SC 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 SC 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.

1   Introduction note

Thank you for your continuous support. Please use this Guidelines in combination with the instruction manual.

The degree of potential danger and damage that may be caused by improper handling of the product is basically

classified using two indications, "WARNING" and "CAUTION", in this Guidelines. The definitions are as follows.

⚠ **WARNING**	Due to mishandling, a dangerous condition may occur and there is a possibility of serious injury or death
⚠ **CAUTION**	Due to mishandling, a dangerous condition may occur and there is a possibility of moderate impairment or minor injury, or only property damage

Note that even the cases indicated by "CAUTION" could lead to serious results depending on the situation.

As both the "WARNING" and "CAUTION" indications include important precautions, be sure to observe the

instructions.

⚠ **WARNING**

- 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**

- 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

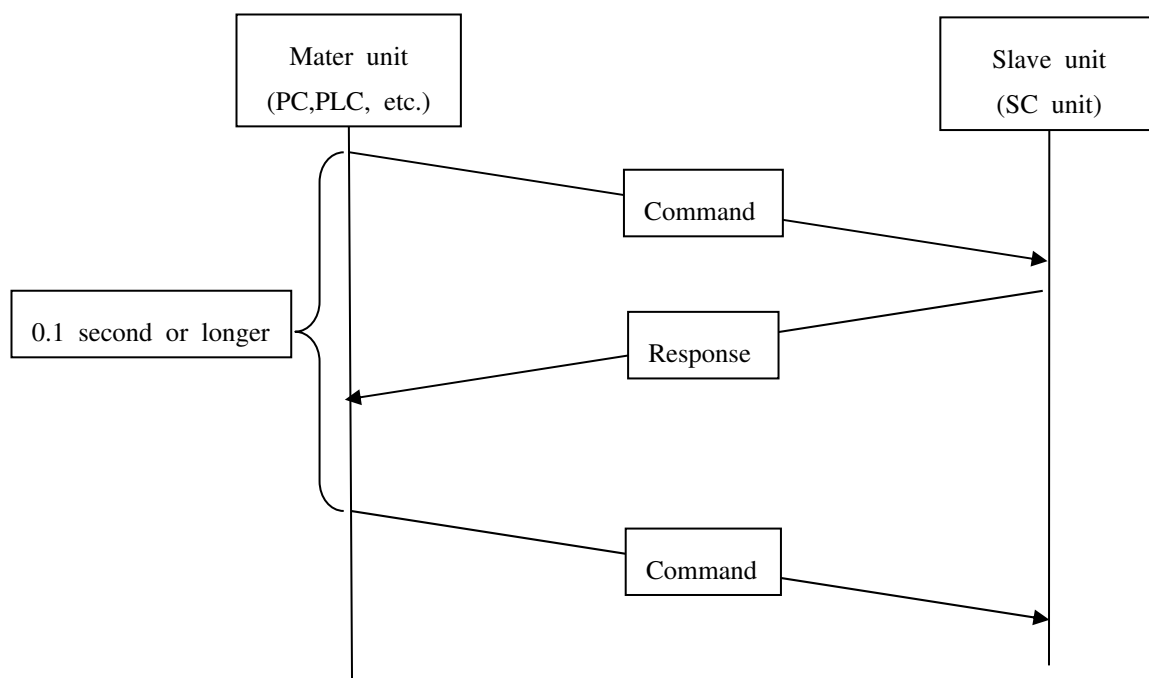| Protocol *1	Modbus-RTU
Transmission line connection	RS-485
Communication speed	9600bps
Start bit length	1bit
Data bit length	8bit
Stop bit length	1bit
Parity bit	EVEN
Endian	LSB
Slave addresses *2	1-16 (0x01-0x10)
Default password *3	**password**(ASCII code)

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.)
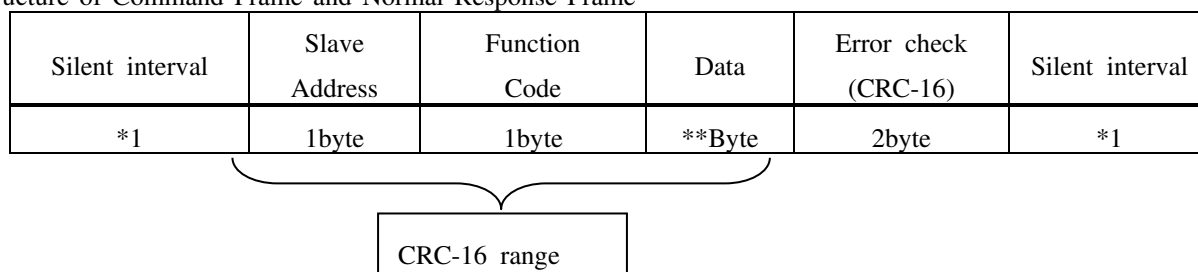
*3 The password is required when writing data. Initially, change the default password.

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 logout 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	Trip count clear
	100	Stop
	200	Start
Input state (DI)	0	Power frequency
Input register (AI)	0-8	SET parameter
	100-106	Instantaneous data
	200-204	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)
	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)
	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)
Holding register (AO)	0-54	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.)	-	SC 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	Trip count clear	When it is ON, the "number of trips" of the input register (AI) is cleared to 0. Then, it is automatically turned OFF.
100	Stop	When it is ON, the motor stops. It is then turned OFF when the coil (DO) of the "Start" is turned ON.
200	Start	When ON, restart the motor. Then, it is automatically turned OFF. (However, it will not restart when tripped, and will be turned OFF automatically.)

9   Input status (DI) data details

The data is in hexadecimal format, 1 byte.

Address	Data name	Content
0	Power frequency	When OFF, the power frequency is 50 [Hz]. When ON, the power frequency is 60 [Hz].

10   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	Electric power upper limit A SET	Depending on the power frequency (50Hz/60Hz), Stores the set value for each DIP switch number.	[0.1W]
1	Electric power upper limit B SET		
2	Electric power lower limit A SET		
3	Electric power 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 (Instantaneous)	The current value of each data is stored.	[0.1V]
101	Electric current (Instantaneous)		[mA]
102	Electric power (Instantaneous)		[0.1W]
103	Temperature (Instantaneous)		[0.1℃]
104	Acceleration X-axis (Instantaneous)		[0.01m/s^2]
105	Acceleration Y-axis (Instantaneous)		
106	Acceleration Z-axis (Instantaneous)		
200	Number of trips	Stores the number of trips. When "Clear trip count" of the coil (DO) is turned ON It is cleared to 0.	-
201	Motor status	Stores the value according to the operation status of the motor. *1	-
202	Trip factor (Log 1)	Stores the cause of the last trip. *1	-
203	Trip factor (Log 2)	Stores the cause of the two times before trip. *1	-
204	Trip factor (Log 3)	Stores the cause of the three times before trip. *1	-
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 each data at trip.	[0.1V]
1100-1119	Log data 1 (Electric current)		[mA]
1200-1219	Log data 1 (Electric power)		[0.1W]
1300-1319	Log data 1 (Temperature)		[0.1℃]
1400-1419	Log data 1 (Acceleration X-axis)		[0.01m/s^2]
1500-1519	Log data 1 (Acceleration Y-axis)		
1600-1619	Log data 1 (Acceleration Z-axis)		

2000-2019	Log data 2 (Voltage)		[0.1V]
2100-2119	Log data 2 (Electric current)		[mA]
2200-2219	Log data 2 (Electric power)	*2	[0.1W]
2300-2319	Log data 2 (Temperature)	At the two times before time	[0.1°C]
2400-2419	Log data 2 (Acceleration X-axis)	Stores each data at trip.	
2500-2519	Log data 2 (Acceleration Y-axis)		$[0.01\text{m/s}^2]$
2600-2619	Log data 2 (Acceleration Z-axis)		
3000-3019	Log data 3 (Voltage)		[0.1V]
3100-3119	Log data 3 (Electric current)		[mA]
3200-3219	Log data 3 (Electric power)	*2	[0.1W]
3300-3319	Log data 3 (Temperature)	At the three times before time	[0.1°C]
3400-3419	Log data 3 (Acceleration X-axis)	Stores each data at trip.	
3500-3519	Log data 3 (Acceleration Y-axis)		$[0.01\text{m/s}^2]$
3600-3619	Log data 3 (Acceleration Z-axis)		

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

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

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

e.g.) Normal   :0x00

When tripped at electric power upper limit B   :0x02

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

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

11　Holding register (AO) data

All data are in hexadecimal format, 2 bytes.

Address	Data name	Content	Unit	Lower limit	Upper limit
0	Electric power upper limit A 1 (50Hz)				
1	Electric power upper limit A 1 (60Hz)				
2	Electric power upper limit B 1 (50Hz)				
3	Electric power upper limit B 1 (60Hz)		[0.1W]	*1 0	10000
4	Electric power lower limit A 1 (50Hz)				
5	Electric power lower limit A 1 (60Hz)	Stores the set value for DIP switch setting No.1.			
6	Electric power lower limit B 1 (50Hz)				
7	Electric power lower limit B 1 (60Hz)				
8	Start time 1			1	50
9	Shock time 1(Upper limit A)				
10	Shock time 1(Upper limit B)		[0.1s]		
11	Shock time 1(Lower limit A)			0	300
12	Shock time 1(Lower limit B)				
13	Electric power upper limit A 2 (50Hz)				
14	Electric power upper limit A 2 (60Hz)				
15	Electric power upper limit B 2 (50Hz)				
16	Electric power upper limit B 2 (60Hz)		[0.1W]	*1 0	10000
17	Electric power lower limit A 2 (50Hz)				
18	Electric power lower limit A 2 (60Hz)				
19	Electric power lower limit B 2 (50Hz)	Stores the set value for DIP switch setting No.2.			
20	Electric power lower limit B 2 (60Hz)				
21	Start time 2			1	50
22	Shock time 2(Upper limit A)				
23	Shock time 2(Upper limit B)		[0.1s]		
24	Shock time 2(Lower limit A)			0	300
25	Shock time 2(Lower limit B)				
26	Electric power upper limit A 3 (50Hz)				
27	Electric power upper limit A 3 (60Hz)				
28	Electric power upper limit B 3 (50Hz)				
29	Electric power upper limit B 3 (60Hz)		[0.1W]	*1 0	10000
30	Electric power lower limit A 3 (50Hz)				
31	Electric power lower limit A 3 (60Hz)				
32	Electric power lower limit B 3 (50Hz)	Stores the set value for DIP switch setting No.3.			
33	Electric power lower limit B 3 (60Hz)				
34	Start time 3			1	50
35	Shock time 3(Upper limit A)				
36	Shock time 3(Upper limit B)		[0.1s]		
37	Shock time 3(Lower limit A)			0	300
38	Shock time 3(Lower limit B)				

No.	Name	Description	Unit		
39	Electric power upper limit A 4 (50Hz)	Stores the set value for DIP switch setting No.4.	[0.1W]	*1 0	10000
40	Electric power upper limit A 4 (60Hz)				
41	Electric power upper limit B 4 (50Hz)				
42	Electric power upper limit B 4 (60Hz)				
43	Electric power lower limit A 4 (50Hz)				
44	Electric power lower limit A 4 (60Hz)				
45	Electric power lower limit B 4 (50Hz)				
46	Electric power lower limit B 4 (60Hz)				
47	Start time 4		[0.1s]	1	50
48	Shock time 4(Upper limit A)			0	300
49	Shock time 4(Upper limit B)				
50	Shock time 4(Lower limit A)				
51	Shock time 4(Lower limit B)				
52	Overheat limit	Stores each set value to be tripped.	[0.1℃]	*1	1250
53	Excessive shock limit		[0.01m/s^2]	0	15000
54	Log Acquisition Interval	Stores the sampling time for recording. Retaining the data immediately before a tripping.	[0.1s]	1	100
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", tripping 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.

12   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

TSUBAKIMOTO CHAIN CO.

1-1, Kohtari-Kuresumi, Nagaokakyo
Kyoto 617- 0833, Japan

Global Associated Partners:

Website : https://tsubakimoto.com/

U.S. Tsubaki Power Transmission, LLC
https://www.ustsubaki.com/

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https://tsubaki.sg/

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