

SM Unit Communication Guidelines

- Thank you for purchasing our Tsubaki Gear Motor. The Tsubaki Gear Motor should only be handled by the engineers with expertise in the relevant procedures. This guideline only describes the communication specifications of the SM unit. Before using the product, be sure to thoroughly read and fully understand the contents described in the instruction manual.
- Please use a person with expert knowledge to change the communication.
- This guideline may not be reproduced or copied, in whole or in part, without permission.



Tsubakimoto Chain Co.

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1 Introduction note


Please use this Guidelines in combination with the instruction manual.


The level of damage and injury that can occur if the correct operations are not followed is generally divided into "WARNING" and "CAUTIONS" in the Guidelines. The definition of each is described below.

 WARNING	Incorrect operation can result in death or serious injury.
 CAUTION	Incorrect operation can result in minor or moderate injury or damage.

Items denoted with "caution" can also lead to a serious result depending on the situation.

Be sure to read these, as they contain important information.

 WARNING
<ul style="list-style-type: none"> Do not perform live-line operations. Before starting any procedure, confirm that the power is OFF. Failure to do so may result in an electric shock. Communication-related changes must be made by qualified personnel. Otherwise failure or damage can result.

 CAUTION
<ul style="list-style-type: none"> We shall not be held responsible for any product modifications by the customer as they are not covered by the warranty. As the entire device, including the terminal box, is extremely hot during operation or immediately after the operation has been stopped, avoid contact of your fingers or any other objects with the device. Failure to do so may cause a burn or property damage. When changing parameters, carefully check the writing contents and ensure safety. Injury, failure or damage can result.

2 Specifications

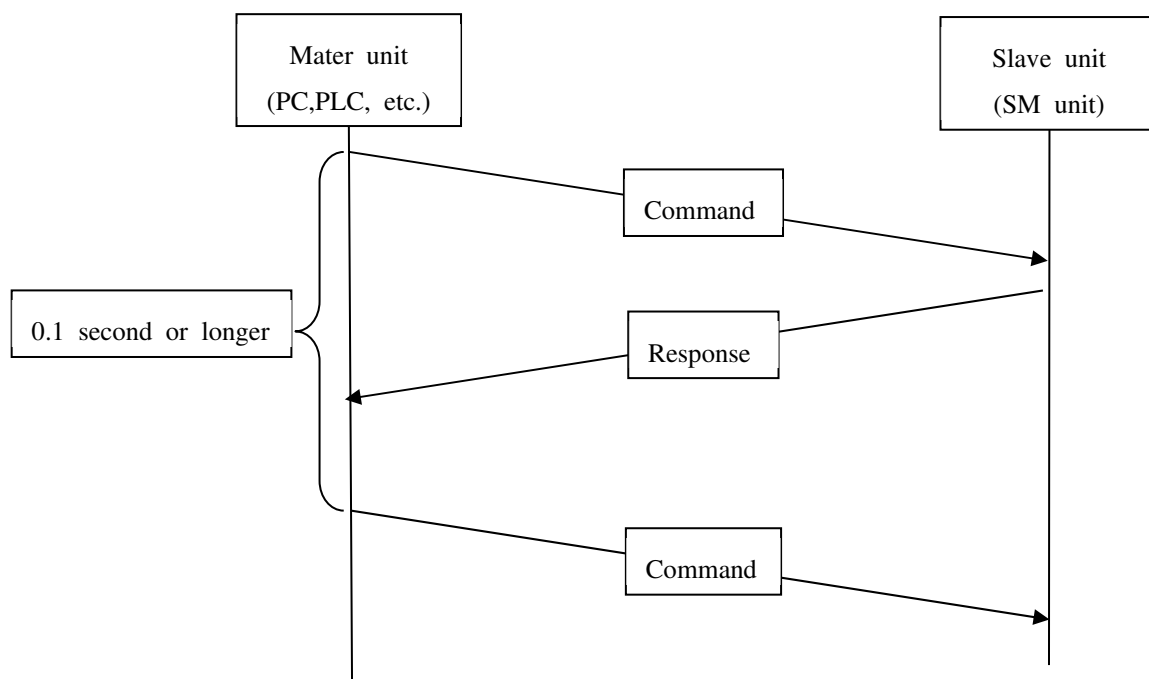
Protocol *1	Modbus-RTU
Transmission line connection	RS-485
Communication speed	9600bps
Start bit length	1bit
Data bit length	8bit
Stop bit length	1bit
Parity bit	EVEN
Endian	LSB
Slave addresses *2	1-16 (0x01-0x10)
Default password	password (ASCII code)

NOTE) *1 Modbus is a registered trademark of Schneider Automation Inc.

*2 These are switched using the DIP switches. (For more details, refer to section 6 of the Instruction Manual.)

3 Procedure

After sending the command, wait at least 0.1 second before sending the next command.



4 Structure of Command Frame and Normal Response Frame

Silent interval	Slave Address	Function Code	Data	Error check (CRC-16)	Silent interval
*1	1byte	1byte	**byte	2byte	*1

CRC-16 range

NOTE) *1 The Silent interval should be 5ms or longer.

●Error check

The calculated 16-bit data is set after the data in the order of low order and high order.

"Calculation method"

- Note 1: Set the default setting of the CRC register to 0xFFFF.
- Note 2: Calculates the lower 8 [bits] of the CRC register and the XOR of the first byte of the message, and assigns the value to the CRC register.
- Note 3: The MSB shifts the CRC register one bit to the right, padding with 0.
- Note 4: Repeat Note 3 if the bit shifted from the LSB is 0.
If the bit shifted from the LSB is 1, the XOR of the CRC register and 0xA001 is calculated, and the value is assigned to the CRC register.
- Note 5: Repeat steps Note 3 and 4 until 8-bit shift is performed.
- Note 6: Calculate the next byte of the message and the XOR of the lower 8 bits of the CRC register, assign the value to the CRC register, and repeat steps Note 3 to 5 until the last data.
- Note 7: Set the value of the CRC register to the end of the data in the lower/higher order.

●No response

In the following cases, the slave does not process the receive command and does not return a response.

- Slave address mismatch
- Parity error, overrun error, framing error occurred
- Error check (CRC-16) mismatch
- The reception interval of each data is 5ms or longer for silent interval.

In the following cases, the slave processes the receive command but does not return a response.

- Slave address is 0x00 (broadcast)

5 Structure of abnormal response frame

Silent interval	Slave Address	*2 Function Code	Error Code	Error check (CRC-16)	Silent interval
*1	1byte	1byte	1byte	2byte	*1

NOTE) *1 The Silent interval should be 5ms or longer.

*2 The most significant bit of the function code received by the slave is set to 1, and the response is returned.

Error code	Error name	Content	Discovery Priority
0x01	Function error	Use function codes that are not supported	1
0x02	Address error	Use unsupported data addresses	2
0x03	Data error	The number of registers and bytes are invalid. Password is outside the range of 8 to 16 characters Coil write value other than 0xFF00/0x0000	3
0x04	Login error	Password authentication failure Write at logout Read Password on logout	4

6 Function codes

Code	Function name	Function
0x01	Read Coil Status	Read Coil (DO)
0x02	Read Input Status	Read input status (DI)
0x03	Read Holding Register	Read holding register (AO) *1
0x04	Read Input Resister	Read input register (AI)
0x05	Force Single Coil	Writing to Coil (DO) *1,2
0x06	Preset Single Register	Writing to the holding register (AO) *1,2
0x0F	Force Multiple Coils	Batch writing to multiple coils (DO) *1,2
0x10	Preset Multiple Resisters	Batch write to multiple holding registers (AO) *1,2
0x11	Report Slave ID	Reading slave information

NOTE) *1 Passwords can be read and written only in the login state. **When the power is turned on, the tester enters the login state regardless of the state before the shutdown.**

To writing a password to the holding register (AO) address 100-107 "Login/Logout" therefore, the login/logout status changes.

*2 Simultaneous writing by broadcast (slave address: 0x00) is possible.

7 Data Address List

	Address	Data name
Coil (DO)	0	Number of warnings for clearing
	100	Warning reset
Input register (AI)	0-8	Set parameter
	100-108	Instantaneous data
	200-207	State parameter
	300	Login Status
	1000-1019	Log data 1 (Voltage)
	1100-1119	Log data 1 (Electric current)
	1200-1219	Log data 1 (Electric power)
	1300-1319	Log data 1 (Temperature)
	1400-1419	Log data 1 (Acceleration X-axis)
	1500-1519	Log data 1 (Acceleration Y-axis)
	1600-1619	Log data 1 (Acceleration Z-axis)
	1700-1719	Log data 1 (Power frequency)
	1800-1819	Log data 1 (Output shaft torque)
	2000-2019	Log data 2 (Voltage)
	2100-2119	Log data 2 (Electric current)
	2200-2219	Log data 2 (Electric power)
	2300-2319	Log data 2 (Temperature)
	2400-2419	Log data 2 (Acceleration X-axis)
	2500-2519	Log data 2 (Acceleration Y-axis)
	2600-2619	Log data 2 (Acceleration Z-axis)
	2700-2719	Log data 2 (Power frequency)
	2800-2819	Log data 2 (Output shaft torque)
	3000-3019	Log data 3 (Voltage)
	3100-3119	Log data 3 (Electric current)
	3200-3219	Log data 3 (Electric power)
	3300-3319	Log data 3 (Temperature)
	3400-3419	Log data 3 (Acceleration X-axis)
	3500-3519	Log data 3 (Acceleration Y-axis)
	3600-3619	Log data 3 (Acceleration Z-axis)
	3700-3719	Log data 3 (Power frequency)
	3800-3819	Log data 3 (Output shaft torque)

Holding register (AO)	0-39	Various parameters
	100-107	Login/Logout *1
	200-207	Password *1
	300-301	Product code *1,2
	350-354	MFG number *1,2
Slave information (Ver.)	-	SM unit software version

NOTE) *1 It is not possible to write to or read from a single address.

Write and read data with address consecutive specify.

*2 The product code and MFG number can only be read regardless of the login/logout status.

8 Coil (DO) data details

All data are in hexadecimal format, 1 byte.

Address	Data name	Content
0	Number of warnings for clearing	When it is ON, the "number of warnings" of the input register (AI) is cleared to 0. Then, it is automatically turned OFF.
100	Warning reset	Resets the warning status when it is ON.

9 Input register (AI) data details

All data are in hexadecimal format, 2 bytes.

The temperature/acceleration X/Y/Z is signed. Otherwise, it is unsigned.

Address	Data name	Content	Unit
0	Output torque upper limit A SET	Stores the set value for each DIP switch number.	[%]
1	Output torque upper limit B SET		
2	Output torque lower limit A SET		
3	Output torque lower limit B SET		
4	Start time SET		[0.1s]
5	Shock time SET(Upper limit A)		
6	Shock time SET(Upper limit B)		
7	Shock time SET(Lower limit A)		
8	Shock time SET(Lower limit B)		
100	Voltage (Average value method)	The current value of each data is stored.	[0.1V]
101	Electric current (Average value method)		[10mA]
102	Electric power		[0.1W]
103	Temperature		[0.1°C]
104	Acceleration X-axis (Instantaneous maximum)		[0.01m/s ²]
105	Acceleration Y-axis (Instantaneous maximum)		
106	Acceleration Z-axis (Instantaneous maximum)		
107	Power frequency		[Hz]
108	Output shaft torque		[0.1N · m]
200	Number of warnings	Stores the number of warnings. When "Clear warning count" of the coil (DO) is turned ON. It is cleared to 0.	[times]
201	Warning status	Stores the value according to the operation status of the motor. *1	-
202	Warning factor (Log 1)	Stores the cause of the last warning. *1	-
203	Warning factor (Log 2)	Stores the cause of the two times before warning. *1	-
204	Warning factor (Log 3)	Stores the cause of the three times before warning. *1	-
205	Acquisition interval (Log 1)	Stores the sampling time of log data 1.	[0.1s]
206	Acquisition interval (Log 2)	Stores the sampling time of log data 2.	
207	Acquisition interval (Log 3)	Stores the sampling time of log data 3.	
300	Login Status	Stores the login/logout status. When logout: 0x0000, when login: 0xFF00	-
1000-1019	Log data 1 (Voltage)	*2 At the last time Stores the data at the time of warning.	[0.1V]
1100-1119	Log data 1 (Electric current)		[10mA]
1200-1219	Log data 1 (Electric power)		[0.1W]
1300-1319	Log data 1 (Temperature)		[0.1°C]

1400-1419	Log data 1 (Acceleration X-axis)	*2 At the last time Stores the data at the time of warning.	[0.01m/s ²]
1500-1519	Log data 1 (Acceleration Y-axis)		
1600-1619	Log data 1 (Acceleration Z-axis)		
1700-1719	Log data 1 (Power Frequency)		
1800-1819	Log data 1 (Output shaft torque)		
2000-2019	Log data 2 (Voltage)	*2 At the two times before time Stores the data at the time of warning.	[0.1V]
2100-2119	Log data 2 (Electric current)		[10mA]
2200-2219	Log data 2 (Electric power)		[0.1W]
2300-2319	Log data 2 (Temperature)		[0.1°C]
2400-2419	Log data 2 (Acceleration X-axis)		[0.01m/s ²]
2500-2519	Log data 2 (Acceleration Y-axis)		
2600-2619	Log data 2 (Acceleration Z-axis)		
2700-2719	Log data 2 (Power Frequency)		[Hz]
2800-2819	Log data 2 (Output shaft torque)		[0.1N · m]
3000-3019	Log data 3 (Voltage)	*2 At the three times before time Stores the data at the time of warning.	[0.1V]
3100-3119	Log data 3 (Electric current)		[10mA]
3200-3219	Log data 3 (Electric power)		[0.1W]
3300-3319	Log data 3 (Temperature)		[0.1°C]
3400-3419	Log data 3 (Acceleration X-axis)		[0.01m/s ²]
3500-3519	Log data 3 (Acceleration Y-axis)		
3600-3619	Log data 3 (Acceleration Z-axis)		
3700-3719	Log data 3 (Power Frequency)		[Hz]
3800-3819	Log data 3 (Output shaft torque)		[0.1N · m]

NOTE) *1 In the warning state, the operation status of the motor is set to each bit.

The cause of the warning is set to each bit in the past.

Upper	Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8
	-	-	-	-	-	-	-	-
Lower	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	-	Excessive shock	Overheat	-	Torque lower limit B	Torque lower limit A	Torque upper limit B	Torque upper limit A

e.g.) Normal :0x00

Warning at torque upper limit B :0x02

NOTE) *2 The largest address in each log data is the data at the time of warning.

Address	Data name	Content
xx00	Log data warning -19	Warning-19×Log acquisition time
xx01	Log data warning -18	Warning-18×Log acquisition time
xx02	Log data warning -17	Warning-17×Log acquisition time
xx16	Log data warning -3	Warning-3×Log acquisition time
xx17	Log data warning -2	Warning-2×Log acquisition time
xx18	Log data warning -1	Warning-1×Log acquisition time
xx19	Log data warning	Time of warning

10 Holding register (AO) data

All data are in hexadecimal format, 2 bytes.

Address	Data name	Content	Unit	Lower limit	Upper limit
0	Output torque upper limit A1	Stores the set value for DIP switch setting No.1.	[%]	*1 0	200
1	Output torque upper limit B1				
2	Output torque lower limit A1				
3	Output torque lower limit B1				
4	Start time 1		[0.1s]	1 0	300 300
5	Shock time 1(Upper limit A)				
6	Shock time 1(Upper limit B)				
7	Shock time 1(Lower limit A)				
8	Shock time 1(Lower limit B)				
9	Output torque upper limit A2	Stores the set value for DIP switch setting No.2.	[%]	*1 0	200
10	Output torque upper limit B2				
11	Output torque lower limit A2				
12	Output torque lower limit B2				
13	Start time 2		[0.1s]	1 0	300 300
14	Shock time 2(Upper limit A)				
15	Shock time 2(Upper limit B)				
16	Shock time 2(Lower limit A)				
17	Shock time 2(Lower limit B)				
18	Output torque upper limit A3	Stores the set value for DIP switch setting No.3.	[%]	*1 0	200
19	Output torque upper limit B3				
20	Output torque lower limit A3				
21	Output torque lower limit B3				
22	Start time 3		[0.1s]	1 0	300 300
23	Shock time 3(Upper limit A)				
24	Shock time 3(Upper limit B)				
25	Shock time 3(Lower limit A)				
26	Shock time 3(Lower limit B)				
27	Output torque upper limit A4	Stores the set value for DIP switch setting No.4.	[%]	*1 0	200
28	Output torque upper limit B4				
29	Output torque lower limit A4				
30	Output torque lower limit B4				
31	Start time 4		[0.1s]	1 0	300 300
32	Shock time 4(Upper limit A)				
33	Shock time 4(Upper limit B)				
34	Shock time 4(Lower limit A)				
35	Shock time 4(Lower limit B)				

36	Overheat limit	Stores the set value of the temperature to be warned.	[0.1°C]	*1 0	1000
37	Excessive shock limit	Stores the set value of the impact to be warned.	[0.01m/s ²]	*1 0	15000
38	Log acquisition Interval	Stores the sampling time for recording. Retaining the data immediately before a warning.	[0.1s]	1	100
39	Automatic restoration	Stores the automatic restoration time to return from the warning status to the normal status.	[s]	*1 0	300
100 -107	Login/Logout	*2 You can switch the login/logout status by writing a password.	ASCII	-	
200 -207	Password	*2,3 Stores the password with 8 to 16 characters.	ASCII	-	
300 -301	Product code	*2,4 Contains the product-specific number.	ASCII	-	
350 -354	MFG number	*2,4 Contains the product-specific number.	ASCII	-	

Login/Logout

⇒ When writing, if the password is less than 16 characters, enter [NULL(0x00)] or [SP(0x20)] for the shortage.

⇒ When reading, [NULL (0x00)] of 16 characters is read.

Password

⇒ When writing, set within [!(0x21)] to [-(0x7E)] in ASCII code table.

When setting less than 16 characters, enter [NULL(0x00)] or [SP(0x20)] for the shortage.

⇒ When reading, if the setting is less than 16 characters, [NULL (0x00)] is entered in the shortage.

Product code, MFG number

⇒ This is a product-specific number to be set at our shipment, so it is not specifically used.

NOTE) *1 If each value is set to "0", warning and operation will not be performed with the set parameter.

*2 It is not possible to write to or read from a single address. Write and read data with address consecutive specify.

*3 The password cannot be read when logout. Please load in the login state.

*4 The product code and MFG number can only be read regardless of the login/logout status.

11 Slave information (Ver.)

In slave information, the software version of the product can be read.

No	Field Name
1	Slave address
2	Function code: 0x11
3	Version information (upper)
4	Version information (lower)
5	CRC error check (lower)
6	CRC error check (upper)

Example) Version information (upper):0x01

Version-information (lower):0x00

It is Ver.1.0.0



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