

Programmable Controller FP-X

MODBUS RTU Specifications

Issued on 1st April, 2005

Overview of FP-X MODBUS communication function specifications (1)

- 1: The MODBUS master slave function and RTU mode (binary communication) is available with the COM1/COM2 port.
- 2: MODBUS master/slave communication function is selectable by system registers.
- 3: When no message is received for the time of 4 characters, it is regarded as the completion of the reception, and the command operation will be executed.
- 4: For baud rate or format, the settings are the same as before.
- 5: The unit numbers can be specified from the range of 1 to 99.
(Unit number of each control = system register setting value: Same as before)
- 6: The capacity of send and receive buffer is 2048 bytes.
However, due to the restrictions on the MODBUS protocol, the actual maximum capacity is approx. 270 bytes.

MODBUS RTU command message frame

START	ADDRESS	FUNCTION	DATA	CRC CHECK	END
3.5-character time	8 bits	8 bits	n*8 bits	16 bits	3.5-character time

ADDRESS(Unit No.) 8 bits 0 to 99 (Decimal)

Note 1: 0 = Broadcast address

Note 2: Slave unit numbers are 1 to 99 (decimal).

Note 3: For MODBUS, 0 to 247 (decimal)

FUNCTION(Command) 8 bits The detail is described in the next page.

DATA

CRC 16 bits

Response in normal status

The same message as a command is returned for single write command and loopback test.

A part of a command message (6 bytes from the beginning) is returned for multiple write command.

Response in abnormal status

In case a parameter that cannot be processed is found in a command (except transmission error)

Slave address (Unit No.)

Function code + 80H

Error code

CRC

Any one of 1, 2 and 3.

Error code contents

1: Function code error

2: Device number error (out of range)

3: Device quantity error (out of range)

Baud rate and Reception done judgment time

Baud rate	Reception done judgment time
2400	Approx. 3.3 ms
4800	Approx. 6.7 ms
9600	Approx. 3.3 ms
19200	Approx. 1.7 ms
38400	Approx. 0.8 ms
57600	Approx. 0.6 ms
115200	Approx. 0.2 ms

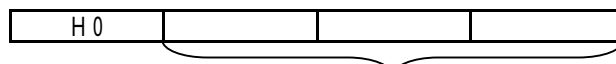
Overview of FP-X MODBUS communication function specifications (2)

Specifications of the instruction for sending data

1: F145(SEND) S1, S2, D, N

S1: Specifying transmission unit and transmission method

When transmitting
in word units



No. of transmission words (H1 to H7F) 1 to 127 words

When transmitting
in bit units

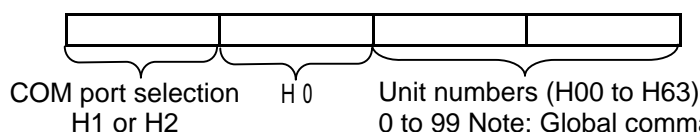


Bit No. of
remote unit

H 0

Bit No. of
local unit

S1+1: Specifying remote units



COM port selection
H1 or H2

H 0

Unit numbers (H00 to H63)
0 to 99 Note: Global command when 0 is specified.

S2: Starting device No. of transmission data of remote units DT0, etc.

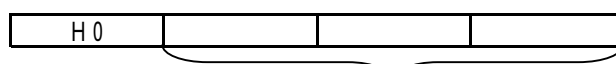
D: Device for storing transmission data of remote units DT0, etc. (The device No. is always set to 0.)

N: Device No. for storing transmission data of remote units For DT1000, specify K1000.

1: F146(RECV) S1, S2, N, D

S1: Specifying transmission unit and transmission method

When transmitting
in word units



No. of received words (H1 to H7F) 1 to 127 words

When transmitting
in bit units



Bit No. of
local unit

H 0

Bit No. of
remote unit

S1+1: Specifying remote units



COM port selection
H1 or H2

H 0

Unit numbers (H00 to H63)
1 to 99 Note: Operation error when 0 is specified.

S2: Starting device of received data of remote units DT0, etc. (The device No. is always set to 0.)

N: Starting device No. of received data of remote units For DT1000, specify K1000.

D: Device for storing received data of local units DT100, etc.

Remarks: The No. of transmitted and received words in the above S1 is according to the restrictions on the MODBUS protocol.

Overview of FP-X MODBUS communication function specifications (2)

Operation overview

1: Specifies the operation mode with the system register setting.

MODBUS RTU mode

2: Operation in the MODBUS slave RTU mode

A response is sent back after the MODBUS command that has completed to receive data was analyzed and processed. Refer to the command specifications described later.

3: Operation in the MODBUS master RTU mode

When executing the F145(SEND)/F146(RECV) instruction,

R9044 (COM1) or R904A (COM2) is turned off.

The MODBUS RTU command for the communication that is specified as the send buffer of a specified communication port is comprised.

The MODBUS RTU command is sent from a specified communication port.

Waiting for receiving data (with time-out function: The time-out period is according to the value set for the system register 32.)

When received data is returned, turns on the R9044(COM1) or R904A(COM2), and judges whether the operation completed normally or abnormally, and sets the R9045(COM1) or R904B(COM2).
An error code will be also stored in the DT90124(COM1) or DT90125(COM2).

Content of error code = 73H: Receive time out

Detection of operation errors

1: The operation error occurs when the F145(SEND)/F146(RECV) instruction was executed
For the COM port that has been set to a mode other than MODBUS RTU mode.

2: When specified parameters are not appropriate

3: When receiving data exceeds the storage area

Supported commands

<u>Executable instructions for master</u>	<u>Code (decimal)</u>	<u>Name (MODBUS original)</u>	<u>Name for FP-X</u>	Remarks (Ref. No.)
F146(RECV)	0 1	Read Coil Status	Read Y and R Coils	0x
F146(RECV)	0 2	Read Input Status	Read X Input	1x
F146(RECV)	0 3	Read Holding Registers	Read DT	4x
F146(RECV)	0 4	Read Input Registers	Read WL and LD	3x
F145(SEND)	0 5	Force Single Coil	Write Single Y and R	0x
F145(SEND)	0 6	Preset Single Register	Write DT 1 Word	4x
Cannot be issued	0 8	Diagnostics	Loopback Test	
F145(SEND)	1 5	Force Multiple Coils	Write Multiple Ys and Rs	0x
F145(SEND)	1 6	Preset Multiple Registers	Write DT Multiple Words	4x
Cannot be issued	2 2	Mask Write 4X Register	Write DT Mask	4x
Cannot be issued	2 3	Read/Write 4X Registers	Read/Write DT	4x

Table for MODBUS reference No. and FP-X device No.

Name of devices		Reference numbers		
MODBUS	MEW	MODBUS	MEW (Decimal)	(Hexadecimal)
Coils	Y	000001 to 002048	0 to 2047	0-7FF
	R	002049 to 009999	2048 to 9998	800-270E
Inputs	X	100001 to 109999	0 to 9998	0-270E
Holding registers	DT	400001 to 432765	0 to 32764	0 to 7FFC
Input registers	WL	<u>300001 to 300128</u>	<u>0 to 127</u>	<u>0 to 7F</u>
	LD	<u>302001 to 302256</u>	<u>2000 to 2255</u>	<u>7D0 to 8CF</u>
Expansion registers	FL			

Command=01 Read Y and R Coils

Broadcast is not available.

Command

Example for reading 20 bits of Y0 to Y14 in slave 17.

1	Slave address
2	Command (01H)
3	Starting No. of read (H)
4	Starting No. of read (L)
5	Quantity to read (H)
6	Quantity to read (L)
7	CRC16(H)
8	CRC16(L)

11
01
00
00
00
14
3E
95

Maximum No. of read = 2040 (bits) (Restrictions on the protocol)

Response in normal status

Examples of the responses to the above commands
(in case all points are ON)

1	Slave address
2	Command (01H)
3	Byte account of response data
4	Status 1
	:
	Status N
7	CRC16(H)
8	CRC16(L)

11	
01	
03	
FF	Y0 to Y7 (bit 0 to bit 7)
FF	Y8 to YF (bit 0 to bit 7)
0F	Y10 to Y13 (bit 0 to bit 3)
0F	The higher 4 bits return 0.
1A	

Response in abnormal status

1	Slave address
2	81H
3	Error code
4	CRC16(H)
5	CRC16(L)

Error code contents

1:	Function code error
2:	Device number error (out of range)
3:	Device quantity error (out of range)

Command=02 Read Input Status

Broadcast is not available.

Command

Example for reading 20 bits of X100 to X114 in slave 17.

1	Slave address
2	Command (02H)
3	Starting No. of read (H)
4	Starting No. of read (L)
5	Quantity to read (H)
6	Quantity to read (L)
7	CRC16(H)
8	CRC16(L)

11
02
00
A0
00
14
7A
B7

Maximum No. of read = 2040 (bits) (Restrictions on the protocol)

Response in normal status

Examples of the responses to the above commands
(in case all points are ON)

1	Slave address
2	Command (02H)
3	Byte account of response data
4	Status 1
	:
	Status N
7	CRC16(H)
8	CRC16(L)

11	
02	
03	
FF	X100 to X107 (bit 0 to bit 7)
FF	X108 to X10F (bit 0 to bit 7)
0F	X110 to X113 (bit 0 to bit 3)
4B	The higher 4 bits return 0.
1A	

Response in abnormal status

1	Slave address
2	82H
3	Error code
4	CRC16(H)
5	CRC16(L)

Error code contents

1:	Function code error
2:	Device number error (out of range)
3:	Device quantity error (out of range)

Command=03 Read DT

Broadcast is not available.

Command

Example for reading 3 words of DT1000 to DT1002 from slave 17.

1	Slave address
2	Command (03H)
3	Starting No. of read (H)
4	Starting No. of read (L)
5	Quantity to read (H)
6	Quantity to read (L)
7	CRC16(H)
8	CRC16(L)

11
03
03
E8
00
03
87
2B

Maximum No. of read = 127 (words) (Restrictions on the protocol)

Response in normal status

Examples of the responses to the above commands

1	Slave address
2	Command (03H)
3	Byte account of response data
4	Read data 1 (H)
5	Read data 1 (L)
6	...
7	...
8	Read data N (H)
9	Read data N (L)
10	CRC16 (H)
11	CRC16 (L)

11	
03	
06	3 words = 6 bytes
11	DT1000 = 1100H
00	
33	DT1001 = 3322H
22	
55	DT1002 = 5544H
44	
7F	
D9	

Response in abnormal status

1	Slave address
2	83H
3	Error code
4	CRC16(H)
5	CRC16(L)

Error code contents

1:	Function code error
2:	Device number error (out of range)
3:	Device quantity error (out of range)

Command=04 Read WL and LD

Broadcast is not available.
It is not supported with FP-e.

Command

Example for reading 3 words of WL0 to WL2 from slave 17.

1	Slave address	11
2	Command (04H)	04
3	Starting No. of read (H)	00
4	Starting No. of read (L)	00
5	Quantity to read (H)	00
6	Quantity to read (L)	03
7	CRC16(H)	B2
8	CRC16(L)	9B

Maximum No. of read = 127 (words) (Restrictions on the protocol)

Response in normal status

Examples of the responses to the above commands

1	Slave address	11
2	Command (04H)	04
3	Byte account of response data	06
4	Read data 1 (H)	11
5	Read data 1 (L)	00
6	:	33
7	:	22
8	Read data N (H)	55
9	Read data N (L)	44
10	CRC16 (H)	3E
11	CRC16 (L)	3F

3 words = 6 bytes
WL0 = 1100H
WL1 = 3322H
WL2 = 5544H

Response in abnormal status

1	Slave address
2	84H
3	Error code
4	CRC16(H)
5	CRC16(L)

Error code contents

1:	Function code error
2:	Device number error (out of range)
3:	Device quantity error (out of range)

Command=05 Read Single Y and R

Broadcast is available.

It is not "Forced set/reset function".

Command

For turning on R10 in slave 17.

1	Slave address	11	
2	Command (05H)	05	
3	Coil No. (H)	08	
4	Coil No. (L)	10	
5	Setting status (H)	FF	Set ON = FF00.
6	Setting status (L)	00	
7	CRC16 (H)	8D	
8	CRC16 (L)	0F	

Setting status: Set FF00H for ON. Set 0000H for OFF.

Response in normal status

Examples of the responses to the above commands

1	Slave address	11	
2	Command (05H)	05	
3	Coil No. (H)	08	
4	Coil No. (L)	10	
5	Setting status (H)	FF	Set ON = FF00.
6	Setting status (L)	00	
7	CRC16 (H)	8D	
8	CRC16 (L)	0F	

Response in abnormal status

1	Slave address
2	85H
3	Error code
4	CRC16 (H)
5	CRC16 (L)

Error code contents

1:	Function code error
2:	Device number error (out of range)
3:	Device quantity error (out of range)

Command=06 Write DT 1 Word

Broadcast is available.

Command

For writing 55AA in DT1000 of slave 17.

1	Slave address
2	Command (06H)
3	Starting No. of write (H)
4	Starting No. of write (L)
5	Write data (H)
6	Write data (L)
7	CRC16 (H)
8	CRC16 (L)

11
06
03
E8
55
AA
B4
05

Response in normal status

Examples of the responses to the above commands.

1	Slave address
2	Command (06H)
3	Starting No. of write (H)
4	Starting No. of write (L)
5	Write data (H)
6	Write data (L)
7	CRC16 (H)
8	CRC16 (L)

11
06
03
E8
55
AA
B4
05

Response in abnormal status

1	Slave address
2	86H
3	Error code
4	CRC16 (H)
5	CRC16 (L)

Error code contents

1:	Function code error
2:	Device number error (out of range)
3:	Device quantity error (out of range)

Command=08 Loopback

Broadcast is not available.

Command

For performing the loopback test for slave 17.

1	Slave address
2	Command (08H)
3	Test code (H)
4	Test code (L)
5	Data (H)
6	Data (L)
7	CRC16 (H)
8	CRC16 (L)

11	
08	
00	Always specify 00. If values other than 00 are specified, it becomes an error.
00	
55	Data is arbitrary.
AA	
5D	
B4	

Response in normal status

Examples of the responses to the above commands.

1	Slave address
2	Command (08H)
3	Test code (H)
4	Test code (L)
5	Data (H)
6	Data (L)
7	CRC16 (H)
8	CRC16 (L)

11	
08	
00	
00	
55	
AA	
5D	
B4	

Response in abnormal status

1	Slave address
2	88H
3	Error code
4	CRC16 (H)
5	CRC16 (L)

Error code contents

1: Function code error
2: Device number error (out of range)
3: Device quantity error (out of range)

Command=15(0F hex) Write Multiple Ys and Rs

Broadcast is available.

It is not "Forced set/reset function".

Command

For writing data for 20 bits from R100 for slave 17.

1	Slave address	11
2	Command (0FH)	0F
3	Starting No. of status change (H)	08
4	Starting No. of status change (L)	A0
5	Quantity of changed coils (H)	00
6	Quantity of changed coils (L)	14
7	Byte count	03
8	Setting data 1	55
	:	AA
	Setting data N	0F
11	CRC16 (H)	DE
12	CRC16 (L)	F8

Maximum quantity of changed coils = 2040 (bits) (Restrictions on the protocol)

Byte count: 8 coils = 1 data (1 byte)

Response in normal status

Examples of the responses to the above commands.

1	Slave address	11
2	Command (0FH)	0F
3	Starting No. of status change (H)	08
4	Starting No. of status change (L)	A0
5	Quantity of changed coils (H)	00
6	Quantity of changed coils (L)	14
7	CRC16 (H)	55
8	CRC16 (L)	16

Response in abnormal status

1	Slave address
2	8FH
3	Error code
4	CRC16 (H)
5	CRC16 (L)

Error code contents

1:	Function code error
2:	Device number error (out of range)
3:	Device quantity error (out of range)

Command=16(10 hex) Write DT Multiple Data

Broadcast is available.

Command

For writing 3 words from DT1000 in slave 17.

1	Slave address	11
2	Command (10H)	10
3	Starting No. of write (H)	03
4	Starting No. of write (L)	E8
5	No. of write registers (H)	00
6	No. of write registers (L)	03
7	Byte count	06
8	Write data 1 (H)	11
9	Write data 1 (L)	00
	:	33
	:	22
12	Write data N (H)	55
13	Write data N (L)	44
14	CRC16 (H)	C1
15	CRC16 (L)	84

Maximum No. of write registers = 127 (words) (Restrictions on the protocol)

Response in normal status

Examples of the responses to the above commands.

1	Slave address	11
2	Command (10H)	10
3	Starting No. fo write (H)	03
4	Starting No. of write (L)	E8
5	No. of write registers (H)	00
6	No. of write registers (L)	03
7	CRC16 (H)	02
8	CRC16 (L)	E8

Response in normal status

1	Slave address
2	90H
3	Error code
4	CRC16 (H)
5	CRC16 (L)

Error code contents

- | |
|---|
| 1: Function code error |
| 2: Device number error (out of range) |
| 3: Device quantity error (out of range) |

Command=22(16 hex) Write DT Mask

Broadcast is not available.

Command

For writing mask in DT1000 in slave 17.

1	Slave address	11
2	Command (16H)	16
3	Starting No. of write (H)	03
4	Starting No. of write (L)	E8
5	And_Mask (H)	00
6	And_Mask (L)	F2
7	Or_Mask (H)	00
8	Or_Mask (L)	25
9	CRC16 (H)	F7
10	CRC16 (L)	06

Detail of the process:

Result = (CurrentContents AND And_Mask)OR(Or_Mask AND /And_Mask)

Response in normal status

Examples of the responses to the above commands.

1	Slave address	11
2	Command (16H)	16
3	Starting No. of write (H)	03
4	Starting No. of write (L)	E8
5	And_Mask (H)	00
6	And_Mask (L)	F2
7	Or_Mask (H)	00
8	Or_Mask (L)	25
9	CRC16 (H)	F7
10	CRC16 (L)	06

In this case, when the DT1000 is 12H, the result becomes 17H.

If the Or_Mask data is zero, the result is simply the logical ANDing of the current contents and And_Mask data.
If the And_Mask data is zero, the result is equal to the Or_Mask data.

Response in abnormal status

1	Slave address
2	96H
3	Error code
4	CRC16 (H)
5	CRC16 (L)

Error code contents

1:	Function code error
2:	Device number error (out of range)
3:	Device quantity error (out of range)

Command=23 (17 hex) Read/Write DT

Broadcast is not available.

Command

For reading 3 words from DT1000 in slave 17 and clear it to 0 later.

1	Slave address	11
2	Command (17H)	17
3	Starting No. of read (H)	03
4	Starting No. of read (L)	E8
5	No. of read registers (H)	00
6	No. of read registers (L)	03
7	Starting No. of write (H)	03
8	Starting No. of write (L)	E8
9	No. of write registers (H)	00
10	No. of write registers (L)	03
11	Byte count of write data	06
12	Write data 1 (H)	00
	Write data 1 (L)	00
	:	00
	:	00
	Write data N (H)	00
	Write data N (L)	00
18	CRC16 (H)	60
19	CRC16 (L)	DB

Maximum No. of read registers = 127 (words) (Restrictions on the protocol)

Maximum No. of write registers = 127 (words) (Restrictions on the protocol)

Response in normal status

1	Slave address	11
2	Command (17H)	17
3	Byte count of response data	06
4	Read data 1 (H)	AA
	Read data 1 (L)	AA
	:	BB
	:	BB
	Read data N (H)	CC
	Read data N (L)	CC
7	CRC16 (H)	ED
8	CRC16 (L)	CC

Response in abnormal status

1	Slave address
2	97H
3	Error code
4	CRC16 (H)
5	CRC16 (L)

Error code contents

1:	Function code error
2:	Device number error (out of range)
3:	Device quantity error (out of range)