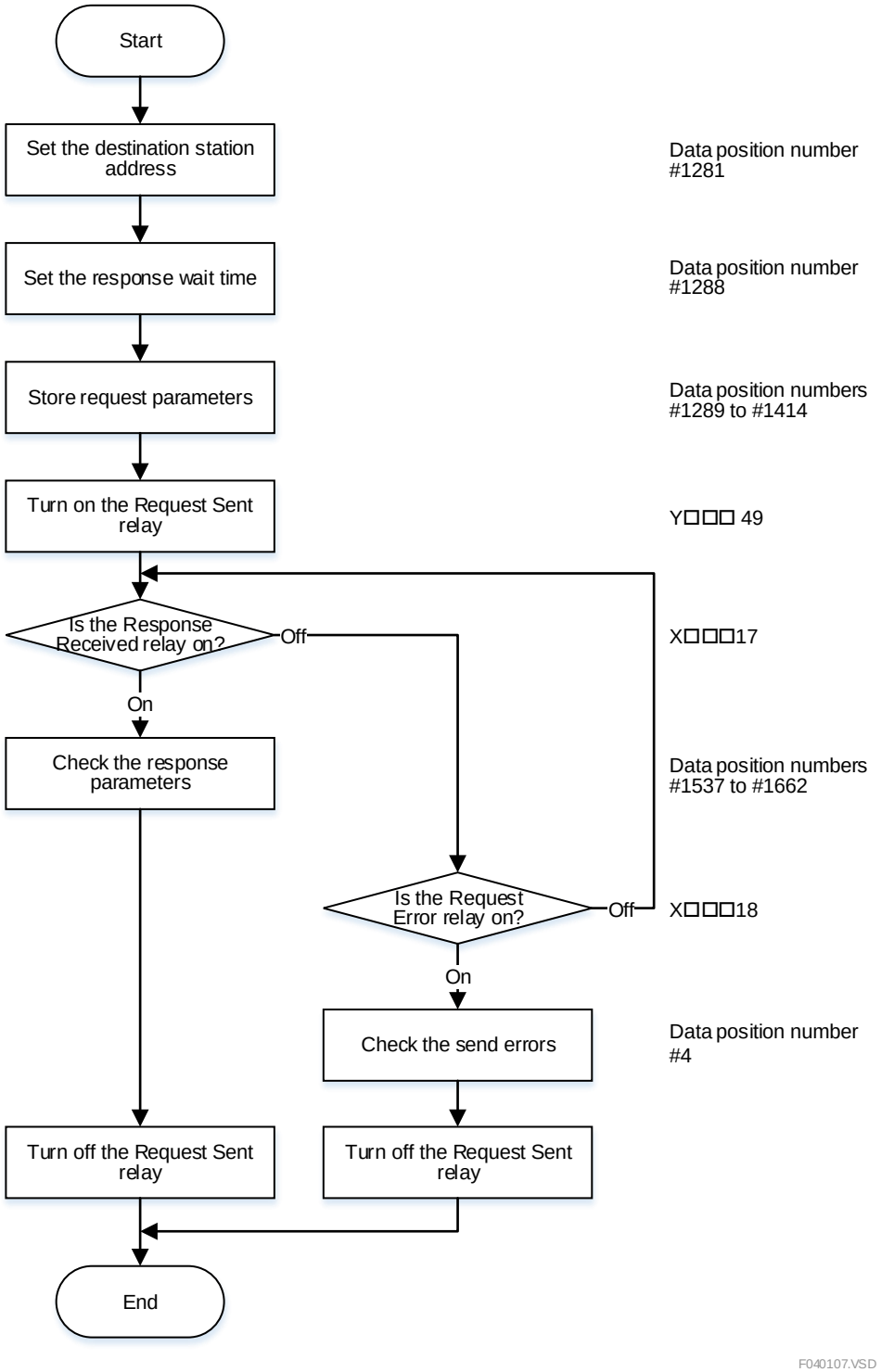


Figure 4.7 Procedure for Sending and Receiving

● Programming

Table 4.9 shows the setting values of request parameters.

Table 4.9 Example of Setting Values

Data position number	Name	Setting value	Remarks
1281	Destination station address	1	Request to station address 1
1288	Response wait time	0	Waiting for response up to 5000 ms
1289	Function code	$0003	Read Holding Registers
1290	Head holding register number	$0000	Holding register 1
1291	The number of read points	$0004	The number of registers: 4

Note

The Modbus device begins with 1, and the setting of head number begins with 0.
(Example) If you specify coil 1, the setting value of head coil number is 0.

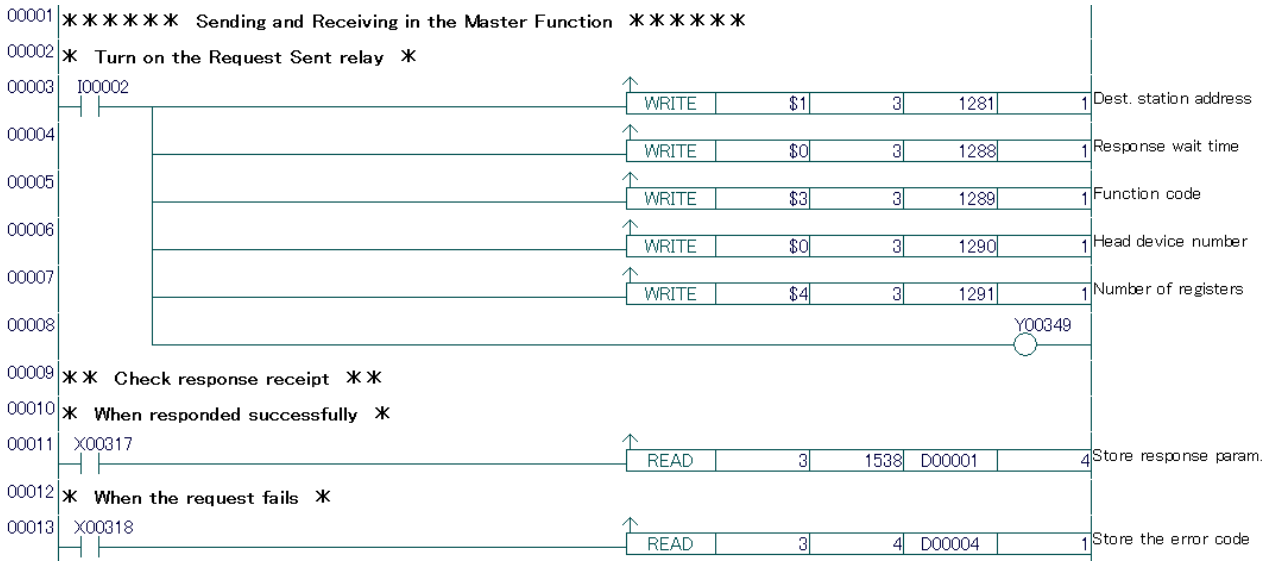


Figure 4.8 Sample Program for Sending and Receiving

5. Slave Function

With the slave function, you can set the module as a slave and connect it to the master. When the master sends request messages, the module returns response messages. This request/response interaction enables read/write access to devices (such as Data registers and Internel relays) of the FA-M3 CPU module.

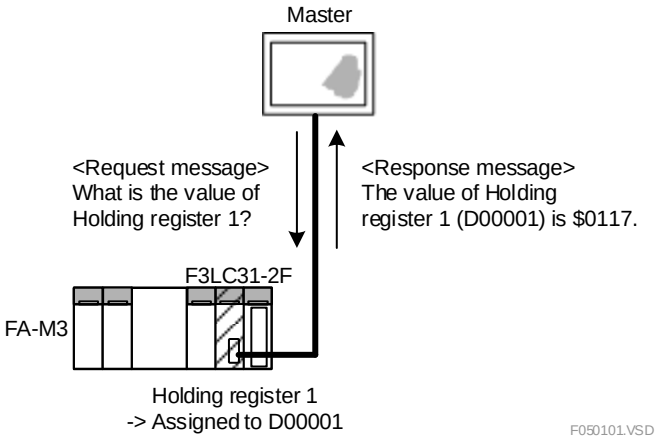


Figure 5.1 Slave Function

■ Supported Function Codes

The master can access Modbus devices of the module with the following function codes.

Table 5.1 Supported Function Codes

Function code	Name	Supported number of devices	Broadcast ✓: Supported ×: Not supported
01($01)	Read Coils	1 to 2,000	×
02($02)	Read Discrete inputs	1 to 2,000	×
03($03)	Read Holding Registers	1 to 125	×
04($04)	Read Input Registers	1 to 125	×
05($05)	Write Single Coil	1	✓
06($06)	Write Single Register	1	✓
07($07)	Read Exception Status	--	×
15($0F)	Write Multiple Coils	1 to 1,968	✓
16($10)	Write Multiple Registers	1 to 123	✓
23($17)	Read/Write Multiple Registers	Read: 1 to 125 Write: 1 to 121	×

■ Auto-Response Function

With the slave function, the module automatically returns a response message in response to a request message from the master. FA-M3 user programs do not need to care about these communications. (In short, no programming for these communications is required on the FA-M3 side.)
To use the auto-response function, the slave function settings are required. The auto-response function is activated when the station address of Data position number 9 is set to a number between 1 and 247, and the Setting Request relay is turned on.

■ Device Assignment Function

The device assignment function assigns Modbus devices to any devices of the CPU module.
This enables the master equipment to directly access devices of the FA-M3 CPU module.

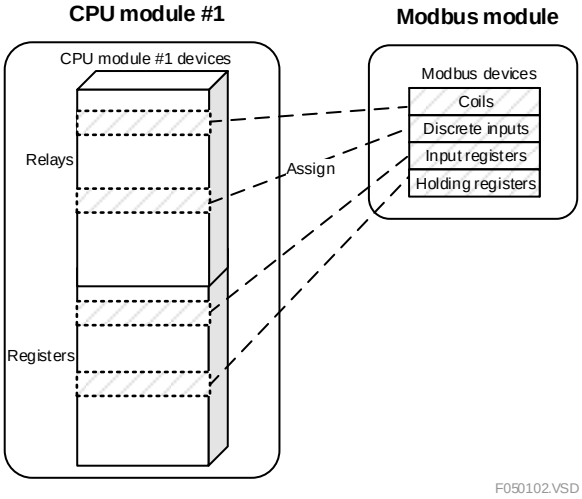


Figure 5.2 Device Assignment Function

Note

The main CPU (CPU1) is the only CPU module that can be accessed with the slave function. The multi-slave function supports multi-CPU systems. For details, refer to Chapter 6 in this manual.

● Notation of CPU module device

Devices of CPU module are represented by device names with 6 to 7 character strings. The device name consists of device type and device number.

(Example) The first device in the data register is represented by D00001.
- Device name: D00001
- Device type: D
- Device number: 00001

5.1 Input and Output Relays

This section describes relays used in the slave function.

■ Output Relays

Table 5.2 Output Relays

Output relay number	Name	Overview of the action
Y□□□41	Setting Request	When this relay turns on after setting parameters are written, setting processing is performed. After setting processing is completed, X□□□09 turns on. If the setting is completed successfully, X□□□11 turns on. If an error is included in the settings, X□□□10 turns on. Keep the relay on during Modbus communications.

■ Input Relays

Table 5.3 Input Relays

Input relay number	Name	Overview of the action
X□□□01	Ready	Turns on when the module starts up successfully. All of the setting processing must be performed after this relay turns on.
X□□□09	Setting Completed	Turns on upon completion of the setting request. This relay turns off when Y□□□41 turns off.
X□□□10	Setting Error	Turns on if an error occurs when the setting request is processed. This relay turns off when Y□□□41 turns off.
X□□□11	Setting Success	Turns on when the setting request is processed successfully. This relay turns off when Y□□□41 turns off.
X□□□16	Master Mode	This relay is on when the master function is in operation. It is off when the slave function is in operation. This relay turns off when Y□□□41 turns off.

5.2 Registers

This section describes registers used in the slave function.

■ List

Table 5.4 List of Registers

Data position number	Name		Description
3	Setting error code		Indicate wrong setting parameters
9	Station address		Select the slave function Set the station address (1 to 247)
10	Communication setting parameters		Set RS-485 communication parameters including the transmission mode and the write protection
11	Delay between frames		Delay in sending a response message
33	Coil	Device type	Device assignment settings Refer to Section 5.3
35		Head device number	
36			
37	Discrete input	Device type	
39		Head device number	
40			
41	Input register	Device type	
43		Head device number	
44			
45	Holding register	Device type	
47		Head device number	
48			

● Setting Error Code

The Setting Error relay (X□□□10) turns on when a setting error occurs, and the corresponding error code is stored in Data position number #3. The error code is initialized to $0000 when the Setting Request relay (Y□□□41) turns off.
For details on troubleshooting the setting errors, refer to Section 7.3.

Table 5.5 Setting Error Codes

Error code	Description
$0000	Success
$0001	Station address error
$0003	Invalid delay between frames
$0101	Coil assignment error
$0102	Discrete input assignment error
$0103	Input register assignment error
$0104	Holding register assignment error

● Station Address

Data position number	Name	Description
9	Station address	0: Master function 1 to 247: Slave function $8000: Multi-slave function

To select the slave function, set a number between 1 and 247 to Data position number #9. The setting value is the station address of the slave.

Communication Setting Parameters

You set RS-485 communication parameters. Set the parameters in Data position number #10. The communication parameters must match those of the master equipment.

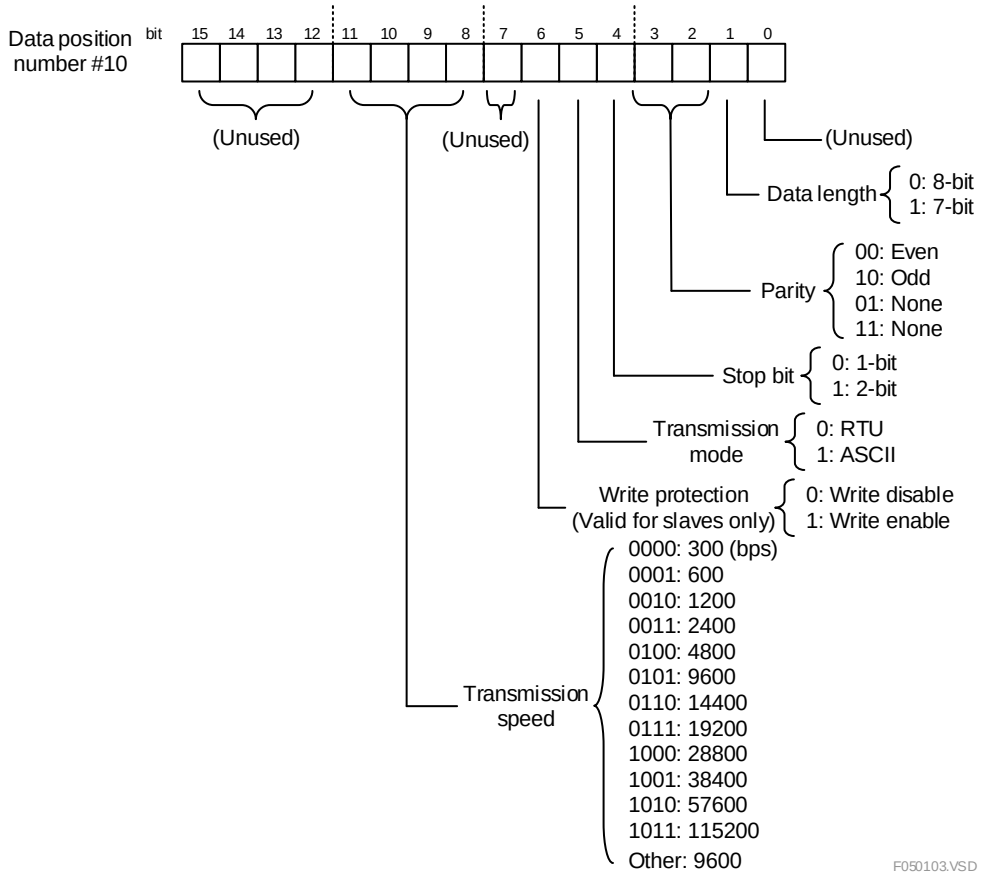


Figure 5.3 16-Bit Data in Communication Settings

Delay Between Frames

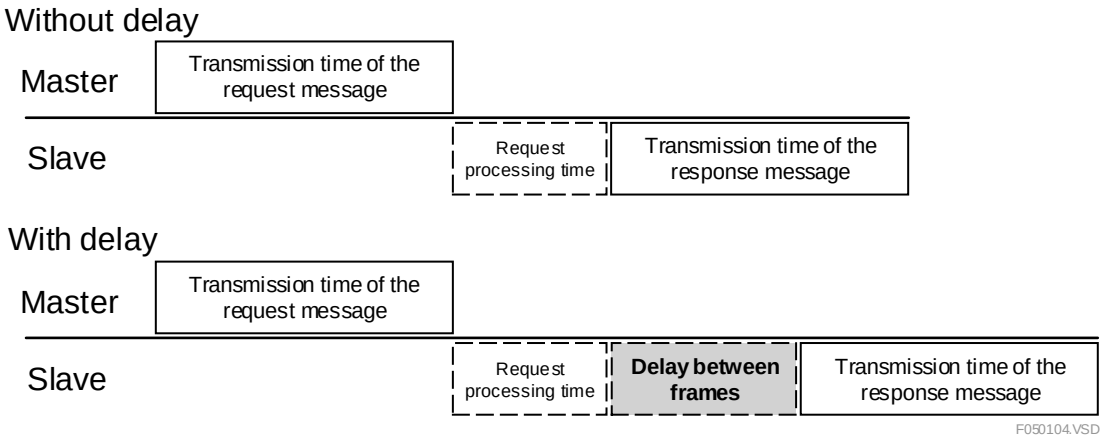


Figure 5.4 Delay Between Frames

Set the wait time before sending a response message in Data position number #11. Delay times can be specified in ms. (0 to 16382)
For the RTU mode, if the specified value of the wait time is shorter than 3.5 characters, it is ignored.

5.3 Device Assignment Settings

In device assignments settings, you specify device names assigned to each Modbus device.

● Device Types

The following table shows device types that the module supports.

Table 5.6 Supported Device types

Modbus Devices	Device types	Setting value	Remarks
Coil	Internal relay (I)	$09	
	Special relay (M)	$0D	Read only
Discrete input	Internal relay (I)	$09	
	Input relay (X)	$18	
	Special relay (M)	$0D	
Input register	Data register (D)	$04	
	File register (B)	$02	
	Cache register (F)	$06	
	Special register (Z)	$1A	
Holding register	Data register (D)	$04	
	File register (B)	$02	
	Cache register (F)	$06	
	Special register (Z)	$1A	Read only

The setting value for a device type is determined by the alphabetical position of the letter for the device.
Example) For D000117, its setting value is $04 because ‘D’ is the fourth letter of the alphabet.

● Head Device Number

Represent the head device number in 8-digit hexadecimal format. Then, store the upper 4 digits in the upper digits of the head device number and the lower 4 digits in the lower digits of the head device number.
Example) For B252525, the upper digits of the head device number is $0003 and the lower digits of the head device number is $DA6D because 252525 = $3DA6D.

● Example of Device Assignment Settings

When assigning Holding registers 00001 to the cache register, starting from F2001:

Data position number	Name	Setting value	Remarks
45	Holding register Device type	$0006	‘F’ is the sixth letter of the alphabet
47	Holding register Head device number(lower digits)	$07D1	2001 → $000007D1
48	Holding register Head device number(upper digits)	$0000	

● Initial Values of Device Assignment

If the device type is set to 0, initial values are applied.

Table 5.7 Initial Values of Device Assignment

Modbus device		Assigned device name
Coils	00001	I00001
Discrete inputs	00001	M00001
Input registers	00001	Z00001
Holding registers	00001	D00001

Note

The accessible devices are determined by the specifications of the CPU module. For details, refer to the manuals for the applicable CPU module.

5.4 Exception Status

As response parameters to function code $07, the module returns M129 to M136 of the CPU module. Each Special relay has special functionality such as indicating the internal status or errors of the CPU module.

Note

The behavior of Special relays depends on the specifications of the CPU module. For details, refer to the manuals for the applicable CPU module.

5.5 Response Error Codes

If a request message has not been processed, the module returns a response error code.

Table 5.8 Response Error Codes

Error code	Name	Description
$0001	Invalid function code	The function code is not supported
$0002	Invalid data address	The address is not supported
$0003	Invalid data value	The data is out of range
$0004	Unable to process	The function cannot be executed due to some reasons

● Cases Where the Module Does Not Respond

- A transmission error has been detected, such as an overrun, framing, parity, LRC, or CRC-16 error
- An inter-character timeout has occurred
- Destination station address is incorrect
- Destination station address is set to “00” (broadcast)
- A receive buffer overflow has occurred (The size of the receive buffer is 2048 bytes)

5.6 How to Use

■ Slave Function Settings

● Procedure

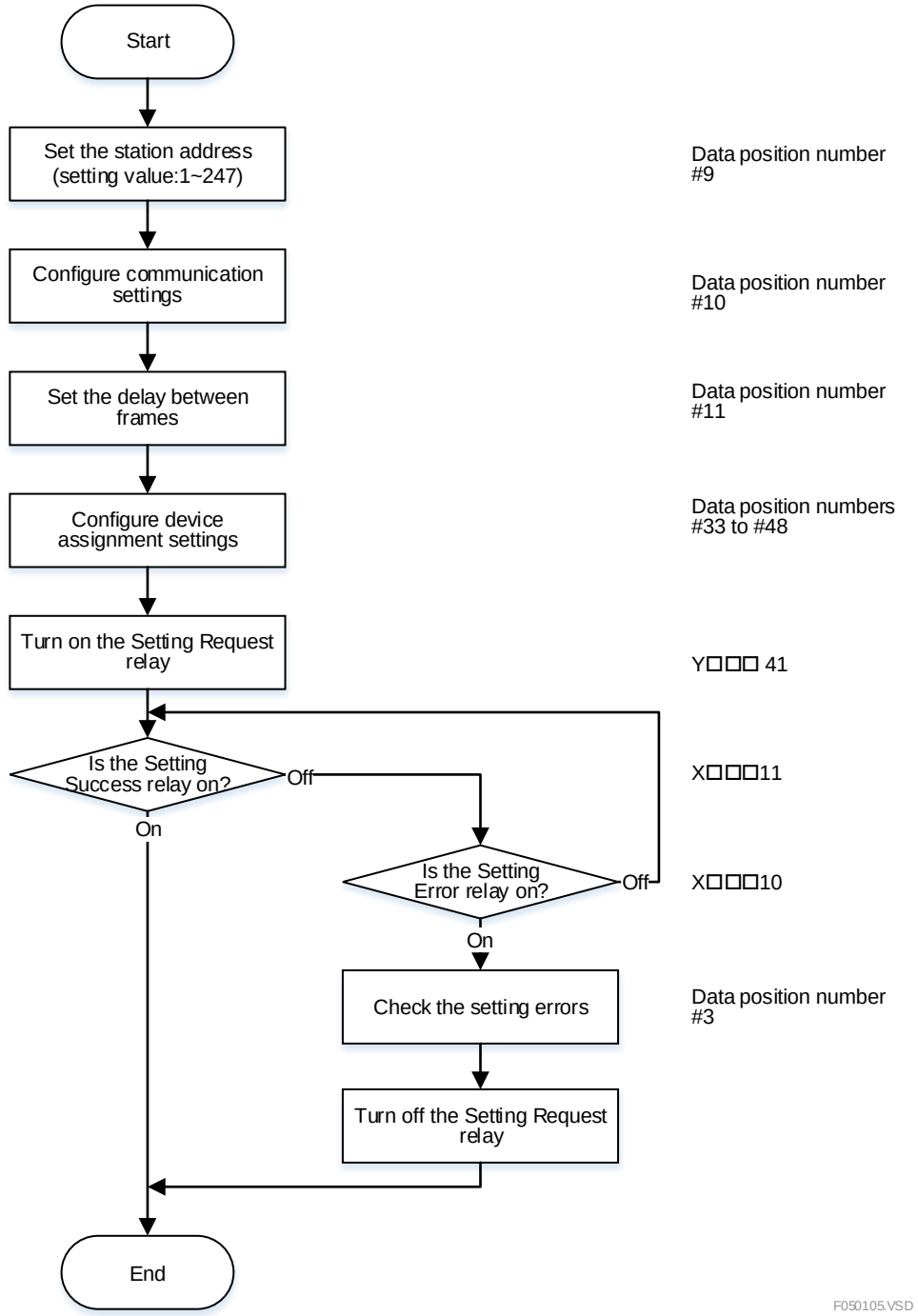


Figure 5.5 Slave Function Settings

● Programming

Table 5.9 Example of Setting Values

Data position number	Name		Setting value	Remarks
9	Station address		1	Station address 1
10	Communication setting parameters		$0B40	Transmission speed: 115200 bps Write protection: write enable Transmission mode: RTU Stop bit: 1 bit Parity: Even Data length: 8-bit
11	Delay between frames		10	Delay between frames: 10 ms
33	Coil	Device type	$0009	From I10001
35		Head device number	$2711	
36			$0000	
37	Discrete input	Device type	$0018	From X00301
39		Head device number	$012D	
40			$0000	
41	Input register	Device type	$0000	From Z00001 (Initial value)
43		Head device number	$0000	
44			$0000	
45	Holding register	Device type	$0004	From D20001
47		Head device number	$4E21	
48			$0000	

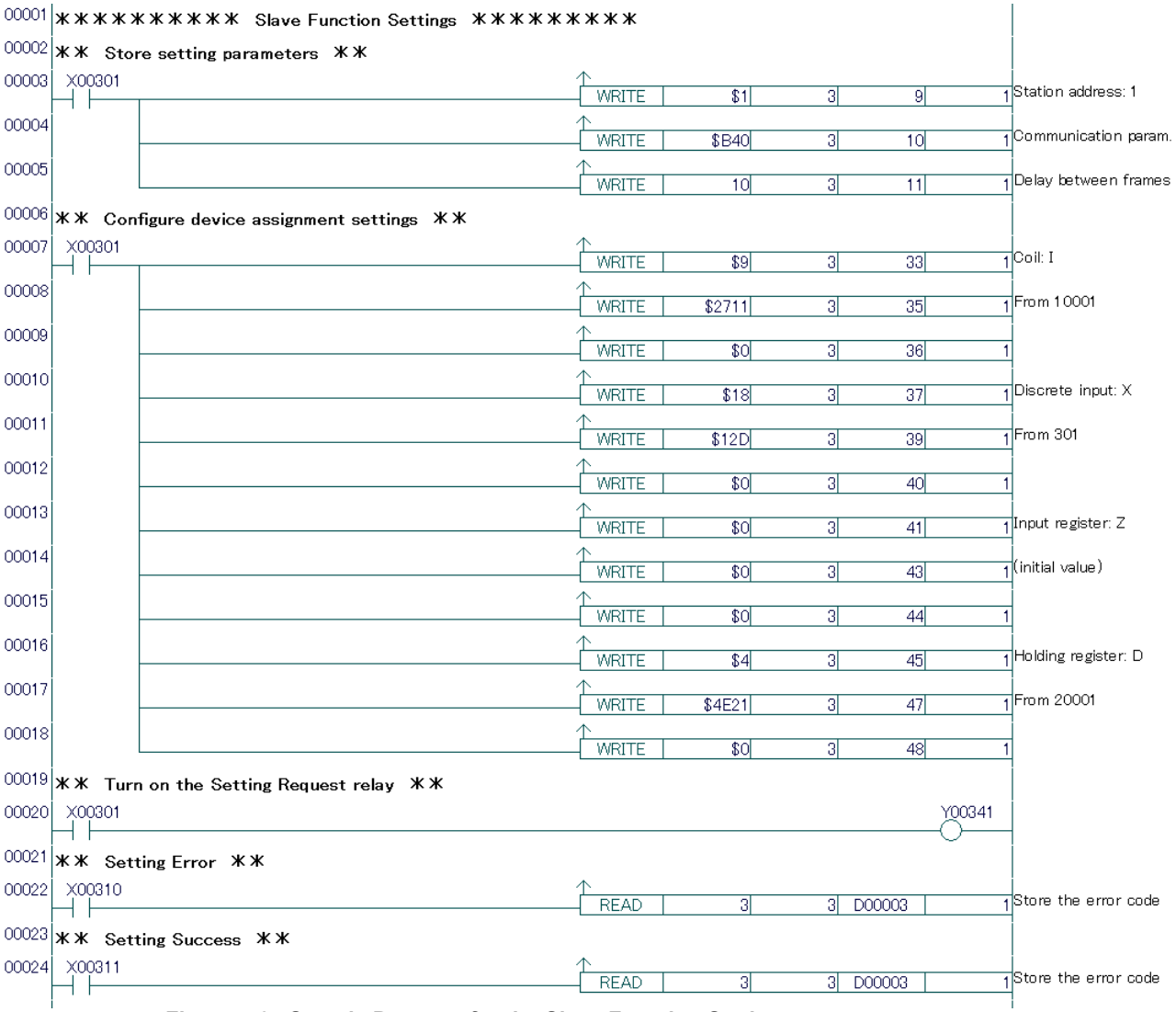


Figure 5.6 Sample Program for the Slave Function Settings

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6. Multi-Slave Function

The module provides the multi-slave function as an extended function of the slave function. Multiple station addresses can be set to the module, allowing the module to communicate as multiple slaves. Each station address has a Modbus device. Up to eight station addresses can be set.

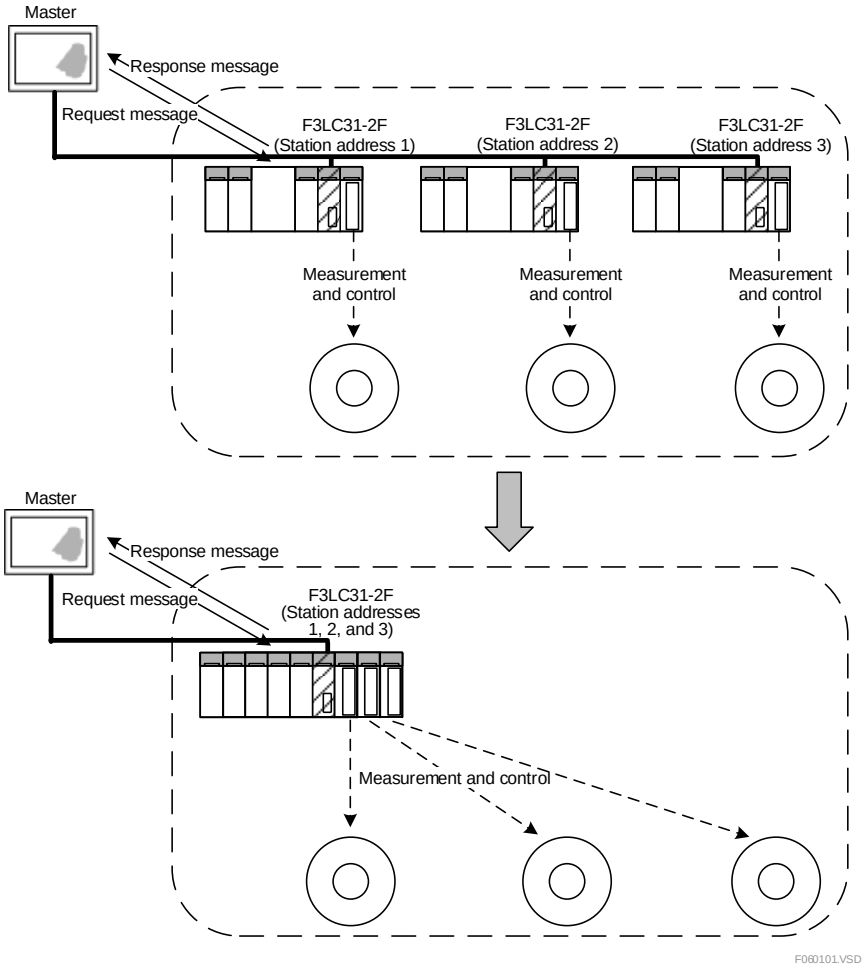

Figure 6.1 Multi-Slave Function

■ Supported Function Codes

The master can access Modbus devices of the module with the following function codes.

Table 6.1 Supported Function Codes

Function code	Name	Supported number of devices	Broadcast ✓: Supported ×: Not supported
01($01)	Read Coils	1 to 2,000	×
02($02)	Read Discrete inputs	1 to 2,000	×
03($03)	Read Holding Registers	1 to 125	×
04($04)	Read Input Registers	1 to 125	×
05($05)	Write Single Coil	1	✓
06($06)	Write Single Register	1	✓
07($07)	Read Exception Status	--	×
15($0F)	Write Multiple Coils	1 to 1,968	✓
16($10)	Write Multiple Registers	1 to 123	✓
23($17)	Read/Write Multiple Registers	Read: 1 to 125 Write: 1 to 121	×

■ Multi-CPU Systems Supported

With the multi-slave function, you can specify the CPUs to which devices are assigned.

■ Device Assignment Function

In the Modbus communication, devices are accessed in the Modbus device format. With the multi-slave function, Modbus devices can be assigned to any devices of the CPU module.
The Modbus device assignment enables the master to directly access devices of the FA-M3 CPU module.
With the multi-slave function, Modbus devices can be assigned for each station address. CPUs can also be specified.

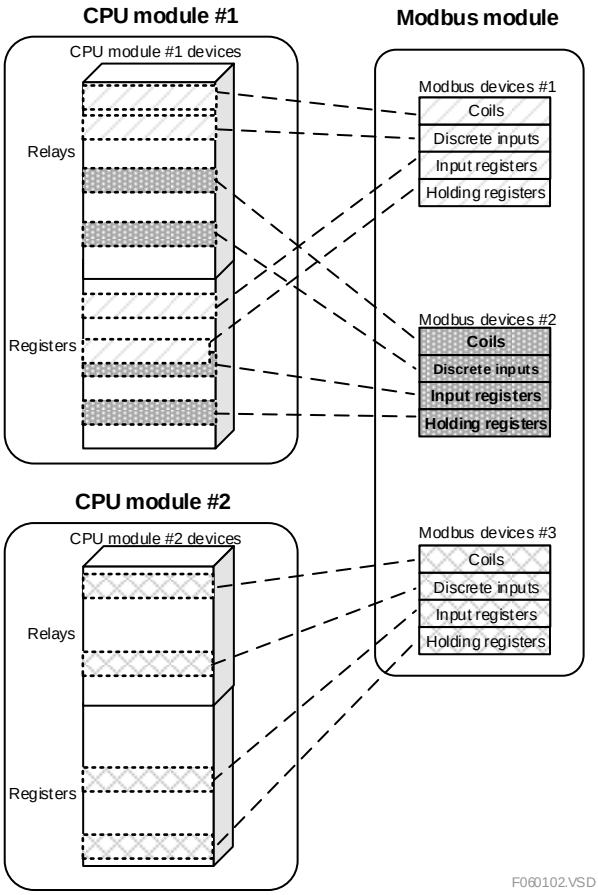

Figure 6.2 Device Assignment with the Multi-Slave Function

● Notation of CPU module device

Devices of CPU module are represented by device names with 6 to 7 character strings. The device name consists of device type and device number.

(Example) The first device in the data register is represented by D00001.
- Device name: D00001
- Device type: D
- Device number: 00001

6.1 Input and Output Relays

This section describes relays used in the multi-slave function.

■ Output Relays

Table 6.2 Output Relays

Output relay number	Name	Overview of the action
Y□□□41	Setting Request	When this relay turns on after setting parameters are written, setting processing is performed. After setting processing is completed, X□□□09 turns on. If the setting is completed successfully, X□□□11 turns on. If an error is included in the settings, X□□□10 turns on. Keep the relay on during Modbus communications.

■ Input Relays

Table 6.3 Input Relays

Input relay number	Name	Overview of the action
X□□□01	Ready	Turns on when the module starts up successfully. All of the setting processing must be performed after this relay turns on.
X□□□09	Setting Completed	Turns on upon completion of the setting request. This relay turns off when Y□□□41 turns off.
X□□□10	Setting Error	Turns on if an error occurs when the setting request is processed. This relay turns off when Y□□□41 turns off.
X□□□11	Setting Success	Turns on when the setting request is processed successfully. This relay turns off when Y□□□41 turns off.
X□□□16	Master Mode	This relay is on when the master function is in operation. It is off when the slave function is in operation. This relay turns off when Y□□□41 turns off.

6.2 Registers

This section describes registers used in the multi-slave function.

■ List

Table 6.4 List of Registers

Data position number	Name			Description
3	Setting error code			Indicate wrong setting parameters
9	Station address			Select the multi-slave function
10	Communication setting parameters			Set RS-485 communication parameters including the transmission mode and the write protection
11	Delay between frames			Delay in sending a response message
17	Slave #1 station address and CPU number			Set station addresses for each slave Multi-CPU systems supported
18	Slave #2 station address and CPU number			
19	Slave #3 station address and CPU number			
20	Slave #4 station address and CPU number			
21	Slave #5 station address and CPU number			
22	Slave #6 station address and CPU number			
23	Slave #7 station address and CPU number			
24	Slave #8 station address and CPU number			
129	Slave #1	Coil	Device type	Device assignment settings Refer to Section 6.3
131			Head device number	
132				
133		Discrete input	Device type	
135			Head device number	
136				
137		Input register	Device type	
139			Head device number	
140				
141		Holding register	Device type	
143			Head device number	
144				
145	Slave #2	Coil	Device type	Device assignment settings Refer to Section 6.3
147			Head device number	
148				
149		Discrete input	Device type	
151			Head device number	
152				
153		Input register	Device type	
155			Head device number	
156				
157		Holding register	Device type	
159			Head device number	
160				
161	Slave #3	Coil	Device type	Device assignment settings Refer to Section 6.3
163			Head device number	
164				
165		Discrete input	Device type	
167			Head device number	
168				
169		Input register	Device type	
171			Head device number	
172				
173		Holding register	Device type	
175			Head device number	
176				
177	Slave #4	Coil	Device type	Device assignment settings Refer to Section 6.3
179			Head device number	
180				
181		Discrete input	Device type	
183			Head device number	
184				
185		Input register	Device type	
187			Head device number	
188				
189		Holding	Device type	

191 192		register	Head device number	
193	Slave #5	Coil	Device type	Device assignment settings Refer to Section 6.3
195 196			Head device number	
197		Discrete input	Device type	
199 200			Head device number	
201		Input register	Device type	
203 204			Head device number	
205		Holding register	Device type	
207 208			Head device number	
209	Slave #6	Coil	Device type	Device assignment settings Refer to Section 6.3
211 212			Head device number	
213		Discrete input	Device type	
215 216			Head device number	
217		Input register	Device type	
219 220			Head device number	
221		Holding register	Device type	
223 224			Head device number	
225	Slave #7	Coil	Device type	Device assignment settings Refer to Section 6.3
227 228			Head device number	
229		Discrete input	Device type	
231 232			Head device number	
233		Input register	Device type	
235 236			Head device number	
237		Holding register	Device type	
239 240			Head device number	
241	Slave #8	Coil	Device type	Device assignment settings Refer to Section 6.3
243 244			Head device number	
245		Discrete input	Device type	
247 248			Head device number	
249		Input register	Device type	
251 252			Head device number	
253		Holding register	Device type	
255 256			Head device number	

● Setting Error

The Setting Error relay (X□□□10) turns on when a setting error occurs, and the corresponding error code is stored in Data position number #3. The error code is initialized to $0000 when the Setting Request relay (Y□□□41) turns off.
For details on troubleshooting the setting errors, refer to Section 7.3.

Table 6.5 Setting Error Codes

Error code	Description
$0000	Success
$0001	Station address error
$0002	Wrong CPU number
$0003	Invalid delay between frames
$0111	Slave #1 coil assignment error
$0112	Slave #1 discrete input assignment error
$0113	Slave #1 input register assignment error
$0114	Slave #1 holding register assignment error
$0121	Slave #2 coil assignment error
$0122	Slave #2 discrete input assignment error
$0123	Slave #2 input register assignment error
$0124	Slave #2 holding register assignment error
$0131	Slave #3 coil assignment error
$0132	Slave #3 discrete input assignment error
$0133	Slave #3 input register assignment error
$0134	Slave #3 holding register assignment error
$0141	Slave #4 coil assignment error
$0142	Slave #4 discrete input assignment error
$0143	Slave #4 input register assignment error
$0144	Slave #4 holding register assignment error
$0151	Slave #5 coil assignment error
$0152	Slave #5 discrete input assignment error
$0153	Slave #5 input register assignment error
$0154	Slave #5 holding register assignment error
$0161	Slave #6 coil assignment error
$0162	Slave #6 discrete input assignment error
$0163	Slave #6 input register assignment error
$0164	Slave #6 holding register assignment error
$0171	Slave #7 coil assignment error
$0172	Slave #7 discrete input assignment error
$0173	Slave #7 input register assignment error
$0174	Slave #7 holding register assignment error
$0181	Slave #8 coil assignment error
$0182	Slave #8 discrete input assignment error
$0183	Slave #8 input register assignment error
$0184	Slave #8 holding register assignment error

● Station Address

Data position number	Name	Description
9	Station address	0: Master function 1 to 247: Slave function $8000: Multi-slave function

To select the multi-slave function, set $8000 to Data position number #9. You can set station addresses for each slave as described in “●Slave#n Station Address and CPU Number”.

● Slave#n Station Address and CPU Number

You set the station address and the CPU number for each slave.

The station address can be set in the lower 8 bits. Specify a number between 1 and 247.
Up to eight settings are allowed. The smaller the data position number is, the earlier the data is set. The settings are valid until 0 is set. Subsequent settings are ignored.

The CPU number can be set in the upper 8 bits. Specify 0 or a number between 1 and 4. Setting 0 means that you specify CPU1.

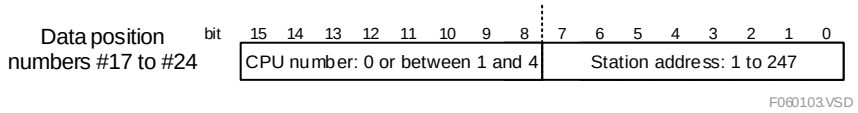

Figure 6.3 16-Bit Data in Slave#n Station Address and CPU Number

A setting example is shown in the following table. As 0 is set to Multi-slave station address #5, four slaves are set and fifth and succeeding settings are ignored.

Table 6.6 Setting Example of Slave#n Station Address and CPU Number

Data position number	Setting value	Remarks
9	$8000	Select the multi-slave function
17	$0002	Slave #1: CPU1, Station address $02
18	$0115	Slave #2: CPU1, Station address $15
19	$0249	Slave #3: CPU2, Station address $49
20	$0401	Slave #4: CPU4, Station address $01
21	0	End specification
22	-	
23	-	
24	-	

Note

If a station address is specified more than once, the slave for which the station address is specified first takes precedence over the others. When a broadcast request is sent, all the slaves process the same request.
(Example) If the station addresses of both Slave #1 and Slave #2 are set to $09, when the slaves receive a request to Station address $09 from the master, only Slave #1 processes the request. In contrast, for a broadcast request, both Slave #1 and Slave #2 process the request.

Note

If you use a multi-CPU system, you need to set only one CPU module that uses the module. For details on the configuration settings, refer to “FA-M3 Programming Tool WideField3 (Introduction and Troubleshooting)” (IM 34M06Q16-01E).

Communication Setting Parameters

You set RS-485 communication parameters. Set the parameters in Data position number #10. The communication parameters must match those of the master equipment.

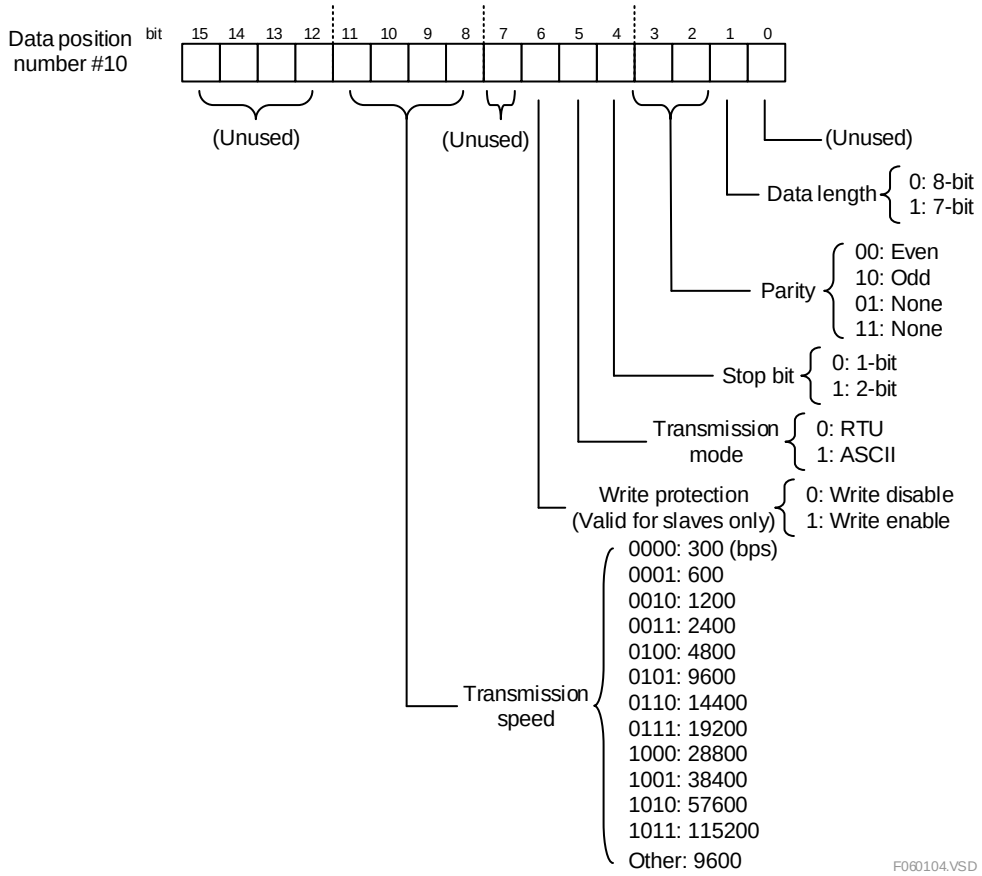

Figure 6.4 16-Bit Data in Communication Settings

Delay Between Frames

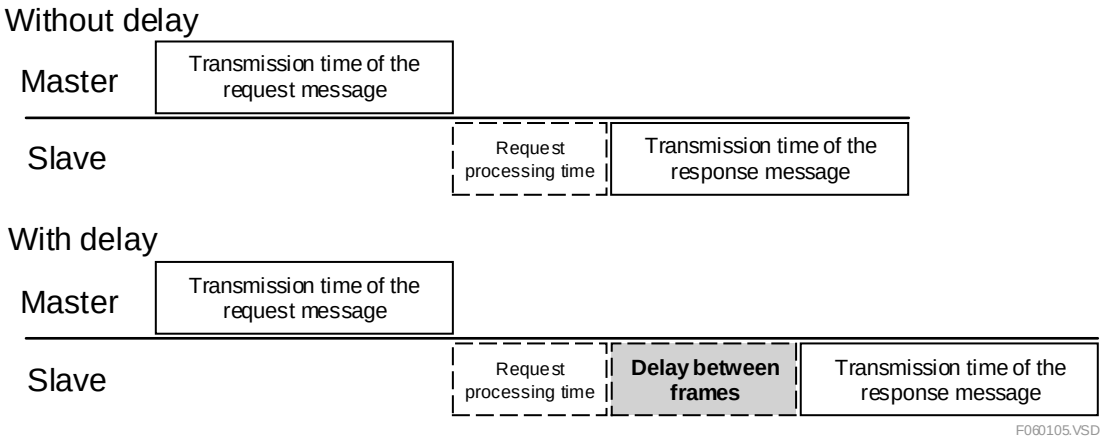

Figure 6.5 Delay Between Frames

Set the wait time before sending a response message in Data position number #11. Delay times can be specified in ms. (0 to 16,382 ms)
For the RTU mode, if the specified value of the wait time is shorter than 3.5 characters, it is ignored.

6.3 Device Assignment Settings

In device assignments settings, you specify device names assigned to each Modbus device.

● Device Types

The following table shows device types that the module supports.

Table 6.7 Supported Device Types

Modbus Devices	Device types	Setting value	Remarks
Coil	Internal relay (I)	$09	
	Special relay (M)	$0D	Read only
Discrete input	Internal relay (I)	$09	
	Input relay (X)	$18	
	Special relay (M)	$0D	
Input register	Data register (D)	$04	
	File register (B)	$02	
	Cache register (F)	$06	
	Special register (Z)	$1A	
Holding register	Data register (D)	$04	
	File register (B)	$02	
	Cache register (F)	$06	
	Special register (Z)	$1A	Read only

The setting value for a device type is determined by the alphabetical position of the letter for the device.
Example) For D00117, its setting value is $04 because ‘D’ is the fourth letter of the alphabet.

● Head Device Number

Represent the head device number in 8-digit hexadecimal format. Then, store the upper 4 digits in the upper digits of the head device number and the lower 4 digits in the lower digits of the head device number.
Example) For B252525, the upper digits of the head device number is $0003 and the lower digits of the head device number is $DA6D because 252525 = $3DA6D.

● Example of Device Assignment Settings

When assigning Holding register 00001 of Slave #1 to F2001, and Holding register 00001 of Slave #2 to B3001:

Data position number	Name	Setting value	Remarks
141	Slave #1 Holding register Device type	$0006	‘F’ is the sixth letter of the alphabet
143	Slave #1 Holding register Head device number(lower digits)	$07D1	2001 -> $000007D1
144	Slave #1 Holding register Head device number(upper digits)	$0000	
157	Slave #2 Holding register Device type	$0002	‘B’ is the second letter of the alphabet
159	Slave #2 Holding register Head device number(lower digits)	$0BB9	3001 -> $00000BB9
160	Slave #2 Holding register Head device number(upper digits)	$0000	

● Initial Values of Device Assignment

If the device type is set to 0, initial values are applied.

Table 6.8 Initial Values of Device Assignment

Modbus device		Assigned device name (vary by slave)							
		#1	#2	#3	#4	#5	#6	#7	#8
Coils	00001	I00001	I01025	I02049	I03073	I04097	I05121	I06145	I07169
Discrete inputs	00001	M00001							
Input registers	00001	Z00001							
Holding registers	00001	D00001	D01025	D02049	D03073	D04097	D05121	D06145	D07169

Note

The accessible devices are determined by the specifications of the CPU module. For details, refer to the manuals for the applicable CPU module.

6.4 Exception Status

As response parameters to function code $07, the module returns M129 to M136 of the CPU module. Each Special relay has special functionality such as indicating the internal status or errors of the CPU module.

Note

The behavior of Special relays depends on the specifications of the CPU module. For details, refer to the manuals for the applicable CPU module.

6.5 Response Error Codes

If a request message has not been processed, the module returns a response error code.

Table 6.9 Response Error Codes

Error code	Name	Description
$0001	Invalid function code	The function code is not supported
$0002	Invalid data address	The address is not supported
$0003	Invalid data value	The data is out of range
$0004	Unable to process	The function cannot be executed due to some reasons

● Cases Where the Module Does Not Respond

- A transmission error has been detected, such as an overrun, framing, parity, LRC, or CRC-16 error
- An inter-character timeout has occurred
- Destination station address is incorrect
- Destination station address is set to “00” (broadcast)
- A receive buffer overflow has occurred (The size of the receive buffer is 2048 bytes)

6.6 How to Use

■ Multi-Slave Function Settings

● Procedure

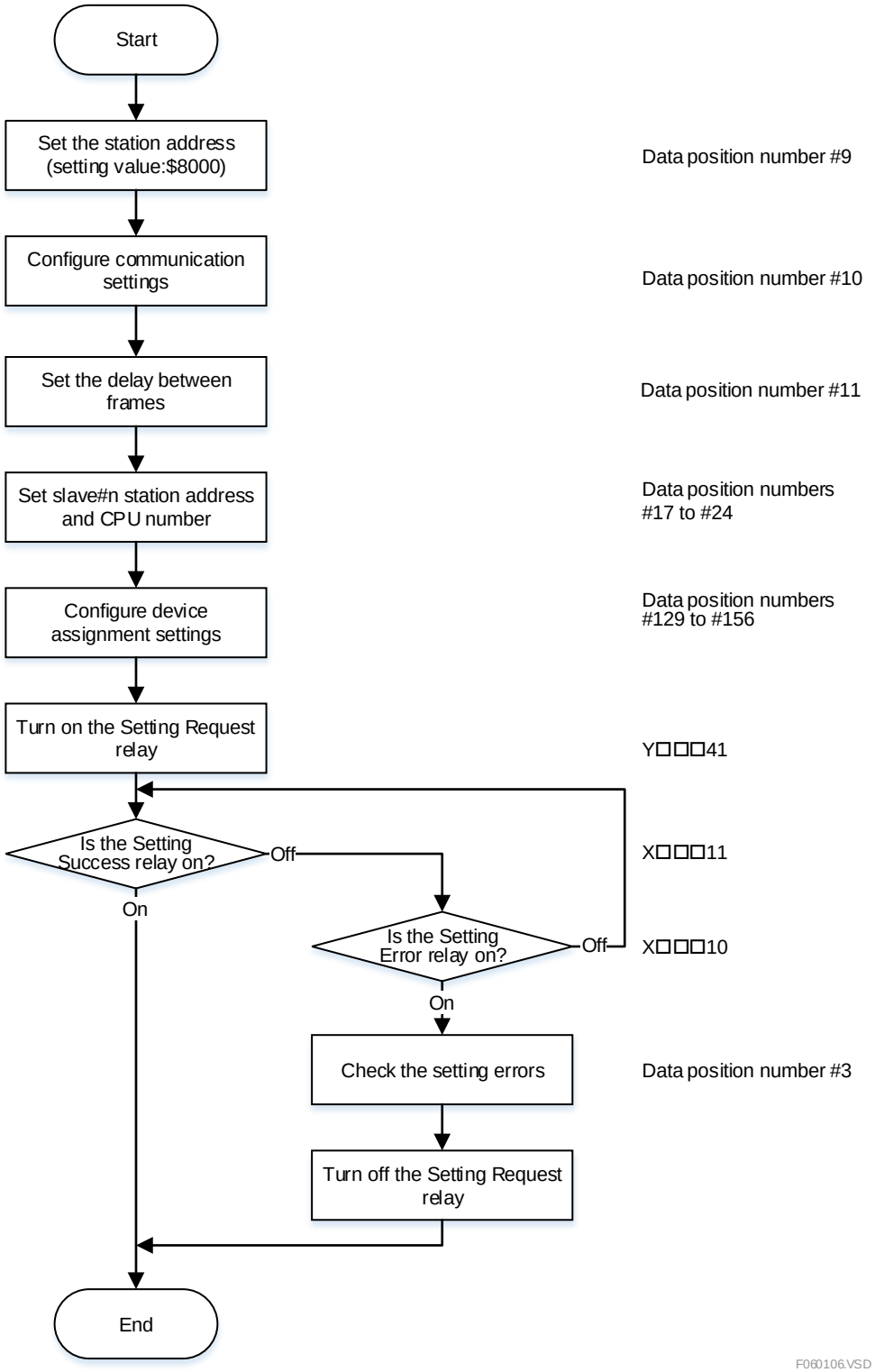

Figure 6.6 Multi-Slave Function Settings

● Programming

Table 6.10 Example of Setting Values

Data position number	Name			Setting value	Remarks
9	Station address			$8000	Select the multi-slave
10	Communication setting parameters			$0540	Transmission speed: 9600 bps Write protection: write enable Transmission mode: RTU Stop bit: 1 bit Parity: Even Data length: 8-bit
11	Delay between frames			10	Delay between frames: 10 ms
17	Slave #1 station address and CPU number			$0011	CPU1, Station address $11
18	Slave #2 station address and CPU number			$0264	CPU2, Station address $64
19	Slave #3 station address and CPU number			$04F7	CPU4, Station address $F7
20	Slave #4 station address and CPU number			0	End specification
129	Slave #1	Coil	Device type	$0009	From I00001
131			Head device number	$0001	
132				$0000	
141		Holding register	Device type	$0004	From X00301
143			Head device number	$03E9	
144				$0000	
149	Slave #2	Discrete input	Device type	$0009	From M00127
151			Head device number	$007F	
152				$0000	
153		Input register	Device type	$0002	From B200001
155			Head device number	$0D41	
156				$0003	

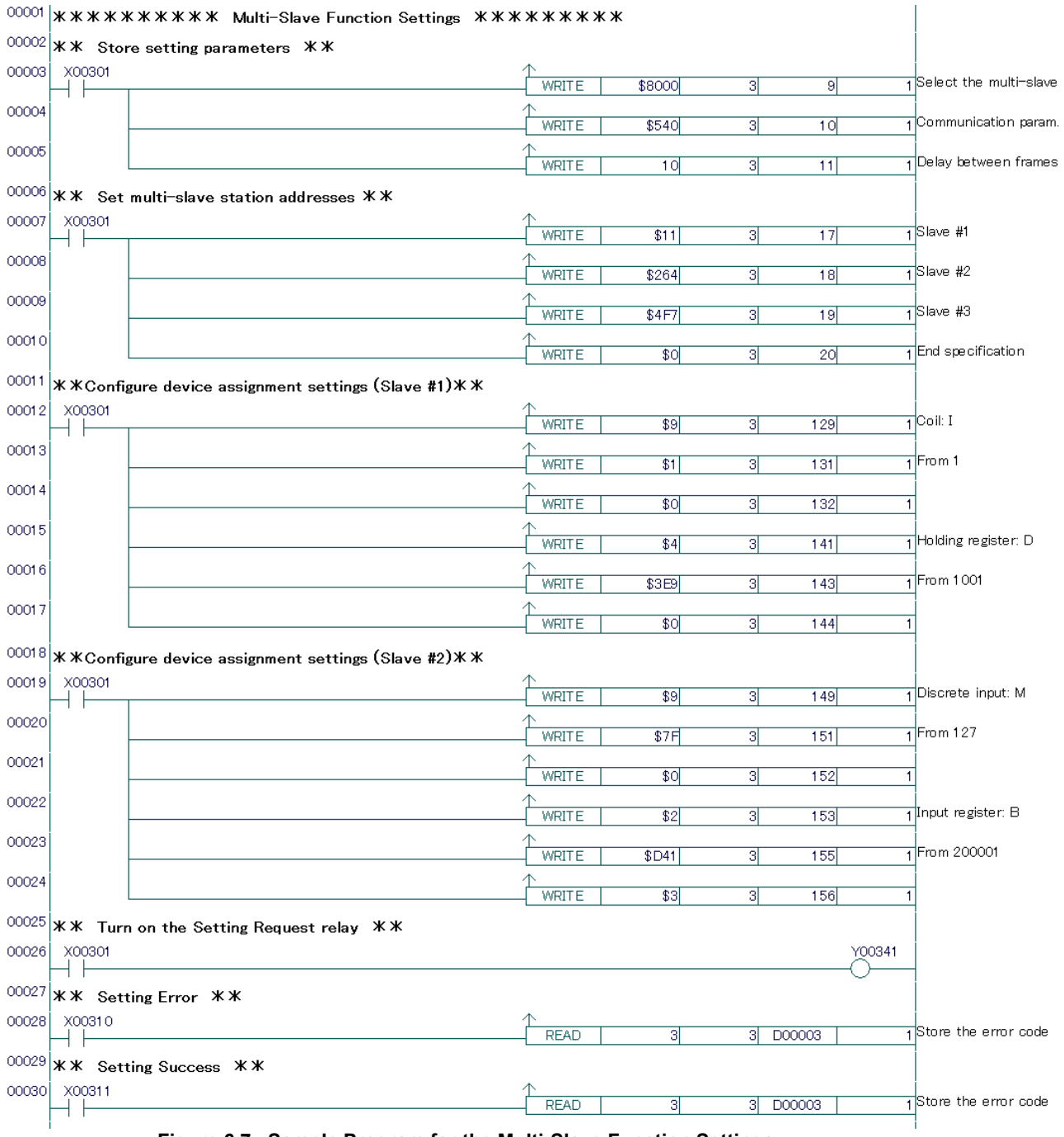

Figure 6.7 Sample Program for the Multi-Slave Function Settings

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7. Troubleshooting

7.1 Flowchart for Troubleshooting When RDY LED is Not Lit

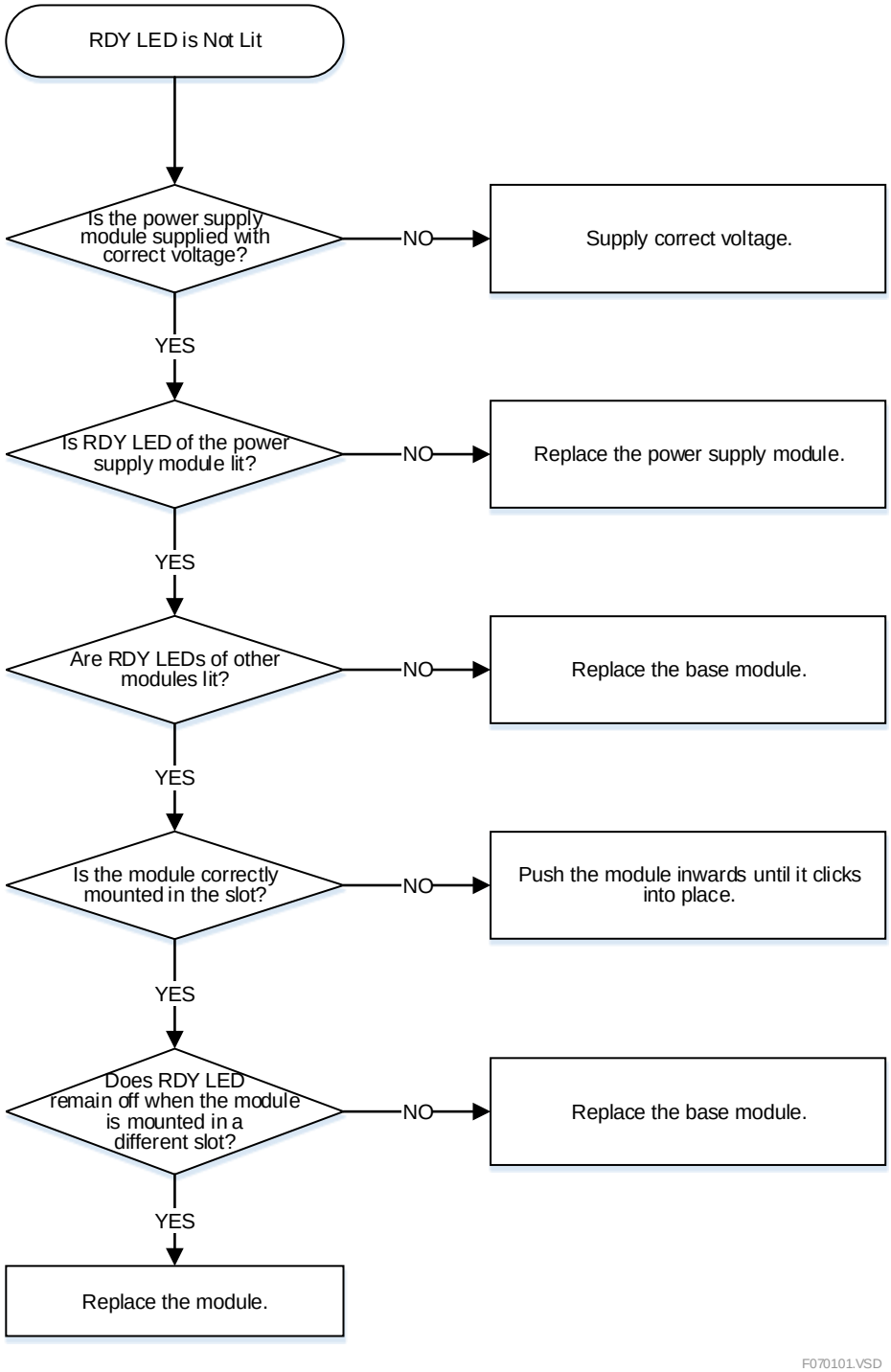

Figure 7.1 Flowchart for Troubleshooting When RDY LED is Not Lit

7.2 Flowchart for Troubleshooting When Communication Fails

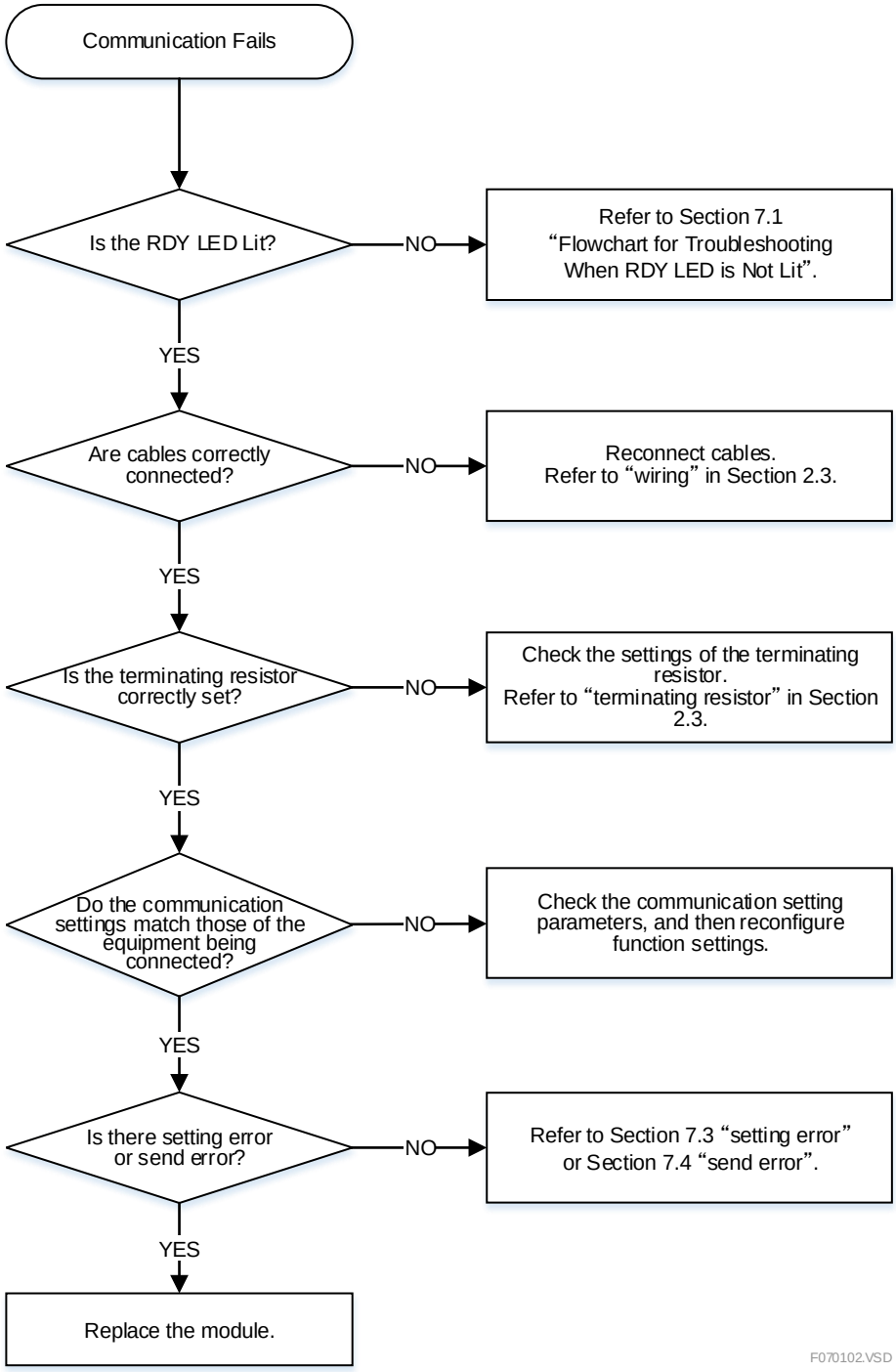

Figure 7.2 Flowchart for Troubleshooting When Communication Fails

7.3 Setting Error Codes

The Setting Error relay (X□□□10) turns on when a setting error occurs, and the corresponding error code is stored in Data position number #3. The error code is initialized to $0000 when the Setting Request relay (Y□□□41) turns off.

Table 7.1 Setting Error Codes

Error code	Name		Details	Solution
$0000	Success		-	-
$0001	Station address error	Common	The setting value of Data position number #9 is out of range	Set one of the following valid values: 0: Master function 1 to 247: Slave function $8000: Multi-slave function
		Multi-slave function	The setting values of Data position numbers #17 to #24 are out of range	Set a number between 1 and 247 to the lower 8 bits Refer to "●Slave#n Station Address and CPU Number" in Section 6.2
$0002	Wrong CPU number		The setting values of Data position numbers #17 to #24 are out of range	Set 0 or a number between 1 and 4 to the upper 8 bits Refer to "●Slave#n Station Address and CPU Number" in Section 6.2
$0003	Invalid delay between frames		The setting value of Data position number #11 is out of range	Set the value from 0 to 16382 Refer to "● Delay Between Frames" in Section 6.2
$0101	Coil assignment error		The setting value of the device assignment in the slave function is out of range	1) Set the supported device types. 2) Set the device number within the range. Refer to Section 5.3
$0102	Discrete input assignment error			
$0103	Input register assignment error			
$0104	Holding register assignment error			
$0111	Slave #1 coil assignment error		The setting value of the device assignment in the multi-slave function is out of range	1) Set the supported device types. 2) Set the device number within the range. Refer to Section 6.3
$0112	Slave #1 discrete input assignment error			
$0113	Slave #1 input register assignment error			
$0114	Slave #1 holding register assignment error			
$0121	Slave #2 coil assignment error			
$0122	Slave #2 discrete input assignment error			
$0123	Slave #2 input register assignment error			
$0124	Slave #2 holding register assignment error			
$0131	Slave #3 coil assignment error			
$0132	Slave #3 discrete input assignment error			
$0133	Slave #3 input register assignment error			
$0134	Slave #3 holding register assignment error			
$0141	Slave #4 coil assignment error			
$0142	Slave #4 discrete input assignment error			
$0143	Slave #4 input register assignment error			
$0144	Slave #4 holding register assignment error			
$0151	Slave #5 coil assignment error			
$0152	Slave #5 discrete input assignment error			
$0153	Slave #5 input register assignment error			
$0154	Slave #5 holding register assignment error			
$0161	Slave #6 coil assignment error			
$0162	Slave #6 discrete input assignment error			
$0163	Slave #6 input register assignment error			
$0164	Slave #6 holding register assignment error			
$0171	Slave #7 coil assignment error			
$0172	Slave #7 discrete input assignment error			
$0173	Slave #7 input register assignment error			
$0174	Slave #7 holding register assignment error			
$0181	Slave #8 coil assignment error			
$0182	Slave #8 discrete input assignment error			
$0183	Slave #8 input register assignment error			
$0184	Slave #8 holding register assignment error			

7.4 Send Error Codes

The Request Error relay (X□□□18) turns on when a send error occurs, and the error code is stored in Data position number #4. The error code is initialized to $0000 when the Send Request relay (Y□□□49) turns off.

Table 7.2 Send Error Codes

Error code	Name	Details	Solution
$0000	Success	-	-
$0301	Station address error	The specified station address is out of range	Set 0 to 247 to Data position number #1281 Refer to "● Destination Station Address" in Section 4.2
$0302	Function code error	The specified function code is unsupported	Change the value of Data position number #1289 Refer to "■ Supported Function Codes" in Chapter 4
$0303	Broadcast is not supported	The specified function code is unsupported	Change the value of Data position number #1289 Refer to "■ Supported Function Codes" in Chapter 4
$0304	Parameter error (count)	The specified value exceeds the supported number of devices	Change the value of the number of devices Refer to Section 4.3
$0307	Communication timeout	A response from the slave is not received after the response wait time	Refer to "Flowchart for Troubleshooting When Communication Fails" in Section 7.2
$0308	Station address unmatched	The station address is different between the request message and response message	1) If the response time from slaves is long, change the response wait time 2) Make sure that no more than one master is set and check whether more than one slave with the same station address is set
$0309	Function code unmatched	The function code is different between the response message and response message	1) If the response time from slaves is long, change the response wait time 2) Make sure that no more than one master is set and check whether more than one slave with the same station address is set
$030A	CRC/LRC error	The received error check and the calculated error check do not match	Retry the operation
$030B	Not in the master mode	The Request Sent relay is turned on without the master function being enabled	Try again after enabling the master function

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