

MICREX-SX How-to Guide

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Fuji Electric Co., Ltd.

Modbus Communication between SPF and Inverter (Ace) (for SX-Programmer Expert)

1. Overview

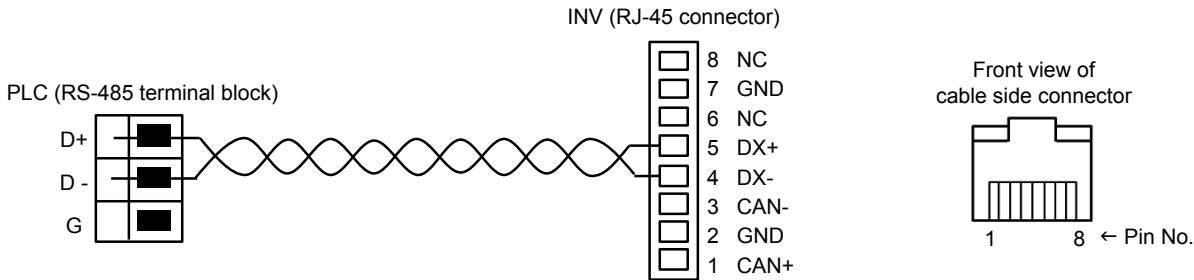
Modbus communication between SPF (PLC), and FRENIC-Ace (Inverter: hereafter abbreviated as INV) can be performed by connecting them via RS-485.

The PLC becomes a master and the INV becomes a slave. The PLC can issue commands to the INV to set the output frequency, select FWD/REV, or monitor the output frequency. This guide describes the settings of INV and PLC, and introduces a sample program.

For the PLC loader, SX-Programmer Expert (D300win) is used.

2. Connecting PLC with INV

Supposing that the RS-485 terminal block of an optional communication board (Type: NA3LA-RS1, front board type) is used on the PLC side and the port 2 built in the INV is used on the INV side, the connection must be as follows. (1:1 connection in the example below)

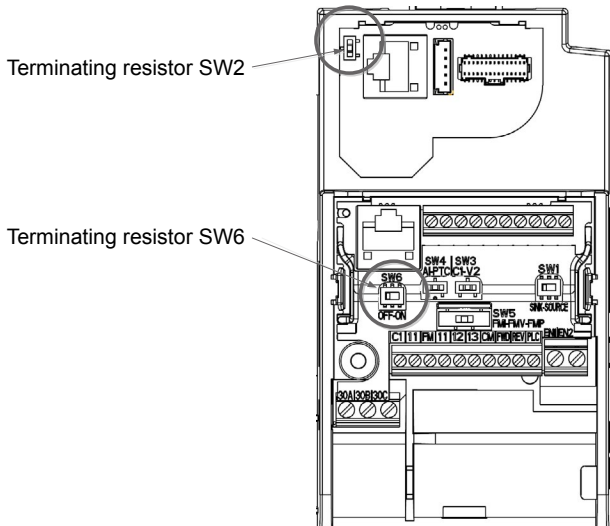


3. Setting of INV

3.1 Operating ON/OFF of terminating resistor

Connect a terminating resistor (100 to 120Ω) on the both ends of the connection cable to suppress reflection of signals and reduce noise. Be sure to attach it to the devices on the both ends of an RS-485 line. The example in this guide is 1:1 connection, therefore, the PLC and INV are both terminating stations. Turn ON the RS-485 terminating resistor switches of both the PLC and INV.

INV (control printed circuit board): Turn ON SW6.



3.2 Changing function codes

To communicate with a PLC, change the function codes of the INV.

“High-level function (H code) and “Link function” (y code) are related to RS-485 communication.

3.2.1 Details of function codes

(1) H30 link function

By default, frequency and operation commands for the INV are issued by the INV itself. To issue these commands via RS-485 communication (Port 2), change the H30 setting to “8”.

Table 1: Description of H30 link function (operation selection) (selection of setting method)

H30 data	Frequency command	Operation command
0	Inverter itself (F01/C30)	Inverter itself (F02)
1	RS-485 communication (Port 1)	Inverter itself (F02)
2	Inverter itself (F01/C30)	RS-485 communication (Port 1)
3	RS-485 communication (Port 1)	RS-485 communication (Port 1)
4	RS-485 communication (Port 2)	Inverter itself (F02)
5	RS-485 communication (Port 2)	RS-485 communication (Port 1)
6	Inverter itself (F01/C30)	RS-485 communication (Port 2)
7	RS-485 communication (Port 1)	RS-485 communication (Port 2)
8	RS-485 communication (Port 2)	RS-485 communication (Port 2)

(2) y11 to y20 link function

You can make detailed settings of RS-485 by using y codes.

Change the y codes according to the PLC setting. * The set values for the example in this guide are parenthesized.

y11: Station address (1) *

y12: Communications error processing (0) *

y13: Timer (2.0) *

y14: Baud rate (4 = 38400 bps)

y15: Data length (0 = 8 bits)

y16: Parity check (1 = Even [Stop bit: 1 bit])

* When either even parity or odd parity is selected for Modbus RTU, the stop bit is automatically set to 1 bit. Therefore, the stop bit (y17) does not need to be set.

y18: No response error detection time (0) *

y19: Response interval (0.01) *

y20: Protocol selection (0 = Modbus RTU protocol) *

Asterisks (*) indicate the factory default settings.

Notes:

Port 1 When using an RJ-45 connector (modular jack) for connecting the keypad, change y01 to y10.

3.2.2 Procedure for changing function codes

(1) Procedure for setting H30

Follow the procedure below to change the H30 setting to "8". (Both the frequency and operation commands are issued via RS-485 communication [Port 2].)

- 1) When the power supply is turned ON, the INV automatically enters the operation mode. Press the [PRG/RESET] key during the operation mode to enter the program mode and display the function selection menu.
- 2) Select "1.H__" function code group using the up and down arrow keys.
- 3) Press the [FUNC/DATA] key to display the "function code list" of H code group.
- 4) Select "H 30" using the up and down arrow keys, and then press the [FUNC/DATA] key.
The currently set data is displayed. (Factory default setting: 0)
- 5) Change the function code data to "8" using the up and down arrow keys.
- 6) Press the [FUNC/DATA] key to determine the function code data.
The message "SAVE" appears on the screen and the data is stored in the memory in the inverter.
Then the screen returns to the function code list, automatically displaying the next function code.
Press the [PRG/RESET] key to return to the function code and press it again to return to the operation mode.
* When no data is changed, the message "SAVE" does not appear even if the [FUNC/DATA] key is pressed.

(2) Procedure for setting y14

Follow the procedure below to change the y14 setting to 4 (38400 bps).

- 1) When the power supply is turned ON, the INV automatically enters the operation mode. Press the [PRG/RESET] key during the operation mode to enter the program mode and display the function selection menu.
- 2) Select "1.y__" function code group using the up and down arrow keys.
- 3) Press the [FUNC/DATA] key to display the "function code list" of y code group.
- 4) Select "y 14" using the up and down arrow keys, and then press the [FUNC/DATA] key.
The currently set data is displayed. (Factory default setting: 3)
- 5) Change the function code data to 4 using the up and down arrow keys.
- 6) Press the [FUNC/DATA] key to determine the function code data.
The message "SAVE" appears on the screen and the data is stored in the memory in the inverter.
Then the screen returns to the function code list, automatically displaying the next function code.
Press the [PRG/RESET] key to return to the function code and press it again to return to the operation mode.
* When no data is changed, the message "SAVE" does not appear even if the [FUNC/DATA] key is pressed.

Set y11 to y20 referring to the procedure for setting y14.

4. Setting of PLC

4.1 Modbus RTU communication procedure

For communication with an INV, a protocol called Modbus RTU is used.

Modbus RTU communication is performed between a master device (PLC) a slave device (INV). The master issues a query to the slave, and the slave returns a response to it.

Modbus has function codes (referred to as M_FNC in this guide).

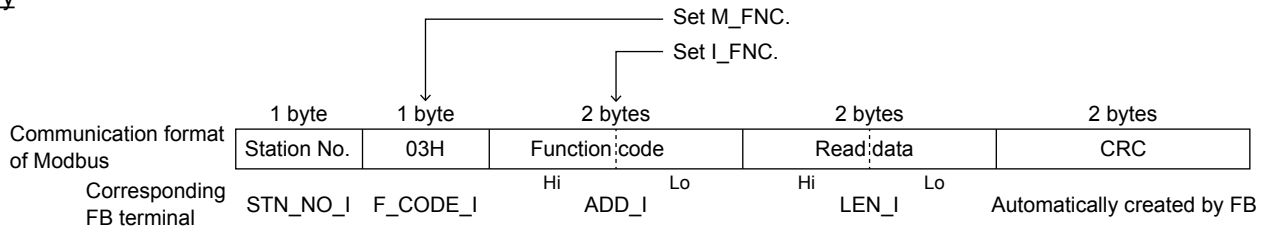
Each function code No. has a different function, such as data writing or reading.

In the sample program in this guide, M_FNC “03” and “06” are used.

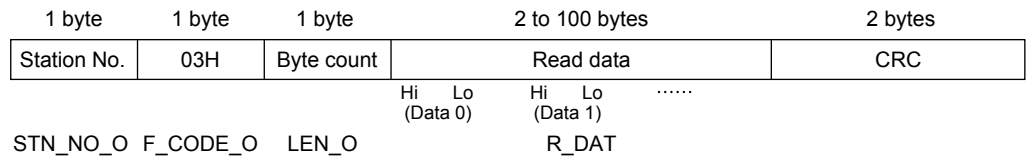
In addition, you need to specify which function code of the INV is controlled. The function codes of the INV are referred to as I_FNC in this guide.

4.1.1 Communication format of M_FNC “03” (function reading)

Query

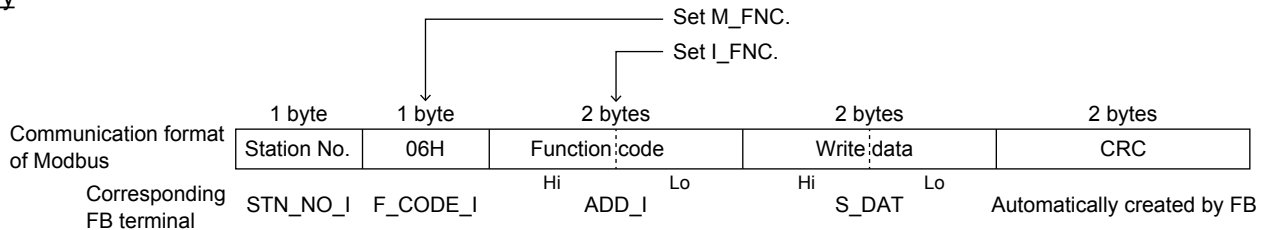


Normal response

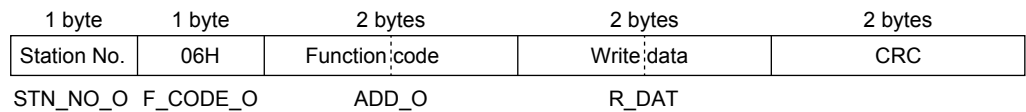


4.1.2 Communication format of M_FNC “06” (single function writing)

Query

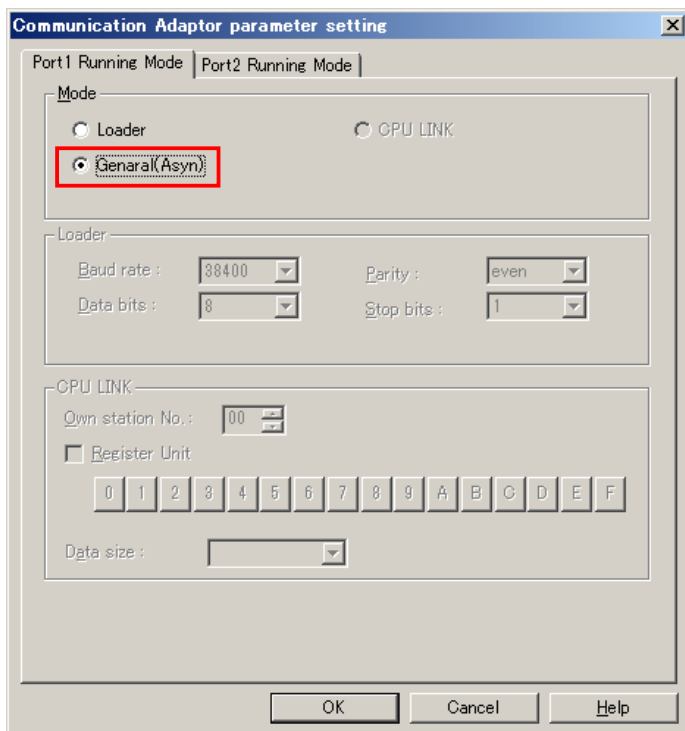


Normal response



4.2 Setting communication board operation

Open the system definition screen. On the “Communication Adaptor parameter setting” dialog box, select “General (Asyn)” for the communication board mode setting.



4.3 FB control procedure

To perform Modbus communication, control the FB following the procedure below.

4.3.1 Setting communication parameters

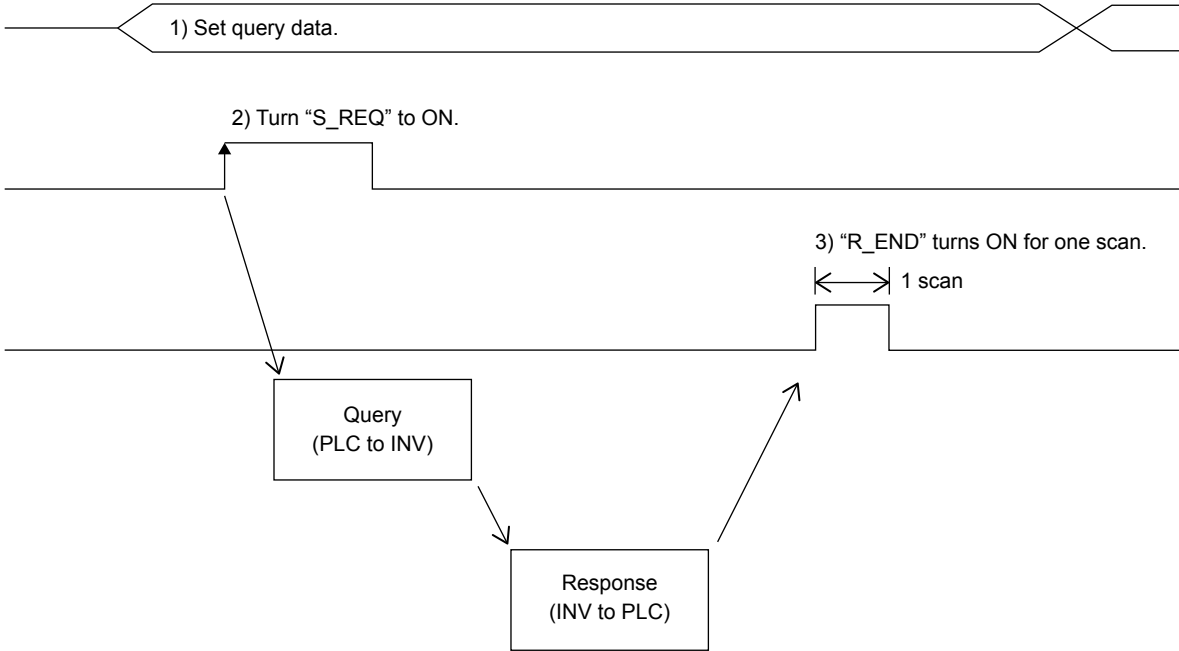
- 1) Set the communication parameters in the “PARA” terminal.
- 2) Turn the “OPEN” terminal from OFF to ON.
(Keep the “OPEN” terminal ON.)
- 3) When the communication is ready, the “OK” output turns ON.

<PARA terminal setting>

Address	Item	Setting
PARA [0]	Communication port No.	2: PORT2
PARA [4]	Baud rate (bps)	5: 38400
PARA [6]	Parity	2: Even
PARA [7]	Stop bits	0: 1 bit
PARA [12]	RS-485 mode	0: 2 wire
PARA [35]	Response monitoring timer value	300: 300 x 10 ms

4.3.2 Communicating with the slave device

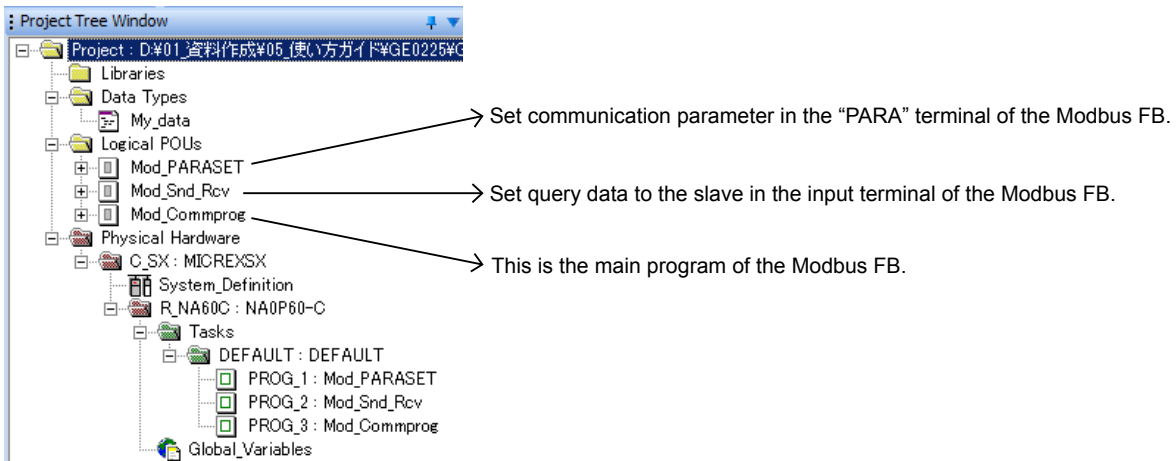
- 1) Set query data to the slave in the input terminals such as "STN_NO_I" and "F_CODE_I."
- 2) Turn "S_REQ" (send request) to OFF, ON and then OFF again.
 At the rising edge of "S_REQ," the PLC sends the query data to the slave.
 While sending the data, "TX" on the communication board lights up.
- 3) The PLC receives a response from the slave.
 While receiving the data, "RX" on the communication board lights up.
 When the reception is completed normally, the "R_END" output turns ON for one scan.
 In the output terminals such as "STN_NO_O" and "F_CODE_O," the data received from the slave are set.
 Performing the steps 1) to 3) completes one communication.



4.4 Description of sample program

4.4.1 Sample program

The sample program in this guide consists of three POUs as shown below.



4.4.2 How to use the sample program

Suppose that the PLC issues the following commands to the slave via Modbus communication.

- (1) Open a communication port.
- (2) Write a frequency (x0.01 Hz) to the INV.
- (3) Issue a FWD command to the INV.
- (4) Read an output frequency (x0.01 Hz) of the INV.
- (5) Stop the INV.

Perform the following operations using the loader.

- (1) Open a communication port.
 - 1) Turn the variable "OPEN" of the POU "Mod_Commprog" from OFF to ON.
 - 2) When communication is ready, the variable "OK" of the POU "Mod_Commprog" turns ON.
- (2) Write a frequency (x0.01 Hz) to the INV.
 - 1) Turn the variable "Write_Freq" of the POU "Mod_Snd_Rcv" to OFF, ON and then OFF again.
The command data of the frequency setting is set in the input terminal of the FB.
 - 2) Turn the variable "S_REQ" of the POU "Mod_Commprog" to OFF, ON and then OFF again.
At the rising edge of "S_REQ," the PLC sends the query data to the INV.
 - 3) When the PLC receives a response from the slave, the variable "R_END" of the POU "Mod_Commprog" turns ON for one scan.
Confirm that the current counter value of the counter FB "CTU_1" is increased by one because you cannot see "R_END" turn ON on the loader screen. The INV displays the frequency that is set from the PLC.
If the communication is failed, both the variable "R_END" and the variable "R_ERR" turn ON for one scan.
In this case, the current counter values of the counter FBs "CTU_1" and "CTU_2" are both increased by one.
In addition, an error status code is stored in the variable "R_STS."
- (3) Issue a FWD command to the INV.
 - 1) Turn the variable "FWD_ON" of the POU "Mod_Snd_Rcv" to OFF, ON and then OFF again.
The command data of ON to "FWD" is set in the input terminal of the FB.
 - 2) Turn the variable "S_REQ" of the POU "Mod_Commprog" to OFF, ON and then OFF again.
At the rising edge of "S_REQ," the PLC sends the query data to the INV.
 - 3) When the PLC receives a response from the slave, the variable "R_END" of the POU "Mod_Commprog" turns ON for one scan.
The motor connected to the INV rotates forward at the set frequency.
- (4) Read the output frequency (x0.01 Hz) of the INV.
 - 1) Turn the variable "Read_Freq" of the POU "Mod_Snd_Rcv" to OFF, ON and then OFF again.
The command data of the frequency reading is set in the input terminal of the FB.
 - 2) Turn the variable "S_REQ" of the POU "Mod_Commprog" to OFF, ON and then OFF again.
At the rising edge of "S_REQ," the PLC sends the query data to the INV.
 - 3) When the PLC receives a response from the slave, the variable "R_END" of the POU "Mod_Commprog" turns ON for one scan.
The frequency data read from the INV is output to "R_DAT [0]."
- (5) Stop the INV.
 - 1) Turn the variable "FWD_OFF" of the POU "Mod_Snd_Rcv" to OFF, ON and then OFF again.
The command data of OFF to "FWD" is set in the input terminal of the FB.
 - 2) Turn the variable "S_REQ" of the POU "Mod_Commprog" to OFF, ON and then OFF again.
At the rising edge of "S_REQ," the PLC sends the query data to the INV.
 - 3) When the PLC receives a response from the slave, the variable "R_END" of the POU "Mod_Commprog" turns ON for one scan.
The motor connected to the INV stops.

4.4.3 Sample program

[Declaration statement of data type]

```
TYPE  
  INT_40 : ARRAY[0..39] OF INT;  
  WORD_125 : ARRAY[0..124] OF WORD;  
END_TYPE
```

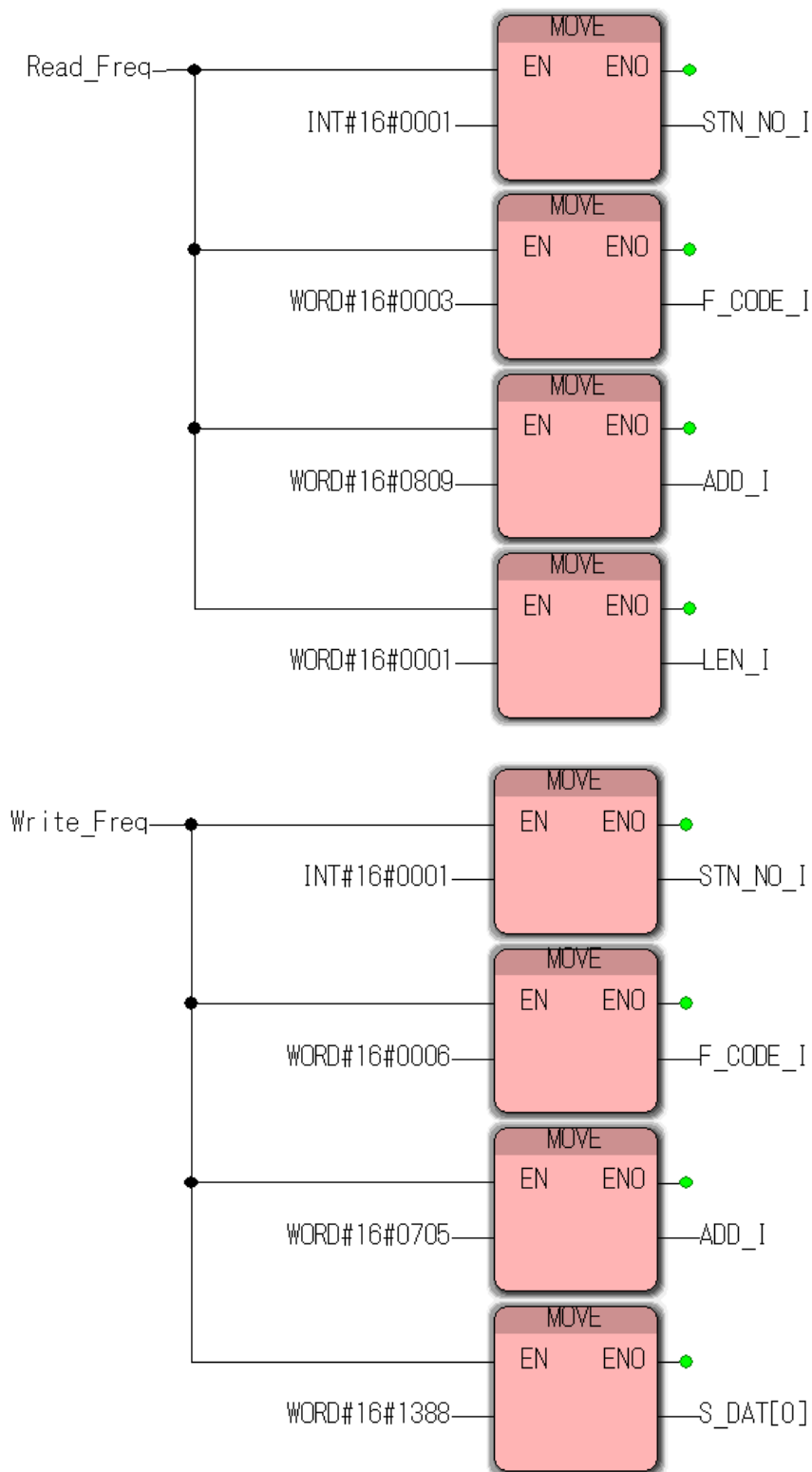
[Code worksheet of POU "Mod_PARASET"]

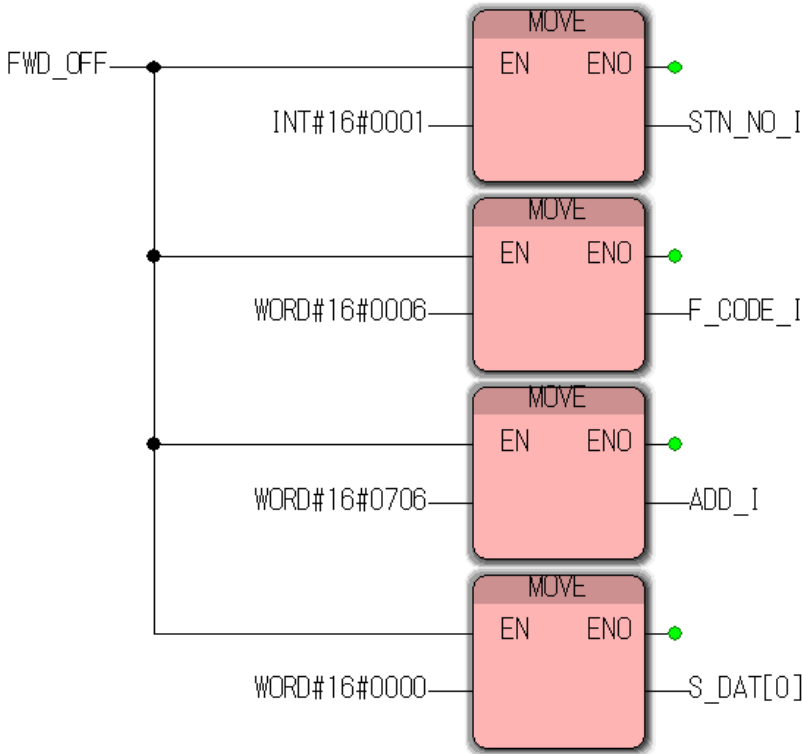
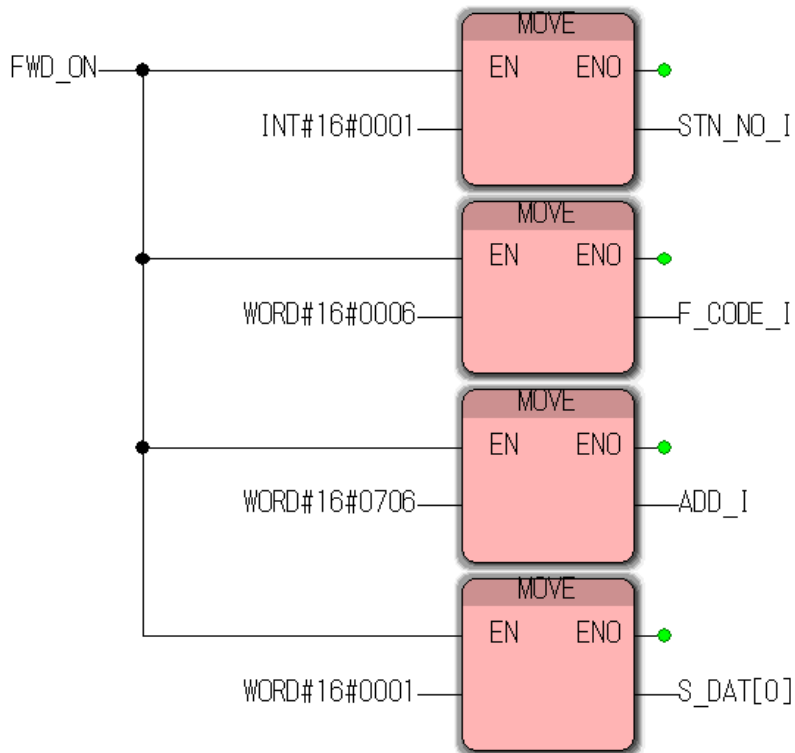
```
IF NOT FLAG THEN  
  PARA[0] := 2; (* 2=PORT2:RS-485 *)  
  PARA[4] := 5; (* 5=38400bps *)  
  PARA[6] := 2; (* 2=even party*)  
  PARA[7] := 0; (* 0=1 Stop bit *)  
  PARA[12] := 0; (* 0=RS-485 2wire *)  
  PARA[35] := 300; (* 300=300x10ms *)  
  FLAG := TRUE;  
END_IF;
```

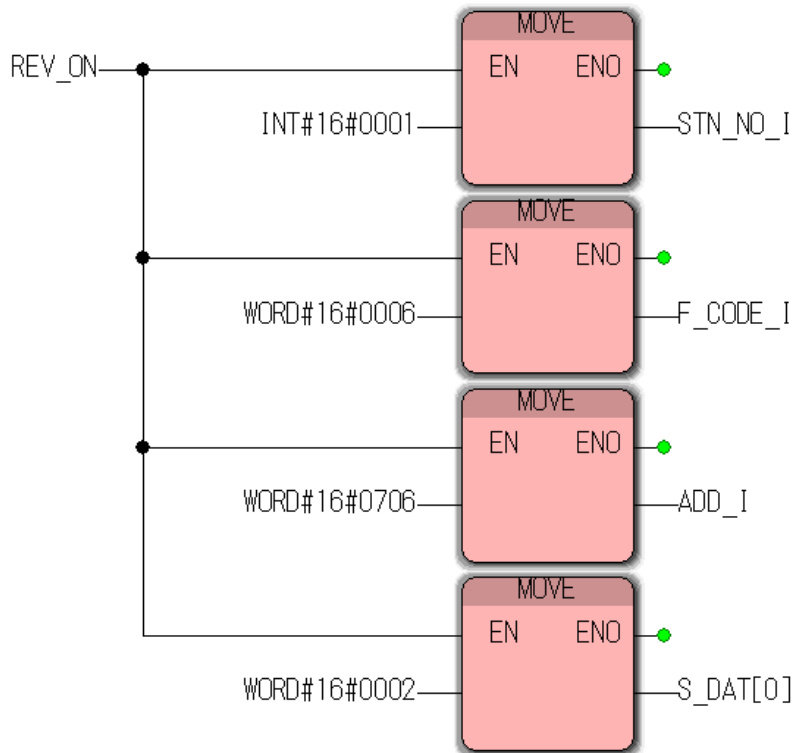
[Variable worksheet of POU "Mod_PARASET"]

Variable	Data type	Usage	Address	Init	RETAIN
☐ Default					
FLAG	BOOL	VAR			<input type="checkbox"/>
PARA	INT_40	VAR_EXTERNAL			<input type="checkbox"/>

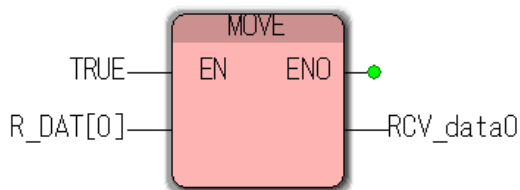
(*Data send from master*)







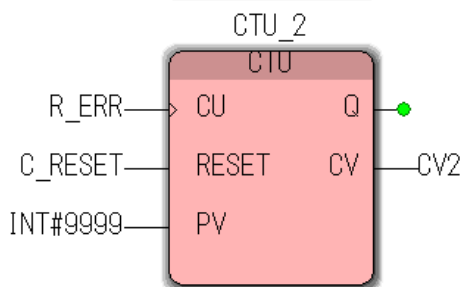
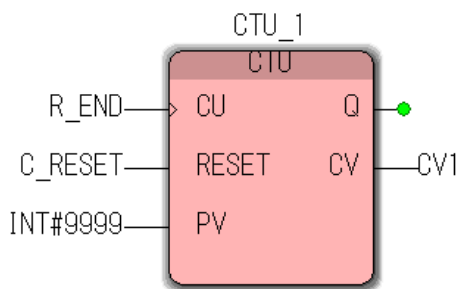
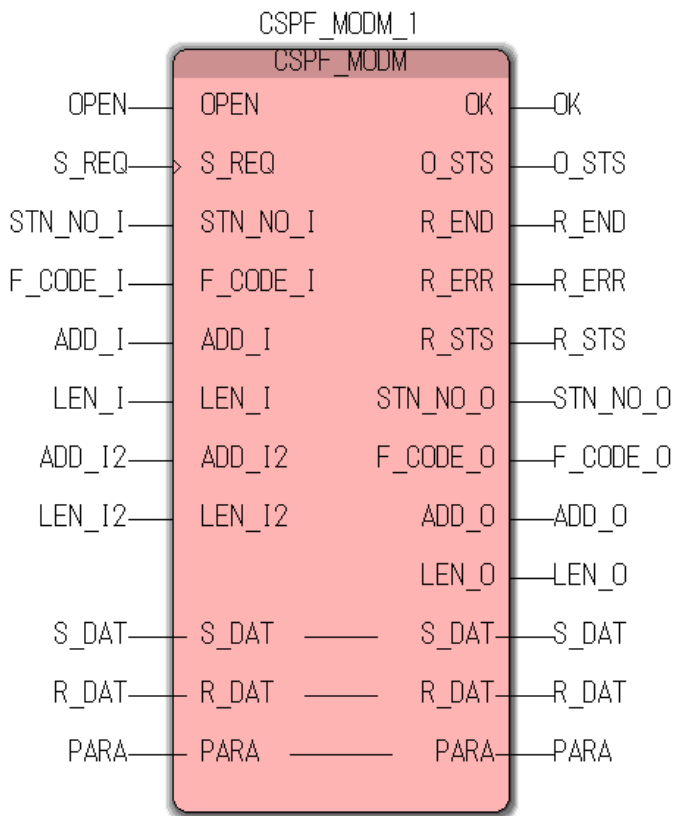
(*Data receive from slave*)



[Variable worksheet of POU "Mod_Snd_Rcv"]

Variable	Data type	Usage	Address	Init	RETAIN
Default					
STN_NO_I	INT	VAR_EXTERNAL			<input type="checkbox"/>
F_CODE_I	WORD	VAR_EXTERNAL			<input type="checkbox"/>
ADD_I	WORD	VAR_EXTERNAL			<input type="checkbox"/>
LEN_I	WORD	VAR_EXTERNAL			<input type="checkbox"/>
S_DAT	WORD_125	VAR_EXTERNAL			<input type="checkbox"/>
R_DAT	WORD_125	VAR_EXTERNAL			<input type="checkbox"/>
Read_Freq	BOOL	VAR			<input type="checkbox"/>
Write_Freq	BOOL	VAR			<input type="checkbox"/>
FWD_ON	BOOL	VAR			<input type="checkbox"/>
FWD_OFF	BOOL	VAR			<input type="checkbox"/>
REV_ON	BOOL	VAR			<input type="checkbox"/>
RCV_data0	WORD	VAR			<input type="checkbox"/>

[Code worksheet of POU "Mod_Commprog"]



[Variable worksheet of POU "Mod_Commprog"]

Variable	Data type	Usage	Address	Init	RETAIN
Default					
CSPF_MODM_1	CSPF_MODM	VAR			<input type="checkbox"/>
OPEN	BOOL	VAR			<input type="checkbox"/>
S_REQ	BOOL	VAR			<input type="checkbox"/>
STN_NO_I	INT	VAR_EXTERNAL			<input type="checkbox"/>
F_CODE_I	WORD	VAR_EXTERNAL			<input type="checkbox"/>
ADD_I	WORD	VAR_EXTERNAL			<input type="checkbox"/>
LEN_I	WORD	VAR_EXTERNAL			<input type="checkbox"/>
ADD_I2	WORD	VAR_EXTERNAL			<input type="checkbox"/>
LEN_I2	WORD	VAR_EXTERNAL			<input type="checkbox"/>
S_DAT	WORD_125	VAR_EXTERNAL			<input type="checkbox"/>
R_DAT	WORD_125	VAR_EXTERNAL			<input type="checkbox"/>
PARA	INT_40	VAR_EXTERNAL			<input type="checkbox"/>
OK	BOOL	VAR			<input type="checkbox"/>
O_STS	WORD	VAR			<input type="checkbox"/>
R_END	BOOL	VAR			<input type="checkbox"/>
R_ERR	BOOL	VAR			<input type="checkbox"/>
R_STS	WORD	VAR			<input type="checkbox"/>
STN_NO_O	INT	VAR_EXTERNAL			<input type="checkbox"/>
F_CODE_O	WORD	VAR_EXTERNAL			<input type="checkbox"/>
ADD_O	WORD	VAR_EXTERNAL			<input type="checkbox"/>
LEN_O	WORD	VAR_EXTERNAL			<input type="checkbox"/>
CTU_1	CTU	VAR			<input type="checkbox"/>
CV1	INT	VAR			<input type="checkbox"/>
CTU_2	CTU	VAR			<input type="checkbox"/>
CV2	INT	VAR			<input type="checkbox"/>
C_RESET	BOOL	VAR			<input type="checkbox"/>

[Global variable worksheet]

Variable	Data type	Usage	Address	Init	RETAIN
Global Variables					
STN_NO_I	INT	VAR_GLOBAL			<input type="checkbox"/>
F_CODE_I	WORD	VAR_GLOBAL			<input type="checkbox"/>
ADD_I	WORD	VAR_GLOBAL			<input type="checkbox"/>
LEN_I	WORD	VAR_GLOBAL			<input type="checkbox"/>
ADD_I2	WORD	VAR_GLOBAL			<input type="checkbox"/>
LEN_I2	WORD	VAR_GLOBAL			<input type="checkbox"/>
S_DAT	WORD_125	VAR_GLOBAL			<input type="checkbox"/>
R_DAT	WORD_125	VAR_GLOBAL			<input type="checkbox"/>
PARA	INT_40	VAR_GLOBAL			<input type="checkbox"/>
STN_NO_O	INT	VAR_GLOBAL			<input type="checkbox"/>
F_CODE_O	WORD	VAR_GLOBAL			<input type="checkbox"/>
ADD_O	WORD	VAR_GLOBAL			<input type="checkbox"/>
LEN_O	WORD	VAR_GLOBAL			<input type="checkbox"/>