ELECTRONIC METER

SX1-A31E

MODBUS® RTU Protocol Specifications

SPEC. NO. : MDD-T0025A

MITSUBISHI ELECTRIC AUTOMATION (THAILAND) CO., LTD

CONTENTS

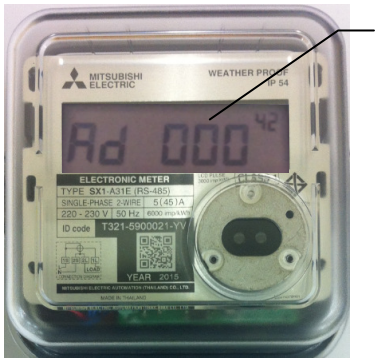
1. Functions

Electronic Meter SX1-A31E provide measurement values with MODBUS® RTU protocol to a PLC or PC via an RS-485 serial link (2 wires).

MODBUS is a registered trademark of SCHNIDER ELECTRIC USA, INC in the United States.

2. Checking before usage

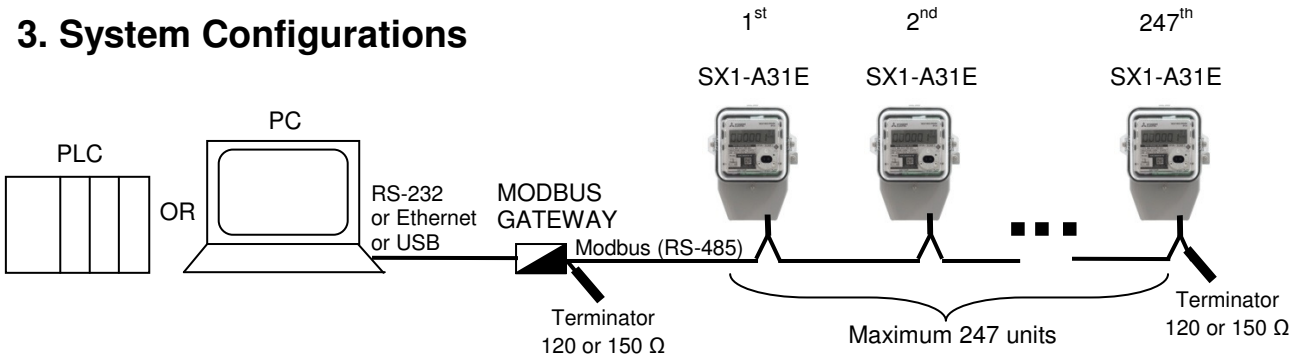
LCD display will show the default slave address (Ad) as “Ad 000”. Before communicating with Modbus protocol, user have to change slave address from “000” to new one (1~247) by using “Modbus Meter Setting” software.
(download setting software from our website: www.meath-co.com/meter)



Slave address display on meter’s LCD (scrolling)

See detail of Slave address in Appendix B

3. System Configurations



※ A terminator 120 or 150 ohm resistance must be connected at both ends of RS-485 bus, between line TR+ and TR- of each end.

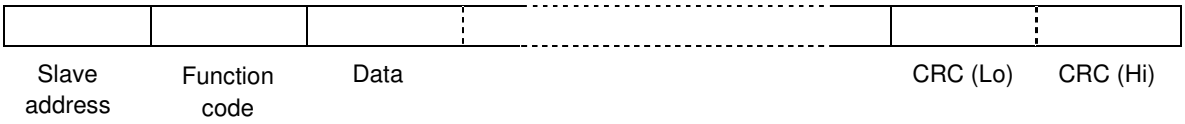
4. Technical Characteristic

Item	Specifications
Physical interface	RS-485 2wires half duplex
Protocol	RTU mode
Transmission wiring type	Multi-point bus (daisy-chain)
Baud rate	1,200 bps.
Data bit	8
Stop bit	1
Parity	Even
CRC polynomial	0xA001
Slave address	1~247 (F7h) (see detail in Appendix B)
Response time	80ms~200ms (programmable) Default 80 ms.
Distance	1,200 m
Max. number	247
Terminator	120 or 150Ω 1/2W
Recommended cable	Shielded twisted pair, recommend LiYCY 2x0.25 mm^2

5. Specification for Communication

5.1 Standard Communication Frame

The standard communication frame consists of :



Slave address : 01~F7H
Function code : 03H….. Read Holding Registers (maximum 250 bytes)
: 10H….. Write multiple registers
Data : 8 bit HEX data
: The Cyclical Redundancy Check (CRC) field is two bytes, containing a 16-bit binary value.

<NOTE>

Procedure for generating CRC:

1. Load a 16-bit register with FFFF hex (all 1's). This is called the CRC register.
2. Exclusive OR the first 8-bit byte of the message with the low-order byte of the 16-bit CRC register, putting the result in the CRC register.
3. Shift the CRC register one bit to the right (toward the LSB), zero-filling the MSB. Extract and examine the LSB.
4. (If the LSB was 0): Repeat Step 3 (another shift).
   (If the LSB was 1): Exclusive OR the CRC register with the polynomial value 0xA001 (1010 0000 0000 0001).
5. Repeat Step 3 and 4 until 8 shifts have been performed. When this is done, a complete 8-bit byte will have been processed.
6. Repeat Step 2 through 5 for the next 8-bit byte of the message. Continue this until all byte will have been processed.
7. The final content of the CRC register is the CRC value.
8. When the CRC is placed into the message, its upper and lower bytes must be swapped as described above.

5.2 Bit Sequence

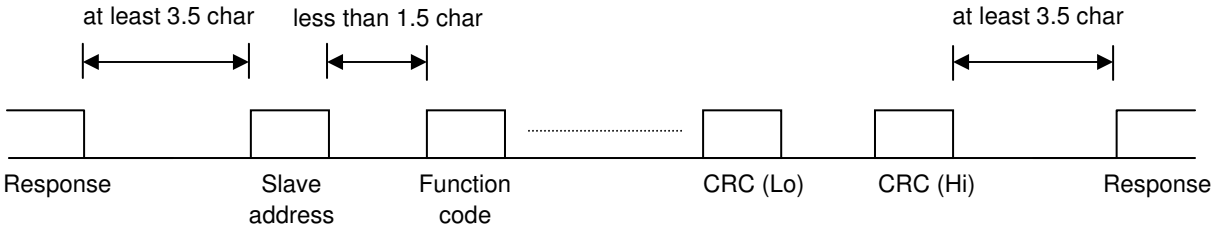
With RTU character framing, the bit sequence is below.

<Example> With Parity Checking and Stop bit is1.

Start	1	2	3	4	5	6	7	8	Parity	Stop
	LSB							MSB		

5.3 MODBUS Message RTU Framing

A MODBUS message is placed by transmitting device into a frame that has a known beginning and ending point. This allows devices to receive a new frame to begin at the start of the message, and to know when the message is completed. Partial messages must be detected and errors must be set as a result. In RTU mode, message frames are separated by a silent interval of at least 3.5 characters items.



6. Framing of Query and Response

6.1 Read Holding Registers (03H)

- Query framing

H	03H	Hi	Lo	Hi	Lo	Lo	Hi
Slave address		Starting address		Quantity of registers		CRC	

  - Slave address : 1 to F7H
  - Starting address : 2 bytes
  - Quantity of registers : Maximum 125
  - CRC : 2 bytes

- Response framing (Maximum 255 bytes)

H	03H		Hi	Lo	Hi	Lo		Lo	Hi
Slave address		Byte count	Data 1		Data 2			CRC	

  - Byte count : Byte count of response data (Maximum 250).

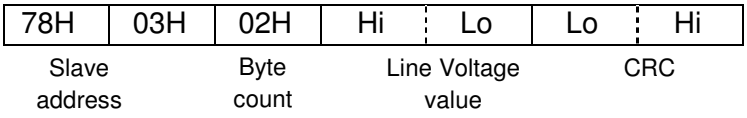
<Example1> In case of reading Line Voltage* value, and the slave address is 78H.

- Query framing

78H	03H	00H	66H	00H	01H	6FH	BCH
Slave address		Starting address		Quantity of registers		CRC (=BC6FH)	

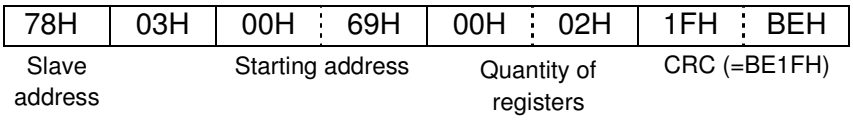
* Register address of Line Voltage is 0066H (see section 8.1).

- Response framing



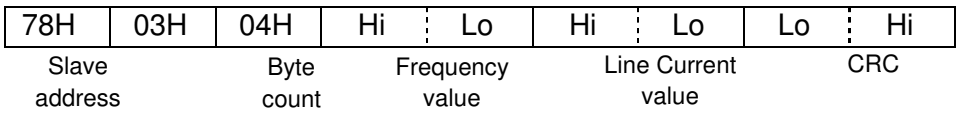
<Example2> In case of reading Frequency* value to Line Current* value. Slave address is 78H.

- Query framing



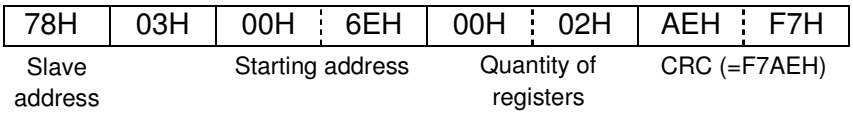
* Register address of Frequency and Line Current is 0069H and 0070H respectively (see section 8.1).

- Response framing



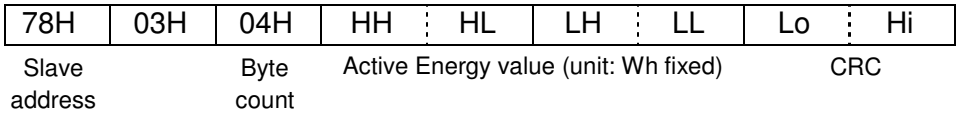
<Example3> In case of reading Active Energy* value (unit: Wh fixed). Slave address is 78H.

- Query framing



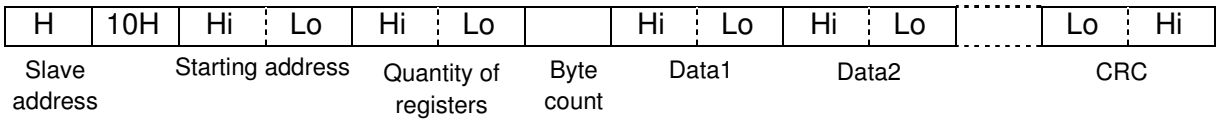
* Register address of Active Energy is 006EH~006FH (see section 8.1).

- Response framing



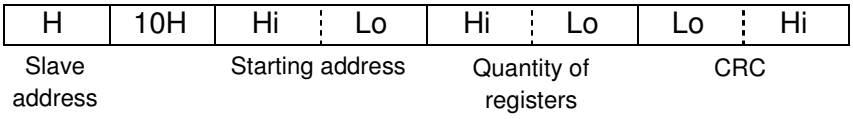
6.2 Write Multiple Registers (10H)

- Query framing



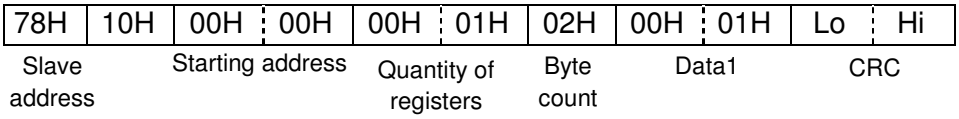
- Slave address : 1 to F7H
- Starting address : 2 bytes
- Quantity of registers : Maximum 123
- Byte count : Maximum 246
- Data1~ : Write data (Minimum 2 bytes)
- CRC : 2 bytes

- Response framing



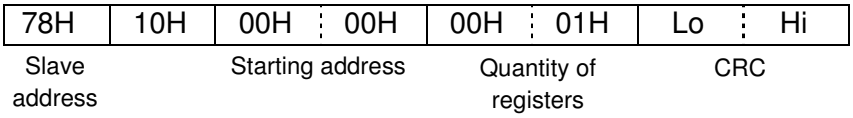
<Example> In case of setting Slave Address*. Change Slave Address from 78H to 01H.

- Query framing



* Register address of Slave Address is 0000H (see section 8.1).

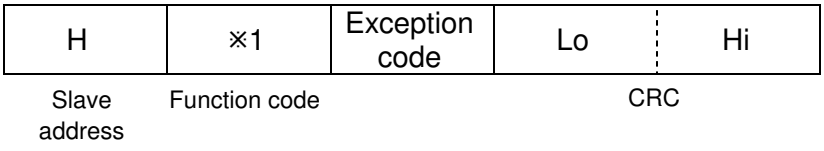
- Response framing



7. Exception Codes

ERROR	Meaning	Exception code
Framing error	Query framing is incorrect.	No response is returned.
Overrun error	1 byte data length is incorrect.	
Parity error	1 byte data is incorrect.	
CRC error	Framing data is incorrect.	
Illegal function	The function code received in the query was except 03H and 10H.	01H
Illegal data address	The data address received in the query is not an allowable address for the slave.	02H
Illegal data value	The data value received in the query is not an allowable data value for the slave.	03H

- Response framing



※1 Function code: In an exception response, the server sets the MSB of the function code.

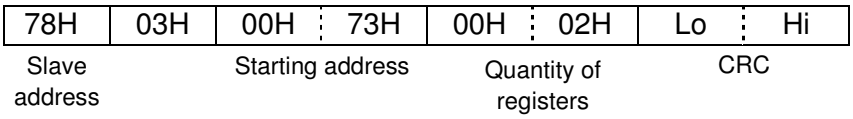
<Example>

Function code in a query	Function code in an exception response
03h	83h
10h	90h

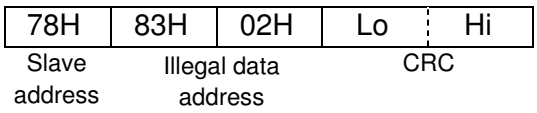
Example of illegal data address is shown as follows.

<Example> In case of reading from Active Power register (register address 0073H) to undefined register (address 0074H). Slave address is 78H.

- Query framing



- Response framing



8. Data

8.1 List of Parameters

At the list of parameters, precautions are following.

※1 R/W : Read and writes register.
R : Reads only register.

(1) Setup Registers

Register Address		Byte Count	R/W ※1	Register Name	RANGE	Unit
Dec.	Hex.					
40001	0000h	2	R/W	Slave Address ※2 (see detail Appendix B)	1 to 247	-
40002	0001h	2	R/W	Response Time ※3	8 to 20 (default 8)	10ms

※2 ⚠ **Warning: Do not write slave address "0" to the meter**.
This case communication mode will change and meter cannot communication.

※3 Response Time is waiting time that slave (SX1 meter) wait to send response after receive a complete query. The response time must be longer than 3.5 char (see section 5.3).

(2) Instantaneous Value

Register Address		Byte Count	R/W ※1	Register Name	RANGE	Unit
Dec.	Hex.					
40103	0066h	2	R	Line Voltage (RMS)	0 to 65535	0.01V
40106	0069h	2	R	Frequency	0 to 65535	0.1Hz
40113	0070h	2	R	Line Current (RMS)	0 to 65535	0.01A
40116	0073h	2	R	Active Power (W)	0 to 65535	W

(3) Counting of Energy Registers

Register Address		Byte Count	R/W ※1	Register Name	RANGE	Unit
Dec.	Hex.					
40111	006Eh	4	R	Active Energy (Wh) imp+exp	0 to 999999999	Wh

(4) General information

Register Address		Byte Count	R/W ※1	Register Name	RANGE	Unit
Dec.	Hex.					
40101	0064h	4	R	Serial No. (see Appendix A)	0 to 9999999	-
40114	0071h	2	R	Current Rating (see definition of reading value Appendix C)	0 to 65535	-

Appendix A Serial No.

The *Serial No.* of each meter is on meter name plate at middle portion of *ID code*.

<Example A1> Serial No. of meter which has ID code *T321-4900160-TK* is 4900160.

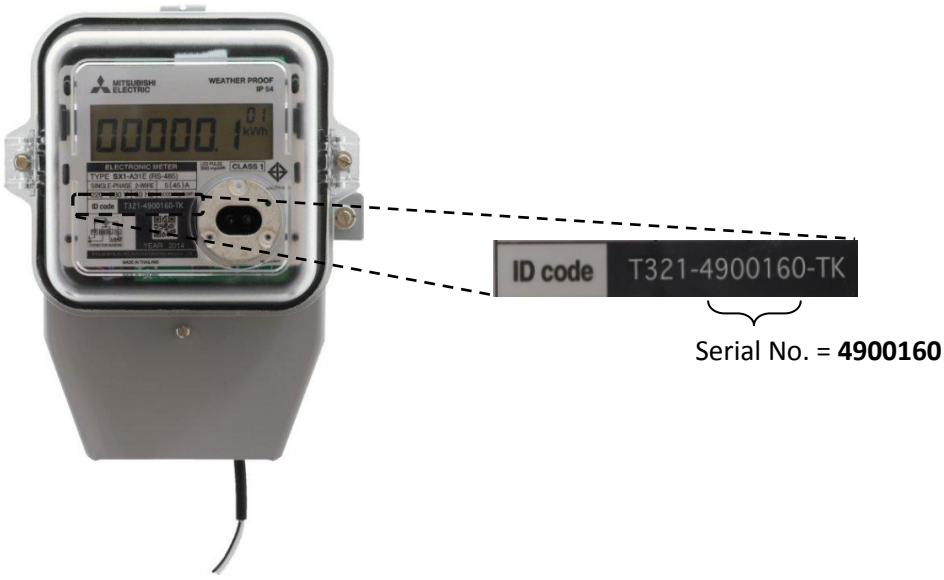
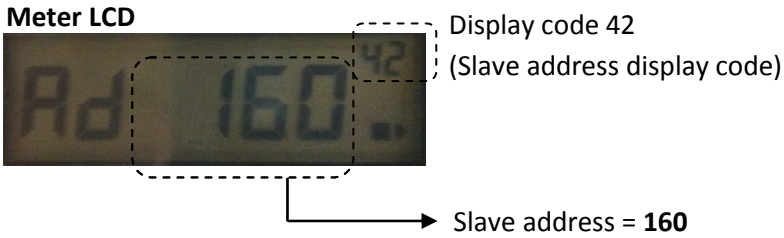


Figure A1 Serial No. on meter name plate.

Appendix B Slave Address

A slave address of any meter is shown on meter LCD by auto scrolling display. The slave address shown by display item, code 42.

<Example B1>



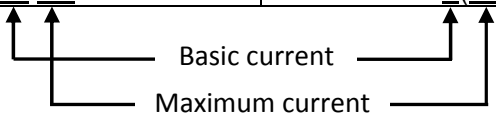
***Note*:** Meter which not show Slave Address display item (Ad) does not support Modbus protocol. Please contact factory.

A slave address must be unique on a Modbus serial bus. If some slave addresses are duplicated on bus, slave address changing must be done by software “Modbus Meter Setting” (download setting software from our website: www.meath-co.com/meter)

Appendix C Current Rating Register Value Definition

Current Rating register (register address 0071h)
There are 2 bytes length, MS byte is Basic current and LS byte is Maximum current in ampere. See table below:

Reading Value (Hex)	Current Rating Definition
05 2D	5(45)A



Meter Technical Support

0-2540-6992

support.025406992 (Line ID)

Working Hours: Mon.– Fri. / 8.00a.m.–5.00p.m.

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