

# **SFLC-110L**

## **COMMUNICATION SPECIFICATION**

(Modbus RTU mode protocol)

HARDWARE MODEL E

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## 1. Communication specification

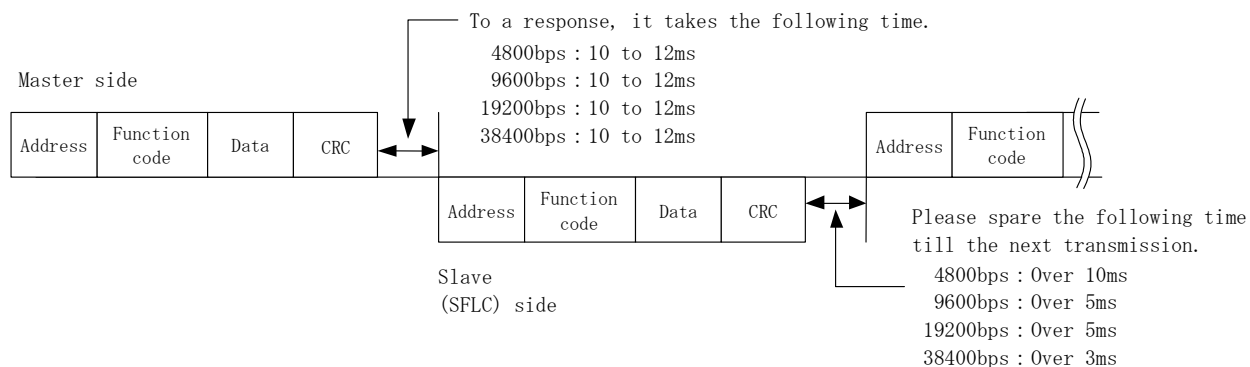
| Item                             | Specification                                 | Default setting |
|----------------------------------|---|-----------------|
| Standard                         | TIA-485-A (2003)                              |                 |
| Protocol                         | Modbus protocol RTU mode                      | —               |
|                                  | Function code : 03H, 04H, 06H, 08H            |                 |
| Transmission system              | Half-duplex two-wire system                   | —               |
| Synchronous system               | Asynchronous communication method             | —               |
| Transmission rate <sup>(1)</sup> | 4800bps / 9600bps / 19200bps / 38400bps       | 9600bps         |
| Modulation code                  | NRZ   | —               |
| Start bit                        | 1 bit   | —               |
| Data length                      | 8 bit   | —               |
| Parity <sup>(1)</sup>            | NONE / Even number / Odd number               | Even number     |
| Stop bit <sup>(1)</sup>          | 1 bit / 2 bit                                 | 1 bit           |
| Cable length                     | 1000m (The total extension)                   | —               |
| Address <sup>(1)</sup>           | 1 to 247 (Connection is possible to 31 sets.) | 1               |
| Error detection                  | CRC-16 ( $X^{16} + X^{15} + X^2 + 1$ )        | —               |
| Transmission character           | Binary  | —               |

Transmission data are sent out from a bit 0.

Note<sup>(1)</sup> A setting change is made with a front switch.

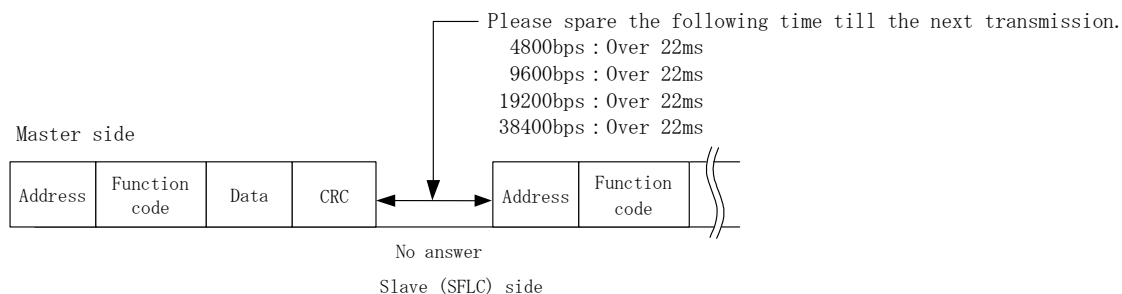
## 2. Transmission and reception protocol

## (1) Usual request (Query)



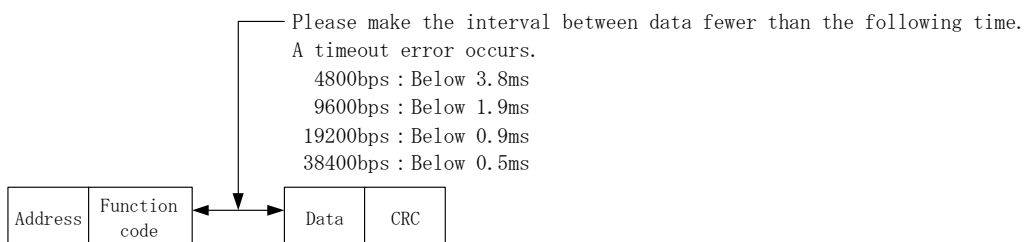
## (2) Broadcast request (Query)

If all stations are specified in the address, it becomes a broadcast request. At this time, the slave side becomes unresponsive.



(3) The timeout between data

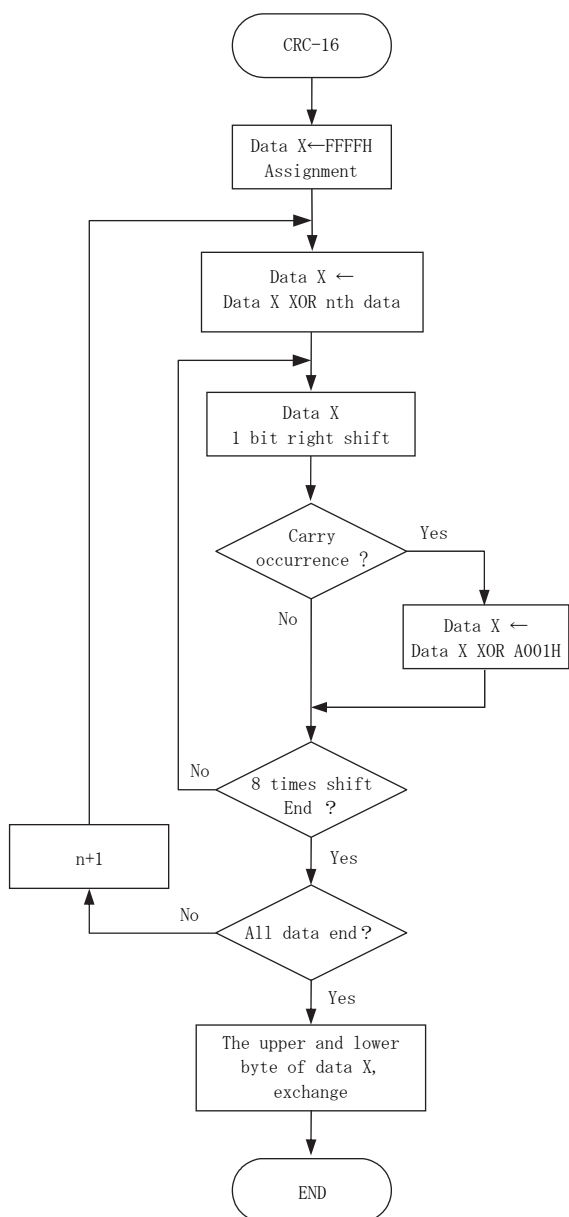
The interval between data must be 1.5 characters or less.



3. Calculation method of CRC-16

CRC-16 is adopted as error checking in Modbus RTU mode.

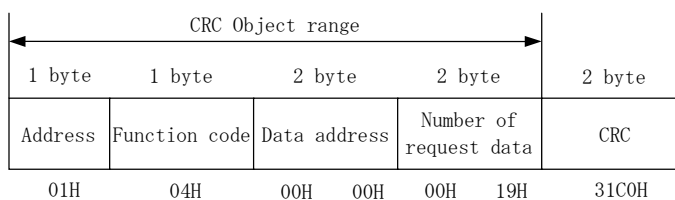
An address, a function code, and data are calculated by the following method.



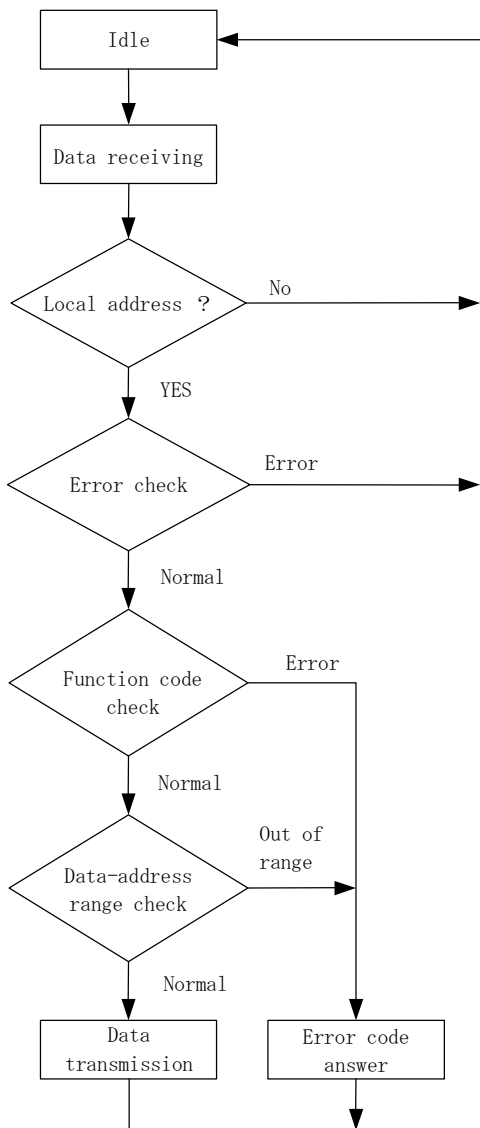
(1) Arithmetic process

- ① 2 bytes of data-area X is secured to a CRC calculation.
- ② FFFFH is substituted for ① as initial value.
- ③ XOR of data X and the nth data (n=1) is calculated. Assign it to data X.
- ④ The 1-bit right shift of the data X is done.
- ⑤ If carry occurs in operation of ④, data X and XOR of A001H are taken.
- ⑥ Operation of ④, ⑤ is repeated until it shifts 8 times.
- ⑦ The next data (n+1) and XOR of data X is calculated. Assign it to data X.
- ⑧ Operation of ④ to ⑦ is repeated until processing of all data is completed.
- ⑨ 1 byte of upper and 1 byte of lower of data-area X for a CRC calculation are exchanged.

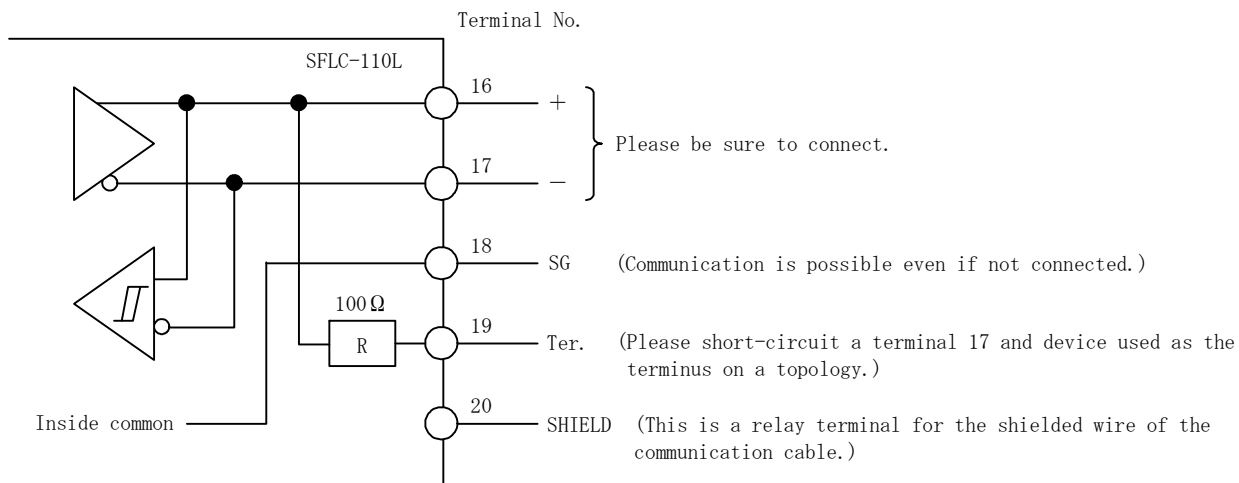
(2) Example of calculation



4. Communication process flow chart



5. SFLC communication specification terminal arrangement



## 6. Modbus protocol RTU mode

### 6.1 Function code

The next function code is supported with this product.

| Code | Name                      | Data address | Contents  | Modbus original function            |
|------|---------------------------|--------------|---|-------------------------------------|
| 03   | Measurement range request | 40001 to     | VT ratio, CT ratio and the readout of multiplying factor.                         | Holding register readout            |
|      | Setting value request     | 40101 to     | The readout of setting value (measurement, alarm).                                |                                     |
|      | Status request            | 40201 to     | The status readout of alarm output.   |                                     |
|      | Model information request | 40501 to     | The readout of model information (type code, phase wire, rated voltage).          |                                     |
| 04   | Measurement value request | 30001 to     | The readout of measurement value (instant value / maximum value / minimum value). | Input-register readout              |
| 06   | Maximum, Minimum reset    | 40301 to     | Reset of the maximum value and the minimum value is performed.                    | Writing of simplex holding register |
| 08   | Loopback test             | —            | The communication test of master and slave is performed.                          | Diagnosis                           |

### 6.2 Abnormal response

In case the message transmitted from the master is judged to be abnormal, this product does the next abnormal answer.

(1) In case it becomes a no answer

① : In case a message transmission error occurs. (Overrun, Framing, Parity error, CRC)

② : In case the data interval of a message exceeds a regulation value (1.5 characters).

③ : In case the message frame exceeding 8 bytes is received.

(2) In case as answered in an error code.

In the error that does not correspond to (1), the following abnormal response is returned.

At this case, the code that applied 80H to the code of a demand is returned to a function code.

And, the generated error code is returned as data.

Error code list

| Error code | Contents   | 1 byte  | 1 byte               | 1 byte     | 2 byte |
|------------|--|---------|----------------------|------------|--------|
| 01H        | The function code besides regulation is received.  | Address | Function code (+80H) | Error code | CRC    |
| 02H        | Data address is out of range.  |         |                      |            |        |
| 03H        | The data more than the number of answer data are required. Setting out of setting range. |         |                      |            |        |
|            |  | 01H     | 84H                  | 02H        | C2C1H  |

### 6.3 Measurement range request

Used for reading measurement-range information, such as VT and CT ratio, in this product.

There is no broadcast. A function code designates 03H.

(1) Data request (Query)

In case it performs setting value request, it is necessary to designate the start address of data to acquire.

When a data address is transmitted, please subtract 40001 from the address in data-address list.

Please assign the number of requested data as the number of data.

| 1       | 2             | 3            | 4 | 5              | 6 | 7 | 8     |
|---------|---------------|--------------|---|----------------|---|---|-------|
| Address | Function code | Data address |   | Number of data |   |   | CRC   |
| 01H     | 03H           | 0000H        |   | 0003H          |   |   | 05CBH |

Data address list

| Function code | Data address | Item               |
|---------------|--------------|--------------------|
| 03H           | 40001        | VT ratio           |
|               | 40002        | CT ratio           |
|               | 40003        | Multiplying factor |

## (2) Response

If range request is performed normally, the following response will be returned from this product side.

Example) Data address : 40001, Number of data : 3.

| 1       | 2             | 3                 | 4        | 5 | 6        | 7 | 8                  | 9 | 10  | 11 |
|---------|---------------|-------------------|----------|---|----------|---|--------------------|---|-----|----|
| Address | Function code | Answer byte count | VT ratio |   | CT ratio |   | Multiplying factor |   | CRC |    |

## ● VT ratio, CT ratio

VT ratio data = Primary rated value  $\div$  110V

CT ratio data = Primary rated value  $\div$  5A  $\times$  10

| Primary rated (V) | Setting value data | Primary rated (A) | Setting value data | Primary rated (A) | Setting value data |
|-------------------|--------------------|-------------------|--------------------|-------------------|--------------------|
| 110               | 0001H (1)          | 5                 | 000AH (10)         | 1500              | 0BB8H (3000)       |
| 220               | 0002H (2)          | 6                 | 000CH (12)         | 1600              | 0C80H (3200)       |
| 380 (2)           | 0003H (3)          | 7.5               | 000FH (15)         | 1800              | 0E10H (3600)       |
| 440               | 0004H (4)          | 8                 | 0010H (16)         | 2000              | 0FA0H (4000)       |
| 460 (2)           | 0005H (5)          | 10                | 0014H (20)         | 2500              | 1388H (5000)       |
| 480 (2)           | 0006H (6)          | 12                | 0018H (24)         | 3000              | 1770H (6000)       |
| 880               | 0008H (8)          | 15                | 001EH (30)         | 4000              | 1F40H (8000)       |
| 1100              | 000AH (10)         | 20                | 0028H (40)         | 5000              | 2710H (10000)      |
| 1650              | 000FH (15)         | 25                | 0032H (50)         | 6000              | 2EE0H (12000)      |
| 2200              | 0014H (20)         | 30                | 003CH (60)         | 7500              | 3A98H (15000)      |
| 3300              | 001EH (30)         | 40                | 0050H (80)         | 8000              | 3E80H (16000)      |
| 6600              | 003CH (60)         | 50                | 0064H (100)        | 9000              | 4650H (18000)      |
| 11k               | 0064H (100)        | 60                | 0078H (120)        | 10000             | 4E20H (20000)      |
| 13.2k             | 0078H (120)        | 75                | 0096H (150)        | 12000             | 5DC0H (24000)      |
| 13.8k (2)         | 007DH (125)        | 80                | 00A0H (160)        | 15000             | 7530H (30000)      |
| 16.5k             | 0096H (150)        | 100               | 00C8H (200)        | 20000             | 9C40H (40000)      |
| 18.4k (2)         | 00A7H (167)        | 120               | 00F0H (240)        | 30000             | EA60H (60000)      |
| 22k               | 00C8H (200)        | 150               | 012CH (300)        |                   |                    |
| 33k               | 012CH (300)        | 200               | 0190H (400)        |                   |                    |
| 66k               | 0258H (600)        | 250               | 01F4H (500)        |                   |                    |
| 77k               | 02BCH (700)        | 300               | 0258H (600)        |                   |                    |
| 110k              | 03E8H (1000)       | 400               | 0320H (800)        |                   |                    |
| 132k              | 04B0H (1200)       | 500               | 03E8H (1000)       |                   |                    |
| 154k              | 0578H (1400)       | 600               | 04B0H (1200)       |                   |                    |
| 187k              | 06A4H (1700)       | 750               | 05DCH (1500)       |                   |                    |
| 220k              | 07D0H (2000)       | 800               | 0640H (1600)       |                   |                    |
| 275k              | 09C4H (2500)       | 900               | 0708H (1800)       |                   |                    |
| 380k (2)          | 0D7FH (3455)       | 1000              | 07D0H (2000)       |                   |                    |
| 550k              | 1388H (5000)       | 1200              | 0960H (2400)       |                   |                    |

The number of ( ) expresses decimal number data.

Note(2) Because broken numbers will occur if it divides by 110V, it becomes intrinsic set-value data.

## ● Multiplying factor

| Multiplying factor | Communication data |
|--------------------|--------------------|
| $\times 0.01$      | 0005H (5)          |
| $\times 0.1$       | 0006H (6)          |
| $\times 1$         | 0000H (0)          |
| $\times 10$        | 0001H (1)          |
| $\times 100$       | 0002H (2)          |
| $\times 1000$      | 0003H (3)          |
| $\times 10000$     | 0004H (4)          |

The number of ( ) expresses decimal number data.

## 6.4 Setting value request

Read the setting value (measurement, alarm) from this product. There is no broadcast. Function code is 03H.

### (1) Data request (Query)

In case it performs setting value request, it is necessary to designate the start address of data to acquire. When a data address is transmitted, please subtract 40001 from the address in data-address list. Please assign the number of requested data as the number of data.

| 1       | 2             | 3            | 4 | 5              | 6 | 7     | 8 |
|---------|---------------|--------------|---|----------------|---|-------|---|
| Address | Function code | Data address |   | Number of data |   | CRC   |   |
| 01H     | 03H           | 0064H        |   | 000EH          |   | 85D1H |   |

### Data address list

| Function code | Data address | Item  |
|---------------|--------------|---|
| 03H           | 40101        | Alarm output Output factor                        |
|               | 40102        | 0000H (Fixation)                                  |
|               | 40103        | Alarm output Reset method                         |
|               | 40104        | Alarm output Contact delay time                   |
|               | 40105        | 0000H (Fixation)                                  |
|               | 40106        | Demand current Upper limit value                  |
|               | 40107        | Demand current Time interval                      |
|               | 40108        | Demand power Upper limit value                    |
|               | 40109        | Demand power Time interval                        |
|               | 40110        | Demand power Operation method                     |
|               | 40111        | 0000H (Fixation)                                  |
|               | 40112        | 0000H (Fixation)                                  |
|               | 40113        | 0000H (Fixation)                                  |
|               | 40114        | 0000H (Fixation)                                  |
|               | 40115        | 0000H (Fixation)                                  |
|               | 40116        | 0000H (Fixation)                                  |
|               | 40117        | 0000H (Fixation)                                  |
|               | 40118        | 0000H (Fixation)                                  |
|               | 40119        | 0000H (Fixation)                                  |
|               | 40120        | 0000H (Fixation)                                  |
|               | 40121        | 0000H (Fixation)                                  |
|               | 40122        | Instantaneous detection Voltage upper limit value |
|               | 40123        | Instantaneous detection Voltage lower limit value |
|               | 40124        | 0000H (Fixation)                                  |
|               | 40125        | 0000H (Fixation)                                  |
|               | 40126        | 0000H (Fixation)                                  |
|               | 40127        | 0000H (Fixation)                                  |
|               | 40128        | Tidal current measurement                         |





## (6) Demand power upper limit value

Demand power upper limit value = Communication data

| Upper limit value        | Communication data                           |
|--------------------------|--|
| 5 to 100% (1% step), OFF | 0005H to 0064H (5 to 100), OFF : 0065H (101) |

## (7) Demand power time interval

Demand power time interval = Communication data

| Time interval | Communication data | Time interval | Communication data | Time interval | Communication data |
|---------------|--------------------|---------------|--------------------|---------------|--------------------|
| 0 second      | 0000H (0)          | 1 minute      | 003CH (60)         | 8 minutes     | 01E0H (480)        |
| 5 seconds     | 0005H (5)          | 2 minutes     | 0078H (120)        | 9 minutes     | 021CH (540)        |
| 10 seconds    | 000AH (10)         | 3 minutes     | 00B4H (180)        | 10 minutes    | 0258H (600)        |
| 20 seconds    | 0014H (20)         | 4 minutes     | 00F0H (240)        | 15 minutes    | 0384H (900)        |
| 30 seconds    | 001EH (30)         | 5 minutes     | 012CH (300)        | 20 minutes    | 04B0H (1200)       |
| 40 seconds    | 0028H (40)         | 6 minutes     | 0168H (360)        | 25 minutes    | 05DCH (1500)       |
| 50 seconds    | 0032H (50)         | 7 minutes     | 01A4H (420)        | 30 minutes    | 0708H (1800)       |

## (8) Demand power operation method

| Operation method                                     | Communication data |
|--|--------------------|
| The operation method tailored to the bimetallic type | 0001H              |
| The averaging operator in a demand time interval     | 0002H              |

## (9) Instantaneous detection voltage upper limit value

Voltage upper limit value = Communication data

| upper limit value         | Communication data                            |
|---------------------------|---|
| 30 to 150% (1% step), OFF | 001EH to 0096H (30 to 150), OFF : 0097H (151) |

## (10) Voltaeg lower limit value

Voltaeg lower limit value = Communication data

| Lower limit value         | Communication data                           |
|---------------------------|--|
| 30 to 150% (1% step), OFF | 001EH to 0096H (30 to 150), OFF : 001DH (29) |

## (11) Tidal current measurement

| Measurement               | Communication data |
|---------------------------|--------------------|
| General measurement       | 0001H              |
| Tidal current measurement | 0002H              |

## 6.5 Status request

Used to read the instrument status. There is no broadcast. Function code is 03H.

### (1) Data request (Query)

In case it performs setting value request, it is necessary to designate the start address of data to acquire. When a data address is transmitted, please subtract 40001 from the address in data-address list. Please assign the number of requested data as the number of data.

| 1       | 2             | 3            | 4 | 5              | 6 | 7     | 8 |
|---------|---------------|--------------|---|----------------|---|-------|---|
| Address | Function code | Data address |   | Number of data |   | CRC   |   |
| 01H     | 03H           | 00C8H        |   | 0001H          |   | 05F4H |   |

Data address list

| Function code | Data address | Item                   |
|---------------|--------------|------------------------|
| 03H           | 40201        | Status of alarm output |

### (2) Response

If status request is performed normally, the following response will be returned from this product side.

Example) Data address : 40201, Number of data : 1.

| 1       | 2             | 3                 | 4                 | 5 | 6   | 7 |
|---------|---------------|-------------------|-------------------|---|-----|---|
| Address | Function code | Answer byte count | Alarm-output data |   | CRC |   |

#### ● Bit allocation of alarm-output data

| B15 | B14 | B13 | B12 | B11 | B10 | B9 | B8 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|-----|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|
| —   | —   | —   | —   | —   | —   | —  | —  | —  | —  | —  | —  | —  | —  | —  | ①  |

| Bit | Name         | OFF (0)      | ON (1)    |
|-----|--------------|--------------|-----------|
| ①   | Alarm output | No detection | Detection |

Those without an alarm output, "0000H" is returned.

## 6.6 Model information request

Used to read model information, rated voltage and rated current from this product.  
There is no broadcast. Function code is 03H.

### (1) Data request (Query)

In case it performs a model information request, it is necessary to designate the start address of data to acquire. When a data address is transmitted, please subtract 40001 from the address in data-address list. Please assign the number of requested data as the number of data.

| 1       | 2             | 3            | 4 | 5              | 6 | 7     | 8 |
|---------|---------------|--------------|---|----------------|---|-------|---|
| Address | Function code | Data address |   | Number of data |   | CRC   |   |
| 01H     | 03H           | 01F4H        |   | 0003H          |   | 45C5H |   |

Data address list

| Function code | Data address | Item                             |
|---------------|--------------|----------------------------------|
| 03H           | 40501        | Model information, Type code     |
|               | 40502        | Model information, Phase wire    |
|               | 40503        | Model information, Rated voltage |

### (2) Response

If model information request is performed normally, the following response will be returned from this product side.

Example) Data address : 40501, Number of data : 3.

| 1       | 2             | 3                 | 4         | 5          | 6 | 7             | 8 | 9   | 10 | 11 |
|---------|---------------|-------------------|-----------|------------|---|---------------|---|-----|----|----|
| Address | Function code | Answer byte count | Type code | Phase wire |   | Rated voltage |   | CRC |    |    |

#### ● Model information. Type code

| Type | Communication data |
|------|--------------------|
| SFLC | 0011H              |

#### ● Model information. Phase wire

| Type                            | Communication data |
|---------------------------------|--------------------|
| Three-phase three-wire          | 0001H              |
| Single-phase three-wire (R-B-W) | 0002H              |
| Single-phase three-wire (R-Y-W) | 0003H              |
| Single-phase three-wire (Y-B-W) | 0004H              |
| Single-phase                    | 0005H              |

#### ● Model information. Rated voltage.

| Rated voltage | Communication data |
|---------------|--------------------|
| AC110V        | 0001H              |
| AC220V        | 0002H              |

## 6.7 Measurement value request

Read the measurement value from this product. There is no broadcast. Function code is 04H.

### (1) Data request (Query)

In case it performs setting value request, it is necessary to designate the start address of data to acquire. If a data address is transmitted, please subtract 30001 from the address in data-address list. Please assign the number of requested data as the number of data.

< Caution > Electric energy (Wh, varh) serves as 2 words (4 bytes) composition. Please give the number of data as 2. And, the point (data 0000H fixation) where a measurement value does not exist depending on a phase wire is also treated as one data.

|         |               |              |   |                |   |       |   |
|---------|---------------|--------------|---|----------------|---|-------|---|
| 1       | 2             | 3            | 4 | 5              | 6 | 7     | 8 |
| Address | Function code | Data address |   | Number of data |   | CRC   |   |
| 01H     | 04H           | 0000H        |   | 001DH          |   | 3003H |   |

### Data-address list (1)

| Function code | Data address | Model                                  |  |  |
|---------------|--------------|--|--|--|
|               |              | 3-phase 3-wire                         | Single-phase 3-wire                    | Single-phase                           |
| 04            | 30001        | 0000H (Fixation)                       | 0000H (Fixation)                       | 0000H (Fixation)                       |
| 04            | 30002        | 0000H (Fixation)                       | 0000H (Fixation)                       | 0000H (Fixation)                       |
| 04            | 30003        | 0000H (Fixation)                       | 0000H (Fixation)                       | 0000H (Fixation)                       |
| 04            | 30004        | Voltage (RY)                           | Voltage (RW)                           | Voltage                                |
| 04            | 30005        | Voltage (YB)                           | Voltage (BW)                           | 0000H (Fixation)                       |
| 04            | 30006        | Voltage (BR)                           | Voltage (RB)                           | 0000H (Fixation)                       |
| 04            | 30007        | Current (R)                            | Current (R)                            | Current                                |
| 04            | 30008        | Current (Y)                            | Current (W)                            | 0000H (Fixation)                       |
| 04            | 30009        | Current (B)                            | Current (B)                            | 0000H (Fixation)                       |
| 04            | 30010        | 0000H (Fixation)                       | 0000H (Fixation)                       | 0000H (Fixation)                       |
| 04            | 30011        | Demand current (R)                     | Demand current (R)                     | Demand current                         |
| 04            | 30012        | Demand current (Y)                     | Demand current (W)                     | 0000H (Fixation)                       |
| 04            | 30013        | Demand current (B)                     | Demand current (B)                     | 0000H (Fixation)                       |
| 04            | 30014        | 0000H (Fixation)                       | 0000H (Fixation)                       | 0000H (Fixation)                       |
| 04            | 30015        | Active power                           | Active power                           | Active power                           |
| 04            | 30016        | Demand power                           | Demand power                           | Demand power                           |
| 04            | 30017        | Watt-hour (Power receiving) High       | Watt-hour (Power receiving) High       | Watt-hour (Power receiving) High       |
| 04            | 30018        | Watt-hour (Power receiving) Low        | Watt-hour (Power receiving) Low        | Watt-hour (Power receiving) Low        |
| 04            | 30019        | Watt-hour (Power transmission) High    | Watt-hour (Power transmission) High    | Watt-hour (Power transmission) High    |
| 04            | 30020        | Watt-hour (Power transmission) Low     | Watt-hour (Power transmission) Low     | Watt-hour (Power transmission) Low     |
| 04            | 30021        | Reactive power                         | Reactive power                         | Reactive power                         |
| 04            | 30022        | var-hour (Power receiving LAG) High    | var-hour (Power receiving LAG) High    | var-hour (Power receiving LAG) High    |
| 04            | 30023        | var-hour (Power receiving LAG) Low     | var-hour (Power receiving LAG) Low     | var-hour (Power receiving LAG) Low     |
| 04            | 30024        | var-hour (Power receiving LEAD) High   | var-hour (Power receiving LEAD) High   | var-hour (Power receiving LEAD) High   |
| 04            | 30025        | var-hour (Power receiving LEAD) Low    | var-hour (Power receiving LEAD) Low    | var-hour (Power receiving LEAD) Low    |
| 04            | 30026        | var-hour (Power transmission LAG) High | var-hour (Power transmission LAG) High | var-hour (Power transmission LAG) High |

Data-address list (2)

| Function code | Data address | Model   |   |   |
|---------------|--------------|---|---|---|
|               |              | 3-phase 3-wire                                | Single-phase 3-wire                           | Single-phase                                  |
| 04            | 30027        | var-hour<br>(Power transmission LAG)<br>Low   | var-hour<br>(Power transmission LAG)<br>Low   | var-hour<br>(Power transmission LAG)<br>Low   |
| 04            | 30028        | var-hour<br>(Power transmission LEAD)<br>High | var-hour<br>(Power transmission LEAD)<br>High | var-hour<br>(Power transmission LEAD)<br>High |
| 04            | 30029        | var-hour<br>(Power transmission LEAD)<br>Low  | var-hour<br>(Power transmission LEAD)<br>Low  | var-hour<br>(Power transmission LEAD)<br>Low  |
| 04            | 30030        | 0000H (Fixation)                              | 0000H (Fixation)                              | 0000H (Fixation)                              |
| 04            | 30031        | Power factor                                  | Power factor                                  | Power factor                                  |
| 04            | 30032        | Frequency                                     | Frequency                                     | Frequency                                     |
| 04            | 30033        | 0000H (Fixation)                              | 0000H (Fixation)                              | 0000H (Fixation)                              |
| 04            | 30034        | 0000H (Fixation)                              | 0000H (Fixation)                              | 0000H (Fixation)                              |
| 04            | 30035        | 0000H (Fixation)                              | 0000H (Fixation)                              | 0000H (Fixation)                              |
| 04            | 30036        | 0000H (Fixation)                              | 0000H (Fixation)                              | 0000H (Fixation)                              |
| 04            | 30037        | Maximum voltage (RY)                          | Maximum voltage (RW)                          | Maximum voltage                               |
| 04            | 30038        | Maximum voltage (YB)                          | Maximum voltage (BW)                          | 0000H (Fixation)                              |
| 04            | 30039        | Maximum voltage (BR)                          | Maximum voltage (RB)                          | 0000H (Fixation)                              |
| 04            | 30040        | 0000H (Fixation)                              | 0000H (Fixation)                              | 0000H (Fixation)                              |
| 04            | 30041        | 0000H (Fixation)                              | 0000H (Fixation)                              | 0000H (Fixation)                              |
| 04            | 30042        | 0000H (Fixation)                              | 0000H (Fixation)                              | 0000H (Fixation)                              |
| 04            | 30043        | Minimum voltage (RY)                          | Minimum voltage (RW)                          | Minimum voltage                               |
| 04            | 30044        | Minimum voltage (YB)                          | Minimum voltage (BW)                          | 0000H (Fixation)                              |
| 04            | 30045        | Minimum voltage (BR)                          | Minimum voltage (RB)                          | 0000H (Fixation)                              |
| 04            | 30046        | Maximum current (R)                           | Maximum current (R)                           | Maximum current                               |
| 04            | 30047        | Maximum current (Y)                           | Maximum current (W)                           | 0000H (Fixation)                              |
| 04            | 30048        | Maximum current (B)                           | Maximum current (B)                           | 0000H (Fixation)                              |
| 04            | 30049        | 0000H (Fixation)                              | 0000H (Fixation)                              | 0000H (Fixation)                              |
| 04            | 30050        | Minimum current (R)                           | Minimum current (R)                           | Minimum current                               |
| 04            | 30051        | Minimum current (Y)                           | Minimum current (W)                           | 0000H (Fixation)                              |
| 04            | 30052        | Minimum current (B)                           | Minimum current (B)                           | 0000H (Fixation)                              |
| 04            | 30053        | 0000H (Fixation)                              | 0000H (Fixation)                              | 0000H (Fixation)                              |
| 04            | 30054        | Maximum demand current (R)                    | Maximum demand current (R)                    | Maximum demand current                        |
| 04            | 30055        | Maximum demand current (Y)                    | Maximum demand current (W)                    | 0000H (Fixation)                              |
| 04            | 30056        | Maximum demand current (B)                    | Maximum demand current (B)                    | 0000H (Fixation)                              |
| 04            | 30057        | 0000H (Fixation)                              | 0000H (Fixation)                              | 0000H (Fixation)                              |
| 04            | 30058        | Minimum demand current (R)                    | Minimum demand current (R)                    | Minimum demand current                        |
| 04            | 30059        | Minimum demand current (Y)                    | Minimum demand current (W)                    | 0000H (Fixation)                              |
| 04            | 30060        | Minimum demand current (B)                    | Minimum demand current (B)                    | 0000H (Fixation)                              |
| 04            | 30061        | 0000H (Fixation)                              | 0000H (Fixation)                              | 0000H (Fixation)                              |
| 04            | 30062        | Maximum power                                 | Maximum power                                 | Maximum power                                 |
| 04            | 30063        | Minimum power                                 | Minimum power                                 | Minimum power                                 |
| 04            | 30064        | Maximum demand power                          | Maximum demand power                          | Maximum demand power                          |
| 04            | 30065        | Minimum demand power                          | Minimum demand power                          | Minimum demand power                          |
| 04            | 30066        | Maximum reactive power                        | Maximum reactive power                        | Maximum reactive power                        |
| 04            | 30067        | Minimum reactive power                        | Minimum reactive power                        | Minimum reactive power                        |
| 04            | 30068        | 0000H (Fixation)                              | 0000H (Fixation)                              | 0000H (Fixation)                              |
| 04            | 30069        | 0000H (Fixation)                              | 0000H (Fixation)                              | 0000H (Fixation)                              |
| 04            | 30070        | Maximum power factor                          | Maximum power factor                          | Maximum power factor                          |
| 04            | 30071        | Minimum power factor                          | Minimum power factor                          | Minimum power factor                          |
| 04            | 30072        | Maximum frequency                             | Maximum frequency                             | Maximum frequency                             |
| 04            | 30073        | Minimum frequency                             | Minimum frequency                             | Minimum frequency                             |
| 04            | 30074        | 0000H (Fixation)                              | 0000H (Fixation)                              | 0000H (Fixation)                              |

## (2) Response

If measurement value requirements are performed normally, the following response will be returned from this product side.

Example) Data address : 30001, Number of data : 29 (3-phase 3-wire)

|   |               |  |    |   |    |  |    |    |
|---|---------------|--|----|---|----|--|----|----|
| 1   | 2             | 3  | 4  | 5   | 6  | 7  | 8  | 9  |
| Address   | Function code | Answer byte count  | 00 | 00  | 00 | 00   | 00 | 00 |
| 10  | 11            | 12   | 13 | 14  | 15 | 16   | 17 |    |
| RY line voltage<br>V(RY)  |               | YB line voltage<br>V(YB)   |    | BR line voltage<br>V(BR)  |    | R phase current<br>A(R)  |    |    |
| 18  | 19            | 20   | 21 | 22  | 23 | 24   | 25 |    |
| Y phase current<br>A(Y)   |               | B phase current<br>A(B)  |    | 00  | 00 | R phase demand current<br>DA(R)                                |    |    |
| 26  | 27            | 28   | 29 | 30  | 31 | 32   | 33 |    |
| Y phase demand current<br>DA(Y)                                   |               | B phase demand current<br>DA(B)                                  |    | 00  | 00 | Active power<br>W  |    |    |
| 34  | 35            | 36   | 37 | 38  | 39 | 40   | 41 |    |
| Demand power<br>DW  |               | Watt-hour<br>(Power receiving)<br>Wh High                        |    | Watt-hour<br>(Power receiving)<br>Wh Low                        |    | Watt-hour<br>(Power transmission)<br>-Wh High                  |    |    |
| 42  | 43            | 44   | 45 | 46  | 47 | 48   | 49 |    |
| Watt-hour<br>(Power transmission)<br>-Wh Low                      |               | Reactive power<br>var  |    | Reactive power<br>(Power receiving, LAG)<br>varh (LAG) High     |    | Reactive power<br>(Power receiving, LAG)<br>varh (LAG) Low     |    |    |
| 50  | 51            | 52   | 53 | 54  | 55 | 56   | 57 |    |
| Reactive power<br>(Power receiving, LEAD)<br>varh (LEAD) high     |               | Reactive power<br>(Power receiving, LEAD)<br>varh (LEAD) Low     |    | Reactive power<br>(Power transmission, LAG)<br>-varh (LAG) High |    | Reactive power<br>(Power transmission, LAG)<br>-varh (LAG) Low |    |    |
| 58  | 59            | 60   | 61 | 62  | 63 |  |    |    |
| Reactive power<br>(Power transmission, LEAD)<br>-varh (LEAD) High |               | Reactive power<br>(Power transmission, LEAD)<br>-varh (LEAD) Low |    | CRC   |    |  |    |    |

## Transmission scaling

| Item  |                                 | Input                           |  | Communication data <sup>(3)</sup>                  | Intrinsic error |
|---|---------------------------------|---------------------------------|--|--|-----------------|
| Voltage,<br>Minimum voltage,<br>Maximum voltage   | 3 $\phi$ 3W<br>1 $\phi$ 2W      | AC0 to 150V, AC0 to 300V (Line) |  | 0000H to 2710H (0 to 10000)                        | $\pm 0.5\%$     |
|   | 1 $\phi$ 3W<br>( <sup>4</sup> ) | AC0 to 300V (Line)              |  | 0000H to 2710H (0 to 10000)                        |                 |
|   |                                 | AC0 to 150V<br>(Phase)          | Phase-voltage full-scale 150V                            | 0000H to 2710H (0 to 10000)                        |                 |
|   |                                 |                                 | Phase-voltage full-scale 300V                            | 0000H to 1388H (0 to 5000)                         |                 |
| Current, Minimum current,<br>Maximum current,<br>Minimum demand current,<br>Maximum demand current,<br>Demand current             | AC0 to 5A                       |                                 | 0000H to 2710H (0 to 10000)                              | $\pm 0.5\%$  |                 |
| Active power,<br>Minimum active power,<br>Maximum active power,<br>Maximum demand power,<br>Minimum demand power,<br>Demand power | 3 $\phi$ 3W                     | 110V                            | -1kW to 0 to +1kW  | D8FOH to 0000H to 2710H<br>(-10000 to 0 to +10000) | $\pm 0.5\%$     |
|   | 1 $\phi$ 3W                     | 220V                            | -2kW to 0 to +2kW  |  |                 |
|   | 1 $\phi$ 2W                     | 110V                            | -500W to 0 to +500W                                      | EC78H to 0000H to 1388H<br>(-5000 to 0 to +5000)   | $\pm 0.5\%$     |
|   |                                 | 220V                            | -1kW to 0 to +1kW  |  |                 |
| Reactive power,<br>Minimum reactive power,<br>Maximum reactive power  | 3 $\phi$ 3W                     | 110V                            | LEAD 1kvar to 0 to LAG 1kvar                             | D8FOH to 0000H to 2710H<br>(-10000 to 0 to +10000) | $\pm 0.5\%$     |
|   | 1 $\phi$ 3W                     | 220V                            | LEAD 2kvar to 0 to LAG 2kvar                             |  |                 |
|   | 1 $\phi$ 2W                     | 110V                            | LEAD 500var to 0 to LAG 500var                           | EC78H to 0000H to 1388H<br>(-5000 to 0 to +5000)   | $\pm 0.5\%$     |
|   |                                 | 220V                            | LEAD 1kvar to 0 to LAG 1kvar                             |  |                 |
| Power factor,<br>Minimum power factor,<br>Maximum power factor  | LEAD 0 to 1 to LAG 0            |                                 | 0000H to 1388H to 2710H<br>(0 to 5000 to 10000)          | $\pm 2.0\%$  |                 |
|   | LEAD 0.5 to 1 to LAG 0.5        |                                 | 09C4H to 1388H to 1D4CH<br>(2500 to 5000 to 7500)        |  |                 |
| Frequency,<br>Minimum frequency,<br>Maximum frequency   | 45 to 55Hz                      |                                 | 1194H to 157CH (4500 to 5500)                            | $\pm 0.5\%$  |                 |
|   | 55 to 65Hz                      |                                 | 157CH to 1964H (5500 to 6500)                            |  |                 |
|   | 45 to 65Hz                      |                                 | 1194H to 1964H (4500 to 6500)                            |  |                 |
| Watt-hour (Power receiving /<br>Power transmission)   | 0 to 99999.9                    |                                 | 00000000H to 000F423FH<br>(0 to 999999) ( <sup>5</sup> ) | $\pm 2.0\%$  |                 |
| var-hour (Power receiving /<br>Power transmission, LAG/LEAD)  | 0 to 99999.9                    |                                 | 00000000H to 000F423FH<br>(0 to 999999) ( <sup>5</sup> ) | $\pm 2.5\%$  |                 |

Note<sup>(3)</sup> The range of communication data, Data at the case of low input.

- Current : 120% rating [0000H to 2EE0H] (0 to 12000), Less than 0.5% of rated current is [0000H] (0).
- Demand current, maximum demand current : 200% rating [0000H to 4E20H] (0 to 20000), Less than 0.5% of rated current is [0000H] (0).
- Voltage : 101% full-scale [0000H to 2774H] (0 to 10100), the phase voltage at the case of single-phase three-wire phase voltage full-scale 300V setting is [0000H to 13BAH] (0 to 5050), Less than 0.5% of rated voltage is [0000H] (0).
- Active power, Reactive power : 120% rating [D120H to 2EE0H] (-12000 to 12000). At the case of single-phase is [E890H to 1770H] (-6000 to 6000). Less than  $\pm 0.5\%$  of rated power and reactive power is [0000H] (0).
- Demand, maximum demand :  $\pm 200\%$  rating [B1E0H to 4E20H] (-20000 to 20000), At the case of single-phase is [D8FOH to 2710H] (-10000 to 10000). Less than  $\pm 0.5\%$  of rated power and reactive power is [0000H] (0).
- Power factor : Less than 20% of input voltage full-scale and less than 2% of rated current are [1388H] (5000).
- Frequency :  $\pm 1\%$  of measuring range. 45 to 55Hz : 44.9 to 55.1Hz [118AH to 1586H] (4490 to 5510)  
55 to 65Hz : 54.9 to 65.1Hz [1572H to 196EH] (5490 to 6510)  
45 to 65Hz : 44.8 to 65.2Hz [1180H to 1978H] (4480 to 6520)  
Less than 20% of voltage full-scale is [0000H].
- Active power, Reactive power : Minus data expresses with two's complement.  
(-10000 to 0 to 10000 : D8FOH to 0000H to 2710H)

Note<sup>(4)</sup> The default setting of phase-voltage full-scale setting is 300V.

Note<sup>(5)</sup> By multiplying the electric energy data by the multiplier data, it becomes kWh (kvarh).

Example) Watt-hour (kWh) = Watt-hour data  $\times$  Multiplying factor data = 123.4 $\times$ 100 = 12340kWh



## 6.8 Maximum / minimum reset request

Used to perform maximum / minimum reset for this product.

When 00H is specified for the address, there will be broadcast. Function code is 06H.

### (1) Maximum / minimum reset request (Query)

When making a maximum / minimum reset request, it is necessary to send the write data including the data address and the element to be reset.

If a data address is transmitted, please subtract 40001 from the address in data-address list.

| 1       | 2             | 3            | 4 | 5          | 6 | 7 | 8     |
|---------|---------------|--------------|---|------------|---|---|-------|
| Address | Function code | Data address |   | Write data |   |   | CRC   |
| 01H     | 06H           | 012CH        |   | 001FH      |   |   | 0837H |

Data address list

| Function code | Data address | Item                   |
|---------------|--------------|------------------------|
| 06H           | 40301        | Maximum, minimum reset |

### ● Maximum minimum reset, Bit allocation of write data (6)

| B15 | B14 | B13 | B12 | B11 | B10 | B9 | B8 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|-----|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|
| —   | —   | —   | —   | ⑫   | ⑪   | ⑩  | ⑨  | ⑧  | ⑦  | ⑥  | ⑤  | ④  | ③  | ②  | ①  |

| No. | Contents of output                | No. | Contents of output                |
|-----|-----------------------------------|-----|-----------------------------------|
| ①   | Voltage (Maximum, Minimum)        | ⑦   | Frequency (Maximum, Minimum)      |
| ②   | Current (Maximum, Minimum)        | ⑧   | —                                 |
| ③   | Active power (Maximum, Minimum)   | ⑨   | Demand current (Maximum, Minimum) |
| ④   | Reactive power (Maximum, Minimum) | ⑩   | Demand power (Maximum, Minimum)   |
| ⑤   | —                                 | ⑪   | —                                 |
| ⑥   | Power factor (Maximum, Minimum)   | ⑫   | —                                 |

Note<sup>(6)</sup> Except an applicable bit and the measurement factor that doesn't exist by the model, data is not reset as for ON (1).

### (2) Response

If data change is performed normally, the following response will be returned from this product side.

If broadcast (address 00H) is specified, there is no response.

| 1       | 2             | 3            | 4 | 5           | 6 | 7 | 8   |
|---------|---------------|--------------|---|-------------|---|---|-----|
| Address | Function code | Data address |   | Change data |   |   | CRC |

The same data as the write data of the maximum / minimum reset element is returned to the change data.

## 6.9 Loopback test

The loopback test is a function to test whether the master and slave (SFLC) are communicating normally. Arbitrary data is returned as it is. There is no broadcast. Function code is 08H.

### (1) The request of loopback (Query)

When performing a loopback test, it is necessary to send data and diagnostic codes used for diagnosis. Specify 0000H as the diagnostic code. Specify any value from 0000H to FFFFH for the diagnostic data.

|         |               |                 |   |                 |   |       |   |
|---------|---------------|-----------------|---|-----------------|---|-------|---|
| 1       | 2             | 3               | 4 | 5               | 6 | 7     | 8 |
| Address | Function code | Diagnostic code |   | Diagnostic data |   | CRC   |   |
| 01H     | 08H           | 0000H           |   | 04D2H           |   | 6296H |   |

### (2) Response

If loopback request is performed normally, the following response will be returned from this product side.

|         |               |                 |   |                 |   |     |   |
|---------|---------------|-----------------|---|-----------------|---|-----|---|
| 1       | 2             | 3               | 4 | 5               | 6 | 7   | 8 |
| Address | Function code | Diagnostic code |   | Diagnostic data |   | CRC |   |

The same data sent by the master in (1) is returned as the diagnosis code and diagnostic data.

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