Instruction Manual

INTEGRAL ULTRASONIC FLOWMETER S-FLOW COMMUNICATION FUNCTIONS

TYPE: FSZ, FLYF

INF-TN5A5601-E Fuji Electric Co., Ltd.

Introduction

Thank you for purchasing Fuji Electric's ultrasonic flowmeter.

This instruction manual describes the communication specifications, MODBUS protocol, and device address mapping for connecting an ultrasonic flowmeter (FSZ) to a PC or programmable controller in order to control and monitor devices through communication.

In addition to this manual, please read the user-friendly instruction manual INF-TN2FSZSIMPLE-EJC (attached to the product) and the separately available instruction manual INF-TN2FSZ-E.

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NOTICE

1. Exemption items from responsibility

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We paid the utmost care for the accuracy of the contents. However, we are not liable for direct and indirect damages resulting from incorrect descriptions, omission of information, and use of information in this document.

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1. COMMUNICATION FUNCTIONS

1.1 General

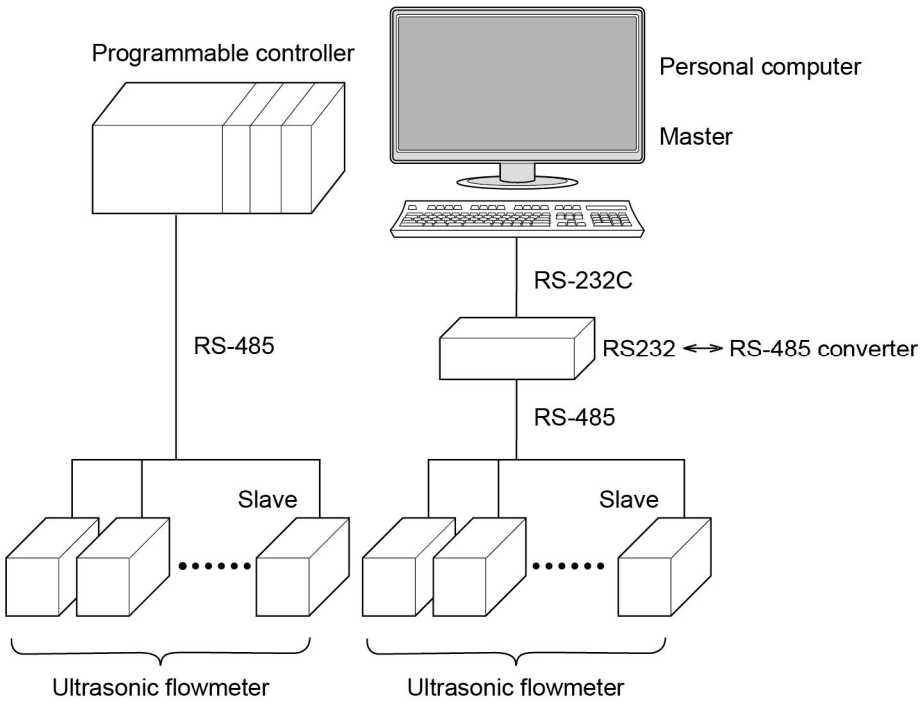
- This instrument provides a communication function by RS-485 interface, by which it can transmit and receive data to and from a host computer, programmable controller, graphic display panel, etc.

- When using the RS-485 interface, the communication system consists of a master station and slave stations. Up to 31 slave stations (this instrument) can be connected per master station.
  Note that, because the master station can communicate with only one slave station at a time, a party to communicate with must be specified by the “Station No.” set at each slave station.

- In order that the master station and slave station can communicate, the format of the transmit/receive data must coincide.
  With this instrument, communication data format is determined by the MODBUS protocol.

- Please use an RS-232C ↔ RS-485 or USB ↔ RS-485 converter in case of designating a personal computer or other devices which have an RS-232C or USB interface as a master station.
  Communication converter (recommended product)
  - RS-232 C ↔ RS-485 converter : Model No. KS-485i-T6P/System Sacom Industry Corp.
  - USB ↔ RS-485 converter : Model No. USB-485I RJ45-T4P/System Sacom Industry Corp.

System configuration (when using the RS-485 interface)



Note) When using the RS-232C ↔ RS-485 converter, pay attention to cable connection between the converter and master station. If the cable is not connected correctly, the master station and slave station cannot communicate.
In addition, be careful about communication settings such as baud rate and parity set for the converter.

2. SPECIFICATIONS

2.1 Communication Specifications

Item	Specification	
Electrical specification	Based on EIA RS-485	
Transmission system	2-wire, semi-duplicate	
Synchronizing system	Start-stop synchronous system	
Connection format	1 : N (RS-485)	
Number connectable units	Up to 31 units (RS-485)	
Transmission distance (total extension)	1,000 m max. (RS-485)	
Transmission speed	9600 bps, 19200 bps, 38400 bps	
Data format	Data length	8 bit
	Stop bit	1 bit, 2 bit
	Parity	None, even, odd (selectable)

2.1.1 Communication protocol

(1) MODBUS protocol

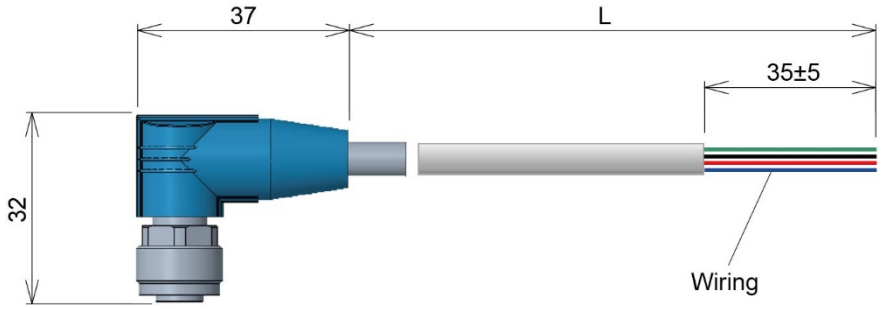
Item	Specification
Transmission code	HEX value (MODBUS RTU mode)
Error detection	CRC-16

3. CONNECTION

⚠ DANGER

For avoiding electric shock and malfunctions, do not turn on the power supply until all wiring have been completed.

3.1 Terminal wiring



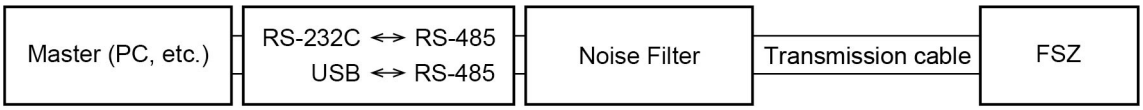
Type	FLYF003	FLYF010
L [m]	3±0.15	10±0.2

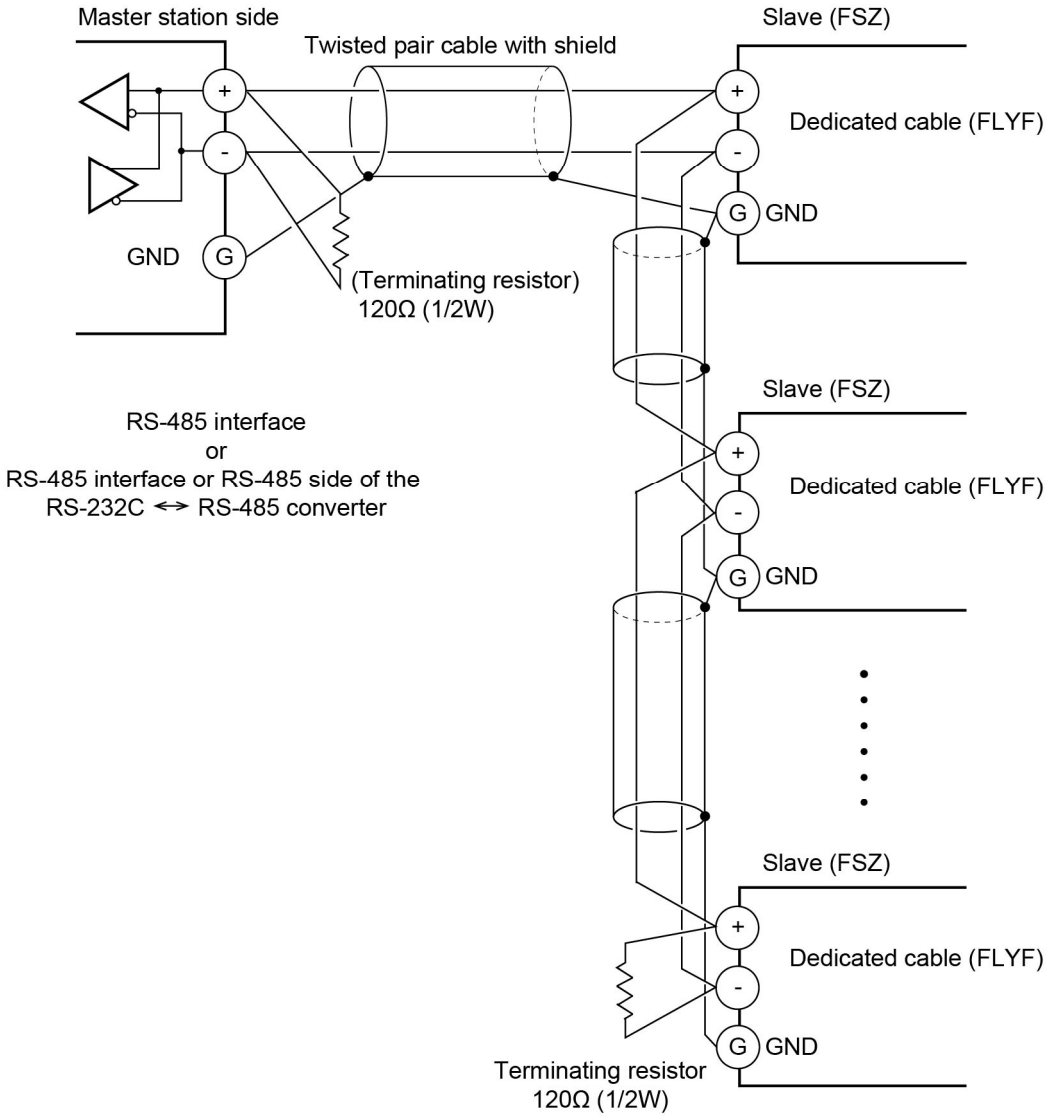
Connection name	Wiring	
Power supply	(5) Gray (GRY) (8) Red (RED)	(+) 20 to 27.5 V DC (-)
Analog current output	(3) Green (GRN) (2) Brown (BRN)	(+) 4 to 20 mA (-)
Digital output 1	(6) Yellow (YEL) (8) Red (RED)	(+) 27.5 V DC max., (-) 0.1 A max.
Digital output 2	(6) Pink (PNK) (8) Red (RED)	(+) 27.5 V DC max., (-) 0.1 A max.
RS-485 communication	(1) White (WHT) (7) Blue (BLU) (8) Red (RED)	(+) RS-485+ (-) RS-485- (GND)

3.2 Wiring

3.2.1 RS-485 interface

- Use twisted pair cables with shield.
- The total extension length of the cable is up to 1000 m. A master station and up to 31 units of this instrument can be connected per line.
- Terminate the both ends of the cable with 120 Ω (1/2 W or higher) terminating resistors.
  Note) See the specifications of the master for the terminating resistors of the master station unit.
- Connect an insulated, ungrounded device on the master station side.
- If this instrument is to be installed where the level of noise applied to this instrument may exceed 1000 V, it is recommended to install a noise filter in the master station side as below.





4. SETTING OF COMMUNICATION CONDITION

In order that the master station and instrument (this instrument) can correctly communicate, following settings are required.

- All communication condition settings of the master station are the same as those of instruments (this instrument).
- All instruments (this instrument) connected on a line are set to “Station No.” which are different from each other. Any “Station No.” is not shared by more than one instrument (when using the RS-485 interface).

4.1 Set Items

The parameters to be set are shown in the following table. Set them by operating the front panel keys.

Item	Value at delivery	Setting range	Remarks
Station No.	1	1 to 31	Set a different value to each station.
Transmission speed	38400 bps	9600 bps, 19200 bps, 38400 bps	Set the same communication condition to the master station and all slave stations.
Parity setting	Odd	None: None parity Odd: Odd parity Even: Even parity	
Data length	8 bit	Fixed (cannot be changed)	
Stop bit	1 bit	1 bit, 2 bit	

4.2 Setting Operation Method

(1) Make communication settings on the maintenance mode screen of the display setting area of the main unit. Refer to the separate instruction manual for “Integral Ultrasonic Flowmeter”, INF-TN2FSZ-E, for the operation method.

5. MODBUS COMMUNICATION PROTOCOL

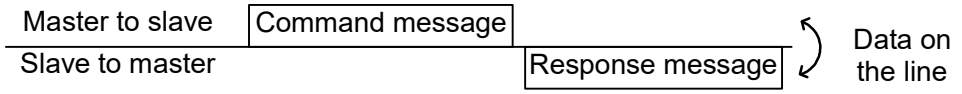
5.1 General

The communication system by the MODBUS protocol is that the communication is always started from the master station and a slave station responds to the received message.

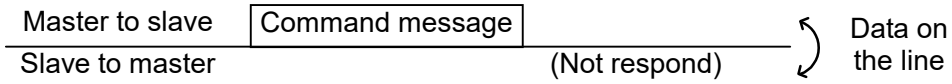
Transmission procedures is as shown below.

1) The master station sends a command message to a slave station.
2) The slave station checks that the station No. in the received message matches with the own station No. or not.
3) If matched, the slave station executes the command and sends back the response message.
4) If mismatched, the slave station discards the command message and waits for the next command message.

a) In case when the station No. in the received command message matches with the own slave station No.



b) In case when the station No. in the received command message mismatches with the own slave station No.



The master station can individually communicate with any one of slave stations connected on the same line upon setting the station No. in the command message.

5.2 Composition of Message

Compositions of the command message and response message are as shown in Fig. 5-1 Composition of message. ; And these are sent in this order.

Station No. (1 byte)
Function code (1 byte)
Data (2 to 133 bytes)
Error check code (CRC-16) (2 bytes)

Fig. 5-1 Composition of message

In the following, each field is explained.

(1) Station No.

Station No. is the number specifying a slave station. When RS-485 interface is used, the command message is received and operated only by the slave station (FSZ) whose station No. matches with the No. set in "Station No."

For details of setting the parameter "Station No.," refer to Chapter 4.

(2) Function code

This is a code to designate the function executed at a slave station.

For details, refer to Section 5.4.

(3) Data

Data are the data required for executing function codes. The composition of data varies with function codes. For details, refer to Chapter 6.

A register number is assigned to each data in the flowmeter. For reading/writing the data by communication, designate the register number.

Note that the register number transmitted on message is expressed as its relative address.

The relative address is calculated by the following expression.

$$\boxed{\text{Relative address}} = \left(\text{The lower 4 digits of the } \boxed{\text{register number}} \right) - 1$$

For example, when the register number designated by a function code is 40003,

Relative address = (lower 4 digits of 40003) – 1
= 0002

is used on the message.

(4) Error check code

This is the code to detect message errors (change in bit) in the signal transmission.

On the MODUBUS protocol (RTU mode), CRC-16 (Cyclic Redundancy Check) is applied.

For CRC calculation method, refer to Section 5.5.

5.3 Response of Slave Station

(1) Response for normal command

To a relevant message, the slave station creates and sends back a response message which corresponds to the command message. The composition of message in this case is the same as in Section 5.2.

Contents of the data field depend on the function code. For details, refer to Chapter 6.

(2) Response for abnormal command

If contents of a command message have an abnormality (for example, non-actual function code is designated) other than transmission error, the slave station does not execute that command but creates and sends back a response message at error detection.

The composition of response message at error detection is as shown in Fig. Fig. 5-2. The value used for function code field is function code of command message plus 80_H.

Table5-1 gives error codes.

Station No.
Function code + 80_H
Error code
Error check (CRC-16)

Fig. 5-2 Response message at error detection

Table5-1 Error Code

Error code	Contents	Description
01H	Illegal function code	Non-actual function code is designated. Check for the function code.
02H	Register address error	A relative address of a register number to which the designated function code cannot be used.
03H	Register count error	Because the designation of number is too much, the area where register numbers do not exist is designated.

(3) No response

Under any of the following items, the slave station takes no action of the command message and sends back no response.

- A station number transmitted in the command message differs from the station number specified to the slave station.
- A error check code is not matched, or a transmission error (parity error, etc.) is detected.
- The time interval between the composition data of the message becomes longer than the time corresponding to 24 bit. (Refer to Section 5.6 Transmission Control Procedure)
- Station No. of a slave station is set to 0.

5.4 Function Code

According to MODBUS protocol, register numbers are assigned by function codes. Each function code acts on specific register number.

This correspondence is shown in Table 5-2, and the message length by function is shown in Table 5-3.

Table 5-2 Correspondence between function codes and objective address

Function code			⟷	Register No.	
No.	Function	Object		No.	Contents
03_H	Read-out (continuously)	Holding register		4xxxx	Read-out/Write word data
04_H	Read-out (continuously)	Input register		3xxxx	Read-out word data
06_H	Write-in	Holding register		4xxxx	Read-out/Write word data
10_H	Write-in (continuously)	Holding register		4xxxx	Read-out/Write word data

Table 5-3 Function code and message length

[Unit: byte]

Function code	Contents	Number of designatable data	Command message		Response message	
			Minimum	Maximum	Minimum	Maximum
03_H	Read-out of word data	64 words	8	8	7	133
04_H	Read-out of word data (read-out only)	64 words	8	8	7	133
06_H	Write-in of word data	1 word	8	8	7	7
10_H	Write-in of continuous word data	64 words	11	137	8	8

5.5 Calculation of Error Check Code (CRC-16)

CRC-16 is the 2-byte (16-bit) error check code. From the top of the message (station No.) to the end of the data field are calculated.

The slave station calculates the CRC of the received message, and does not respond if the calculated CRC is different from the contents of the received CRC code.

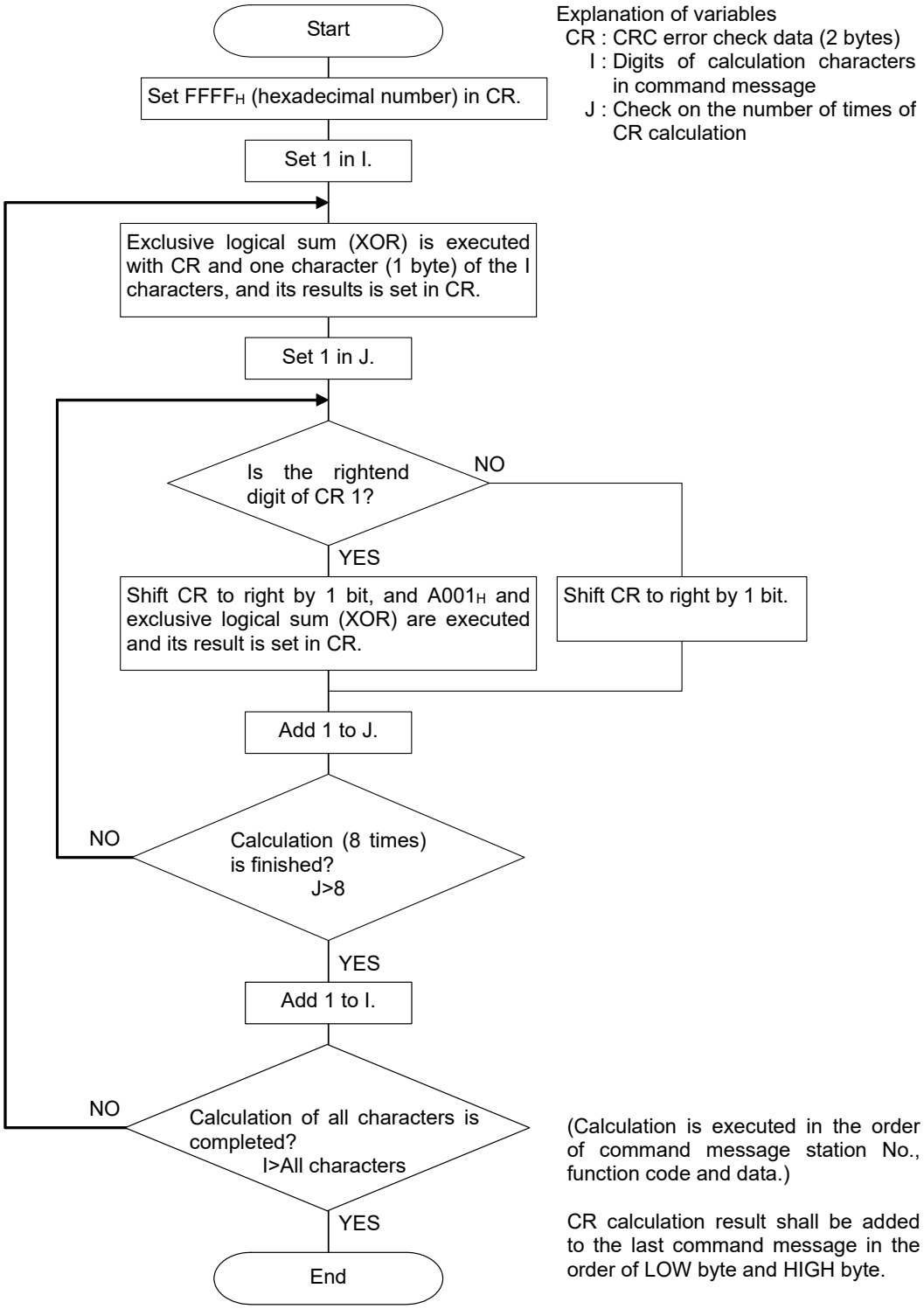


Fig. 5-3 Flow of CRC-16 calculation

5.6 Transmission Control Procedure

(1) Transmission procedure of master station

The master station must proceed to a communication upon conforming to the following items.

(1-1) Before sending a command message, provide 48 bit time or more vacant status.

(1-2) For sending, the interval between bytes of a command message is below 24 bit time.

(1-3) Receiving status is posted within 24 bit time after sending a command message.

(1-4) After receiving a response message, provide 48 bit time or more vacant status before sending the next command message. [same as in (1-1)]

(1-5) For ensuring the safety, make a confirmation of the response message and make an arrangement so as to provide 3 or more retries in case of no response, error occurrence, etc.

Note) The above definition is for most unfavorable value. For ensuring the safety, it's recommended the program of the master to work with safety factors of 2 to 3. Specifically, at 9600 bps, create the program so that the vacant status (1-1) is at least 15 ms and the byte interval (1-2) and changeover from sending to receiving (1-3) within 1 ms.

(2) Description

1) Detection of the message frame

This communication system may have the following 2 statuses on a line.

ⓐ Vacant status (no data on line)

ⓑ Communication status (data is existing)

Instruments connected on the line are initially at a receiving status and monitoring the line.

When 24 bit time or more vacant status has appeared on the line, the end of preceding frame is assumed and, within following 24 bit time, a receiving status is posted.

When data appears on the line, instruments receive it while 24 bit time or more vacant status is detected again, and the end of that frame is assumed. I.e., data which appeared on the line from the first 24 bit time or more vacant status to the next 24 bit time or more vacant status is fetched as one frame.

Therefore, one frame (command message) must be sent upon confirming the following.

(1-1) Before sending a command message, provide 48 bit time or more vacant status.

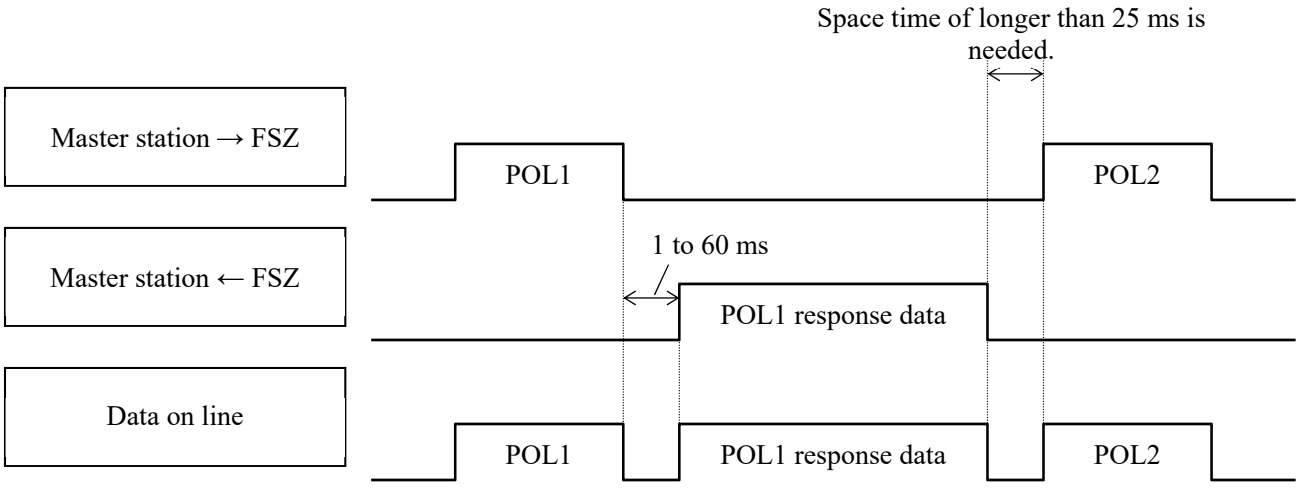
(1-2) For sending, the interval between bytes of a command message is below 24 bit time.

2) Response of this instrument

After a frame detection (24 bit time or more vacant status), this instrument carries out processing with that frame as a command message.

If the command message is destined to the own station, a response message is returned. Its processing time is 5 to 60 ms (depends on contents of command message). After sending a command message, therefore, the master station must observe the following.

(1-3) Receiving status is posted within 24 bit time after sending a command message.


Space time of longer than 25 ms is needed.
Master station → FSZ
POL1
POL2
1 to 60 ms
Master station ← FSZ
POL1 response data
Data on line
POL1
POL1 response data
POL2

6. DETAILS OF MESSAGE

6.1 Read-out of Read-out Word Data [Function code: 03_H]

Function code	Max. word number read-out in one message	Relative data address	Register No.	Kind of data
03_H	64 words	0000_H–0036_H $007C_H$–$007E_H$ $03E8_H$–0400_H	40001–40055 40125–40127 41001–41025	Storage enable data
		$03F2_H$–0400_H	41011–41025	Storage disable data

(1) Composition of message

Command message composition (byte)

Station No.		
Function code		
Read-out start No. (relative address)	Upper	
	Lower	
Read-out word number	Upper	} 1 to 64
	Lower	
CRC data	Lower	
	Upper	

Response message composition (byte)

Station No.		
Function code		
Read-out byte number		Read-out word number × 2
Contents of the first word data	Upper	
	Lower	
Contents of the next word data	Upper	
	Lower	
~		~
Contents of the last word data	Upper	
	Lower	
CRC data	Lower	
	Upper	

* Arrangement of read-out word data

MSB LSB
Upper byte of contents of the first word data
Lower byte of contents of the first word data
Upper byte of contents of the next word data
Lower byte of contents of the next word data
~
Upper byte of contents of the last word data
Lower byte of contents of the last word data

(2) Function explanations

Word data of continuous word numbers from the read-out start No. can be read. Read-out word data are transmitted from the slave station in the order of upper and lower bytes.

(3) Message transmission (example)

An example of reading the calibration span from station No. 2 is shown below.

Calibration span relative address: $001A_H$ (register No. 40027), read-out word count: 01_H

Command message composition (bytes)

Station No.		02_H
Function code		03_H
Read-out start No. (Relative address)	Upper	00_H
	Lower	$1A_H$
Read-out word count	Upper	00_H
	Lower	01_H
CRC data	Lower	$A5_H$
	Upper	FE_H

Response message composition (byte)

Station No.		02_H
Function code		03_H
Read-out byte count		02_H
First word data content	Upper	03_H
	Lower	$E8_H$
CRC data	Lower	FC_H
	Upper	FA_H

* Meaning of read-out data

Calibration span $03E8_H = 1000$

(First word data content)

When the unit is % and the decimal point is 1

Calibration span = 100.0%

A decimal point is not added to the calibration span for transmission data.

The calibration span has a decimal point position of 1. Perform decimal point alignment processing.

Point For the handling of decimal points, refer to Section 7.1.

6.2 Read-out of Read-out Word Data [Function code: 04_H]

Function code	Max. word number read-out in one message	Relative data address	Register No.
04_H	64 words	0000_H–0063_H $00E2_H$–$00E3_H$	30001–30100 30227–30228

(1) Composition of message

Command message composition (byte)

Station No.		
Function code		
Read-out start No. (relative address)	Upper	
	Lower	
Read-out word number	Upper	} 1 to 64
	Lower	
CRC data	Lower	
	Upper	

Response message configuration (bytes)

Station No.		
Function code		
Read-out byte count		Read-out word number × 2
First word data content	Upper	
	Lower	
Contents of the next word data	Upper	
	Lower	
~	~	
Contents of the last word data	Upper	
	Lower	
CRC data	Lower	
	Upper	

* Arrangement of read-out word data

MSB LSB
Upper byte of contents of the first word data
Lower byte of contents of the first word data
Upper byte of contents of the next word data
Lower byte of contents of the next word data
~
Upper byte of contents of the last word data
Lower byte of contents of the last word data

(2) Function explanations

Word data of continuous word numbers from the read-out start No. can be read. Read-out word data are transmitted from the slave station in the order of upper and lower bytes.

(3) Message transmission (example)

The following is an example of reading out the flow rate from station No. 1.

Relative address of the flow rate: 0004_H (Register No. 30005), Number of data to be read out: 02_H

Command message configuration (bytes)

Station No.		01_H
Function code		04_H
Read-out start No. (Relative address)	Upper	00_H
	Lower	04_H
Read-out word count	Upper	00_H
	Lower	02_H
CRC data	Lower	30_H
	Upper	$0A_H$

Response message configuration (bytes)

Station No.		01_H
Function code		04_H
Read-out byte count		04_H
First word data content	Upper	43_H
	Lower	40_H
Contents of the next word data	Upper	00_H
	Lower	00_H
CRC data	Lower	EF_H
	Upper	$D4_H$

Meaning of read-out data

Data having the unit L/min and floating decimal point

The read-out data is expressed as a 32-bit single-precision floating value.

Connect the read-out 4-byte data, and convert it into an actual value using an appropriate conversion program.

Flow rate, 192.0 L/min = 1.5 × (2 to the 7th power)

= 0100 0011 0100 0000 0000 0000 0000 0000 (binary number)

Point For handling of floating data, refer to Section 7.1.

6.3 Write-in of Word Data (1 word) [Function code: 06_H]

Function code	Max. word number read-out in one message	Relative data address	Register No.	Kind of data
06_H	1 word	$03E8_H$–$03F1_H$	41001–41010	Storage enable data
		$03F2_H$–0400_H	41011–41025	Storage disable data

(1) Composition of message

Command message composition (byte)

Station No.	
Function code	
Write-in designate No. (relative address)	Upper
	Lower
Write-in word data	Upper
	Lower
CRC data	Lower
	Upper

Response message composition (byte)

Station No.	
Function code	
Write-in designate No. (relative address)	Upper
	Lower
Write-in word number	Upper
	Lower
CRC data	Lower
	Upper

(2) Function explanations

Designated word data is written in write-in designate No. Write-in data are transmitted from master station in the order of upper and lower bytes.

The current value is returned when the write-in data does not fall within the effective range.

(3) Message transmission (example)

The following shows an example of transmitting the “Zero adjustment” key command to No.1 station.

Key operation command Relative address: $03E8_H$

Command message composition (bytes)

Station No.		01_H
Function code		06_H
Read-out start No. (Relative address)	Upper	03_H
	Lower	$E8_H$
Read-out word count	Upper	00_H
	Lower	01_H
CRC data	Lower	$C8_H$
	Upper	$7A_H$

} Zero adjustment command

Response message composition (byte)

Station No.		01_H
Function code		06_H
Read-out start No. (Relative address)	Upper	03_H
	Lower	$E8_H$
Read-out word count	Upper	00_H
	Lower	01_H
CRC data	Lower	$C8_H$
	Upper	$7A_H$

6.4 Write-in of continuous word data [Function code: 10_H]

Function code	Max. word number read-out in one message	Relative data address	Register No.	Kind of data
10_H	64 words	0000_H–0036_H $007C_H$–$007E_H$	40001–40055 40125–40127	Storage enable data

(1) Composition of message

Command message composition (byte)

Station No.		
Function code		
Read-out start No. (relative address)	Upper	
	Lower	
Write-in word number	Upper	} 1 to 64
	Lower	
Write-in byte number		} Write-in word number × 2
First write-in word data	Upper	
	Lower	
Next write-in word data	Upper	
	Lower	
~		~
Last write-in word data	Upper	
	Lower	
CRC data	Lower	
	Upper	

Response message composition (byte)

Station No.	
Function code	
Write-in start No. (relative address)	Upper
	Lower
Write-in word number	Upper
	Lower
CRC data	Lower
	Upper

* Arrangement of write-in word data

MSB LSB
Upper byte of contents of the first word data
Lower byte of contents of the first word data
Upper byte of contents of the next word data
Lower byte of contents of the next word data
~
Upper byte of contents of the last word data
Lower byte of contents of the last word data

(2) Function explanations

Word data of continuous word number is written from write-in start address. Write-in word data are transmitted from master station in the order of upper and lower bytes.

If write-in data does not fall within the effective range, response is made without counting it as write-in word number.

If an attempt is made to write data in an unused address, write-in is not performed, and response is made without counting it as write-in word number.

(3) Message transmission (example)

The following is an example of writing station No. 1 damping = 5 sec, flow rate unit = L, low flow rate cut-off = 0.15 L/min, calibration zero = -0.20 L/min, calibration span = 100%, full scale = 15.00 L/min.

For low flow rate cut-off, calibration zero, and full scale, no decimal point is added to the transmission data.

The decimal point position is determined by the type and flow rate unit. Perform the decimal point position alignment processing according to the decimal point positions shown in Table 6-1. The calibration span has a decimal point position of 1.

Table 6-1 <Type and decimal point position>

Type	Nominal diameter	Flow rate unit L	Flow rate unit gal
FSZ08	DN8, DN10 (1/4", 3/8")	2 decimal point places	3 decimal point place
FSZ15	DN15, DN20 (1/2", 3/4")	1 decimal point place	2 decimal point places
FSZ25	DN25, DN32 (1", 1・1/4")	1 decimal point place	2 decimal point places

For type FSZ08, Nominal diameters DN8, DN10 (1/4", 3/8")
Damping = 0003_H (= 3_D), flow rate unit = 0000H (= 0_D)
Low flow rate cut-off = $0000F_H$ (= 15_D), calibration zero = $FFEC_H$ (= -20_D)
Calibration span = $03E8_H$ (= 1000_D), full scale = $05DC_H$ (= 1500_D)

Relative address of Flow unit: 0016_H (Register No. 40023), Write-in word number: 06_H

Command message composition (bytes)

Station No.		01_H
Function code		10_H
Write-in start No. (relative address)	Upper	00_H
	Lower	16_H
Write-in word number	Upper	00_H
	Lower	06_H
Write-in byte number		$0C_H$
First write-in word data	Upper	00_H
	Lower	03_H
Next write-in word data	Upper	00_H
	Lower	00_H
Next write-in word data	Upper	00_H
	Lower	$0F_H$
Next write-in word data	Upper	FF_H
	Lower	EC_H
Next write-in word data	Upper	03_H
	Lower	$0E_H$
Last write-in word data	Upper	05_H
	Lower	DC_H
CRC data	Lower	73_H
	Upper	$9C_H$

Response message composition (byte)

Station No.		01_H
Function code		10_H
Write-in start No. (relative address)	Upper	00_H
	Lower	16_H
Write-in word number	Upper	00_H
	Lower	06_H
CRC data	Lower	$A1_H$
	Upper	CF_H

Point　For handling of decimal point, refer to Section 7.1.
For transmission format of each data, refer to the address map (Chapter 7.)

7. ADDRESS MAP AND DATA FORMAT

7.1 Data Format

7.1.1 Transmission data format

The MODBUS protocol used in this product is RTU (Remote Terminal Unit) mode.
The transmitted data is “numerical value”, but ASCII code data is partly included.

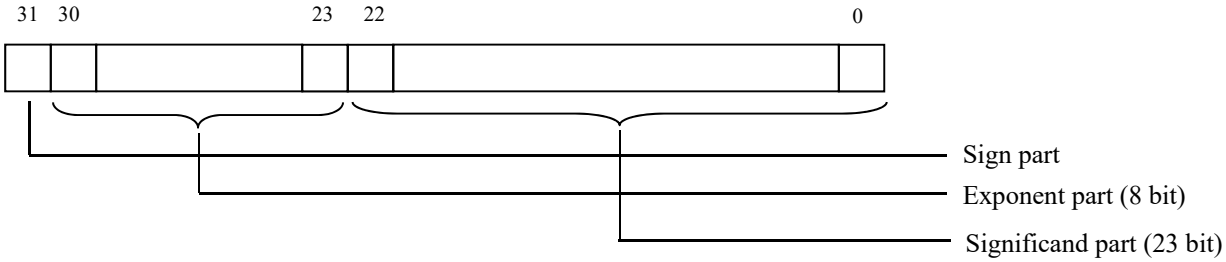
7.1.2 Handling of decimal point

Numerical value data includes integer data, decimal point position fixed data and floating data.
Handling of data containing a decimal point is described below.

(1) Data with determined decimal point position (int type, long type)
No decimal point is added in the transmission data. Execute decimal point position alignment processing (elimination of decimal point at the time of transmission, addition of decimal point at the time of reception) on data with decimal point.

Example: Case of pipe outer diameter
Read-out data: $05DC_H = 1500$
Decimal point position: 2 digit
Value: 15.00 mm

(2) 32-bit floating data (float type)
Instantaneous values or the like are expressed by 32-bit single precision float type.
The meaning of each digit is as follows (standard format specified in IEEE).



1) Sign part
Indicates the sign of the floating decimal point. “0” represents “positive”, and “1” represents “negative”.

2) Exponent part
Indicates the exponent of the floating decimal point by a power of 2. The value obtained by subtracting 127 from this value is the actual exponent.

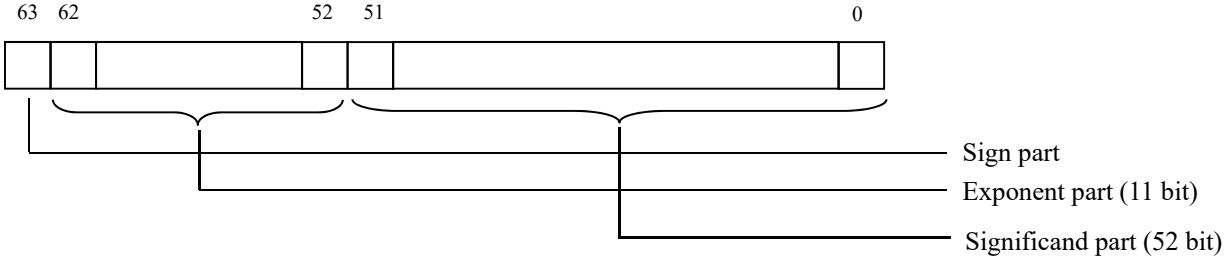
3) Significand part
This is the data that corresponds to the significant figure of the floating decimal point. The actual numerical value is interpreted by adding 1 to the top.

Example: 1 10000000 11000000000000000000000
Sign: Minus
Exponent: 10000000(2) – 127 = 1
Significand: 1.11(2) = 1 + 1/2 + 1/4 = 1.75
Value: –1.75 × (1st power of 2) = -3.5

(3) 64-bit floating data (double type)

Instantaneous values or the like are expressed by 64-bit double precision float type.

The meaning of each digit is as follows (standard format specified in IEEE).



1) Sign part

Indicates the sign of the floating decimal point. “0” represents “positive”, and “1” represents “negative”.

2) Exponent part

Indicates the exponent of the floating decimal point by a power of 2. The value obtained by subtracting 1023 from this value is the actual exponent.

3) Significand part

This is the data that corresponds to the significant figure of the floating decimal point. The actual numerical value is interpreted by adding 1 to the top.

Example: 0 01111111111 1110000000000000000000000000000000000000000000000000

Sign: Plus

Exponent: 01111111111(2) – 1023 = 0

Significand: 1.111(2) = 1 + 1/2 + 1/4 + 1/8 = 1.875

Value: 1.875 × (0th power of 2) = 1.875

7.1.3 Handling of measured data on occurrence of range over

Even if the measured data (instantaneous value) is in excess of the scale range, the measured data (velocity or flow rate) is transmitted as it is as the instantaneous value Read-out data.

7.1.4 RAS information

RAS information consists of 16 bit, each of which indicates a specific status (error) and is expressed as 1 (occurred)/0 (not occurred). The normal status is “0000H.” The bit assignment is in Table 7-1.

Table 7-1 <Assignment of RAS information bit>

Bit	RAS information	Status	LED line 2 display
15	E1: Device error 1	Backup memory failure	E1-1
14	E1: Device error 2	Temperature circuit abnormality	E1-2
13	E1: Device error 3	Display board anomaly	E1-3
12	Reserve	–	–
11	Reserve	–	–
10	E2: No signal	There is no ultrasonic reception wave.	E2-1
9	E2: Signal error	The status of the ultrasonic reception wave is poor.	E2-2
8	E2: Calculate error	The detected measurement data has abnormal values.	E2-3
7	E2: Threshold error	The ultrasonic reception signal has not reached the threshold level.	E2-4
6	E2: Collection error	The ultrasonic reception signal cannot be collected.	E2-5
5	Reserve	–	–
4	Reserve	–	–
3	Reserve	–	–
2	E4: Temperature alarm	The temperature exceeds the measurement range.	T.ALM
1	E4: Range over	The analog output is out of range	OVER
0	E4: Pulse range over	The total output exceeds the range.	OVER

7.2 Address Map

For detailed information on the functions and setting ranges of individual parameters, refer to the instruction manual of the main unit (INF-TN2FSZ-E).

Data type	unsigned char:	Byte data without sign.	This data is handled in byte units. One data per address
	Int:	Word data with sign.	This data is handled in word units. One data per two addresses
	unsigned int:	Word data without sign.	This data is handled in word units. One data per two addresses
	Long:	2-word data with sign.	This data is handled in 2-word units. One data per four addresses
	float:	Floating data.	This data is handled in 2-word units. One data per four addresses
	Double:	Floating data.	This data is handled in 4-word units. One data per eight addresses

7.2.1 Word data [Read-out/Write-in]: Function code [03_H, 10_H]

Relative address	Register number	Data type	Parameter	Read-out data/Write-in data setting range	Remarks
	40XXX				
0000	40001	int	Kind of display	0: Instantaneous flow rate/Instantaneous flow rate (%), 1: Instantaneous flow rate/temperature	1st row/2nd row
0001	40002	int	Decimal point position of flow rate	Type FSZ08, Nominal diameter 8A, 10A: Volume flow unit L/min: 0: 1L/min, 1: 0.1Lmin, 2: 0.01L/min, 3: 0.01L/min Volume flow unit gal/min: 0: 1gal/min, 1: 0.1gal/min, 2:0.01gal/min, 3: 0.01gal/min Type FSZ15, FSZ25 Nominal diameter 15A, 20A, 25A, 32A: Volume flow unit L/min: 0: 1Lmin, 1: 0.1L/min, 2: 0.1L/min Volume flow unit gal/min: 0: 1gal/min, 1: 0. 1gal/min, 2: 0.01gal/min	
0002	40003	int	Reserved		Write-in inhibit
0003	40004	int	Reserved		Write-in inhibit
0004	40005	int	Reserved		Write-in inhibit
0005	40006	int	Reserved		Write-in inhibit
0006	40007	int	Reserved		Write-in inhibit
0007	40008	int	Key lock	0: Protect off, 1: Protect on	
0008	40009	int	Reserved		Write-in inhibit
0009	40010	int	Reserved		Write-in inhibit
000A	40011	int	Pipe outer diameter	500 to 9999 (5.00 to 99.99 mm)	
000B	40012	int	Pipe material	0: Carbon steel, 1: Stainless steel, 2: Copper, 3: PVC, 4: PFA, 5: PTFE	
000C	40013	int	Pipe wall thickness	10 to 999 (0.10 to 9.99 mm)	
000D	40014	int	Kind of fluid	0: Water, 1: seawater, 2: fluid sound velocity	
000E	40015	int	Fluid sound velocity	1000 to 2000 m/s	
000F	40016	int	Viscosity	1 to 9999 (0.001 to 9.999 E-6m^2/s)	
0010	40017	int	Flow direction	0: R-L--Right-to-left, 1: L-R--left-to-right	
0011	40018	int	Reserved		Write-in inhibit
0012	40019	int	Reserved		Write-in inhibit
0013	40020	int	Reserved		Write-in inhibit
0014	40021	int	Reserved		Write-in inhibit
0015	40022	int	Reserved		Write-in inhibit
0016	40023	int	Damping	0: 0sec, 1: 1sec, 2: 3sec, 3: 5sec, 4: 10sec, 5: 30sec, 6: 60sec, 7: 90sec	
0017	40024	int	Flow rate unit	0: L, 1: gal	
0018	40025	int	Low flow rate cut	0000 to 9999 Type FSZ08, Nominal diameter 8A, 10A: Volume flow unit L/min: (0.00 to 99.99 L/ min) Volume flow unit gal/min: (0.000 to 9.999 gal/ min) Type FSZ15, FSZ25 Nominal diameter 15A, 20A, 25A, 32A: Volume flow unit L/min: (0.0 to 999.9 L/ min) Volume flow unit gal/min: (0.00 to 99.99 gal/ min)	
0019	40026	int	Calibration zero	-9999 to 9999 Type FSZ08, Nominal diameter 8A, 10A: Volume flow unit L/min: (-99.99 to 99.99 L/ min) Volume flow unit gal/min: (-9.999 to 9.999 gal/ min) Type FSZ15, FSZ25, Nominal diameter 15A, 20A, 25A, 32A: Volume flow unit L/min: (-999.9 to 999.9 L/ min) Volume flow unit gal/min: (-99.99 to 99.99 gal/ min)	
001A	40027	int	Calibration span	0 to 2000 (0.0 to 200.0%)	

Relative address	Register number	Data type	Parameter	Read-out data/Write-in data setting range	Remarks
001B	40028	int	Full scale	0000 to 9999 Type FSZ08, Nominal diameter 8A, 10A: Volume flow unit L/min: (0.00 to 99.99 L/ min) Volume flow unit gal/min: (0.000 to 9.999 gal/ min) Type FSZ15, FSZ25 Nominal diameter 15A, 20A, 25A, 32A: Volume flow unit L/min: (0.0 to 999.9 L/ min) Volume flow unit gal/min: (0.00 to 99.99 gal/ min)	
001C	40029	int	Burnout	0: Hold, 1: upper limit, 2: lower limit, 3: zero	
001D	40030	int	Burnout timer	10 to 900sec	
001E	40031	int	Reserved		Write-in inhibit
001F	40032	int	Reserved		Write-in inhibit
0020	40033	int	Reserved		Write-in inhibit
0021	40034	int	Reserved		Write-in inhibit
0022	40035	int	DO1 out	0: Not used, 1: All alarm, 2: Hardware Error, 3: Process Error, 4: Range Over/Pulse Range Over, 5: Negative Flow Direction, 6: Total Flow Pulse	
0023	40036	Int	DO1 contact action	0: Active ON, 1: Active OFF	
0024	40037	int	DO2 out	0: 0: Not used, 1: All alarm, 2: Hardware Error, 3: Process Error, 4: Range Over/Pulse Range Over, 5: Negative Flow Direction, 6: Total Flow Pulse	
0025	40038	int	DO2 contact action	0: Active ON, 1: Active OFF	
0026	40039	int	Total rate	Type FSZ08, Nominal diameter 8A, 10A: Volume flow unit L/min: 0: 0.1L, 1: 1L, 2: 10L, 3: 100L, 4: 1000L Volume flow unit gal/min: 0: 0.1gal, 1: 1gal, 2: 10gal, 3: 100gal, 4: 1000gal Type FSZ15, FSZ25 Nominal diameter 15A, 20A, 25A, 32A: Volume flow unit L/min: n0: 1L, 1: 10L, 2: 100L, 3: 1000L, 4: 10000L Volume flow unit gal/min: 0: 1gal, 1: 10gal, 2: 100gal, 3: 1000gal, 4:10 AM000gal	
0027	40040	int	Pulse width	0: 5msec, 1: 10msec, 2: 50msec, 3: 100msec, 4: 200msec	
0028	40041	int	Burnout timer	0 to 900sec	
0029	40042	int	Reserved		Write-in inhibit
002A	40043	int	Reserved		Write-in inhibit
002B	40044	int	Reserved		Write-in inhibit
002C	40045	int	Reserved		Write-in inhibit
002D	40046	int	Reserved		Write-in inhibit
002E	40047	int	Reserved		Write-in inhibit
002F	40048	int	Reserved		Write-in inhibit
0030	40049	int	Measurement display ON/OFF	0: ON, 1: OFF	
0031	40050	int	Reserved		Write-in inhibit
0032	40051	int	Reserved		Write-in inhibit
0033	40052	int	Reserved		Write-in inhibit
0034	40053	int	Reserved		Write-in inhibit
0035	40054	int	ID code	0000 to 9999	
0036	40055	int	Reserved		Write-in inhibit
~	~		Reserved		Write-in inhibit
007C	40125	int	Current calibration 4 mA *1	300 to 8000	
007D	40126	int	Current calibration 20 mA *1	11000 to 22000	
007E	40128		Reserved		Write-in inhibit

*1) Perform current calibration, cancel the test. The operation mode will return from the test state to the measurement state.

7.2.2 Word data [Read-out/Write-in]: Function code [03_H, 06_H]

Relative address	Register number	Data type	Parameter	Read-out data	Remarks
	41XXX				
03E8	41001	int	Zero adjustment *2	0: Clear, 1: Adjust	
03E9	41002	int	Reserved		Write-in inhibit
03EA	41003	int	Reserved		Write-in inhibit
03EB	41004	int	Reserved		Write-in inhibit
03EC	41005	int	Reserved		Write-in inhibit
03ED	41006	int	Reserved		Write-in inhibit
03EE	41007	int	Reserved		Write-in inhibit
03EF	41008	int	Reserved		Write-in inhibit
03E0	41009	int	Reserved		Write-in inhibit
03E1	41010	int	Reserved		Write-in inhibit

The address data indicated below is not stored in the main unit.

Relative address	Register number	Data type	Parameter	Read-out data	Remarks
	41XXX				
03F2	41011	int	Reserved		Write-in inhibit
03F3	41012	int	Current check *1	0: 0.8mA, 1: 4mA, 2: 8mA, 3: 12mA, 4: 16mA, 5: 20mA, 6: 23.2mA	
03F4	41013	int	DO ON/OFF *1	0: ON, 1: OFF	
03F5	41014	int	Pulse check *1	0: STOP, 1: START(1PULSE/S)	
03F6	41015	int	Test mode *1	0: Not use, 1: Set	
03F7	41016	int	Tracking time	0 to 900sec	
03F8	41017	int	Simulated input	-120 to 120%	
03F9	41018	int	Reserved		Write-in inhibit
03FA	41019	int	Reserved		Write-in inhibit
03FB	41020	int	Test cancel *1	0: Termination	Test cancellation for current calibration, current check, DO ON/OFF, pulse check, and test mode
03FC	41021	int	Total reset	0: Not res, 1: Reset	
03FD	41022	int	Reserved		Write-in inhibit
03FE	41023	int	Reserved		Write-in inhibit
03FF	41024	int	Reserved		Write-in inhibit
0422	41025	int	Reserved		Write-in inhibit

*1) Perform current check, DO ON/OFF, pulse check, or test mode, and then cancel the test. The operation mode will return from the test state to the measurement state.

*2) After performing zero point adjustment, check that the status of the data is “1: Zero point adjustment successful” by reading out the zero point adjustment of function code 04H.

7.2.3 Word data [Read-out only]: Function code [04_H]

Relative address	Register number	Data type	Parameter	Read-out data	Remarks
	3XXXX				
0000	30001	unsigned int	RAS information	Hexadecimal data	
0001	30002	int	Reserved		
0002	30003	float	Flow velocity	32-bit floating data, Unit: m/s	
0004	30005	float	Volume flow rate	32-bit floating data	Unit: VOLUME FLOW UNIT
0006	30007	float	Volume flow rate (%)	32-bit floating data	Unit (%)
0008	30009	double	Forward total flow rate	64-bit floating data	Unit: Total flow unit
000C	30013	double	Reserved		
0010	30017	long	Forward total flow rate pulse	No decimal point	Unit: Pulse
0012	30019	long	Reserved		
0014	30021	long	Forward total flow rate (integer part)	No decimal point	Unit: Total flow unit
0016	30023	float	Pipe temperature		Unit: °C
0018	30025	float	Reserved		
001A	30027	float	Reserved		
001C	30029	double	Reserved		
0020	30033	double	Reserved		
0024	30037	long	Reserved		
0026	30039	long	Reserved		
0028	30041	float	Reserved		
002A	30043	float	Reserved		
002C	30045	float	Reserved		
002E	30047	float	Reserved		
0030	30049	float	Reserved		
0032	30051	double	Reserved		
0036	30055	double	Reserved		
003A	30059	long	Reserved		
003C	30061	long	Reserved		
003E	30063	int	Reserved		
~	~		Reserved		
0050	30081	unsigned char	1st and 2nd characters of vendor name	14 characters of ASCII code	
0051	30082	unsigned char	3rd and 4th characters of vendor name		
0052	30083	unsigned char	5th and 6th characters of vendor name		
0053	30084	unsigned char	7th and 8th characters of vendor name		
0054	30085	unsigned char	9th and 10th characters of vendor name		
0055	30086	unsigned char	11th and 12th characters of vendor name		
0056	30087	unsigned char	13th and 14th characters of vendor name		
0057	30088	unsigned char	1st and 2nd character of type	16 characters of ASCII code	
0058	30089	unsigned char	3rd and 4th character of type		
0059	30090	unsigned char	5th and 6th character of type		
005A	30091	unsigned char	7th and 8th character of type		
005B	30092	unsigned char	9th and 10th character of type		
005C	30093	unsigned char	11th and 12th character of type		

Relative address	Register number	Data type	Parameter	Read-out data	Remarks
005D	30094	unsigned char	13th and 14th character of type		
005E	30095	unsigned char	15th and 16th character of type		
005F	30096	unsigned char	1st and 2nd characters of version	8 characters of ASCII code	
0060	30097	unsigned char	3th and 4th characters of version		
0061	30098	unsigned char	5th and 6th characters of version		
0062	30099	unsigned char	7th and 8th characters of version		
0063	30100	int	Reserved		
~	~		Reserved		
00E2	30227	int	Zero adjustment	0: Zero point clear, 1: Zero adjustment successful, -1: Zero adjustment failure	
00E3	30228	int	Reserved		

8. PC LOADER SOFTWARE

8.1 Copyright of This Software

The copyright of this software belongs to Fuji Electric Co., Ltd. No part of this software may be reproduced or transmitted in any form.

8.2 Overview

Using this software, you can set, read and display relevant graphs of this instrument on your PC with ease.
Your data can be easily edited with Microsoft Excel because you can save your data in CSV file format.
Note) Microsoft Excel is the registered Trademark of the Microsoft Corporation in the United States.

8.3 Download PC Loader Software

The latest version of the PC loader software can be downloaded from our website.
Please carefully review the information on the website and the instructions for using the software (license agreement).
URL: https://www.fujielectric.co.jp/products/instruments/software/top.html
Click the ultrasonic flowmeter from the URL to download the FSZ PC loader software.

8.4 PC to Be Used

8.4.1 Interface

RS232C port or RS485 port, MODBUS communication protocol

8.4.2 OS

Windows 10 (Enterprise, Pro) / Windows 11 (Pro)

The editions in parentheses are those for which operation has been verified.
.NET Framework 4.5/4.6/4.7/4.8

Note: Windows is a registered trademark of Microsoft Corporation.
Note: The Microsoft .NET Framework is a registered trademark of Microsoft Corporation.

8.5 Installing of Software

(1) Double-click the installer “FSZ_Loader_Ver1000J.msi”. * The version number indicated is a display example.

Fig. 8-1 <Install file>

(2) When the setup wizard starts, click the [Next] button. To cancel the installation, click the [Cancel] button.

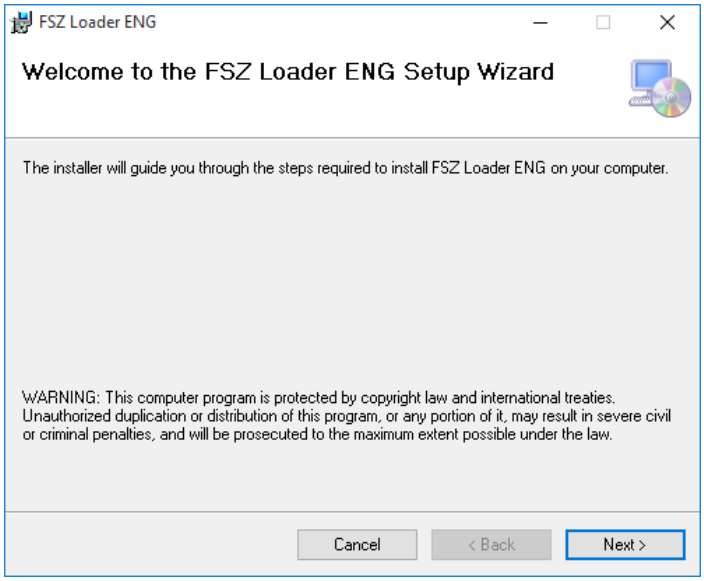


Fig. 8-2 < Setup wizard screen >

(3) There is a query about selection of installation folder. Click the [Next] button to install the software in that folder. To specify a folder click the [Browse] button and select, or enter directly. To return to the previous screen, click the [Previous] button. To cancel the installation, click the [Cancel] button.

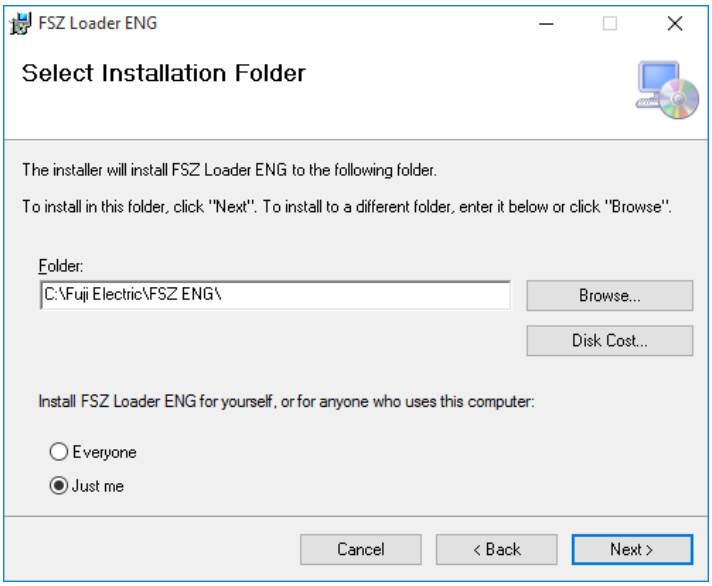


Fig. 8-3 <Select installation folder screen>

(4) Screen is displayed to confirm installation. Click the [Next] button to execute the installation. To return to the previous screen, click the [Previous] button. To cancel the installation, click the [Cancel] button.

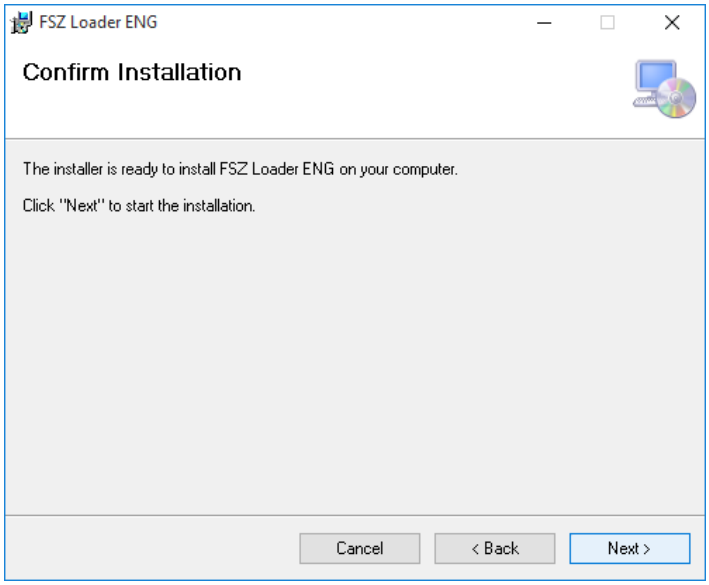


Fig. 8-4 <Installation confirmation screen>

(5) If a “User Account Control” screen is displayed, click the [Yes] button to permit the computer change.

(6) Execute installation.

(7) The Installation Complete screen is displayed. Click the [Close] button to exit the installation screen.

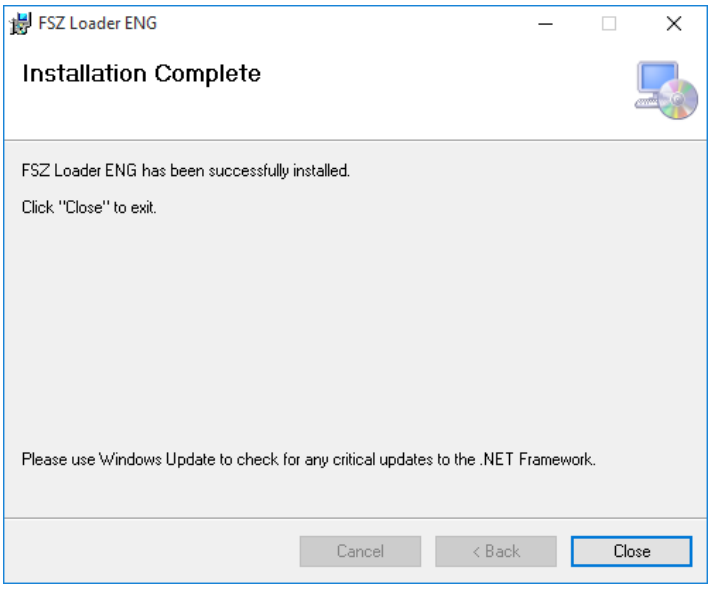


Fig. 8-5 < Installation complete screen >

(8) After installation, the start menu and the application (“FSZ Loader V1000E”) that has been installed in the desktop are created.
* The version number indicated is a display example.

8.6 Startup Method

To start the loader, click on “FSZ Loader V1000E” from the Start menu or from the shortcut on the desktop.

* The version number indicated is a display example.

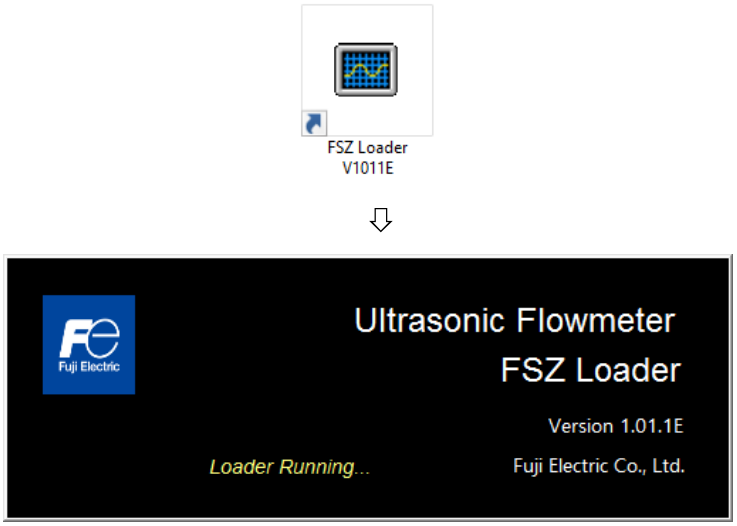


Fig. 8-6 < Start screen >

It communicates with the flowmeter to obtain diameter and unit information.

A message appears if a communication error occurs. Click [OK], and check the “Communication” settings at the menu screen that appears.

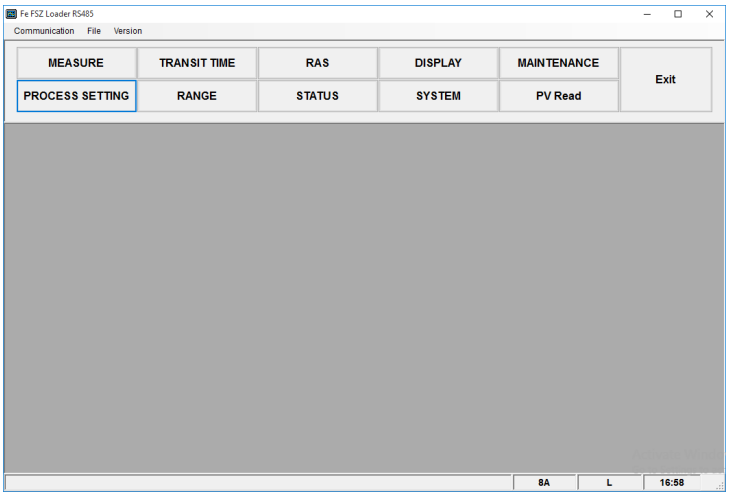


Fig. 8-7 < Menu screen >

Click the menu bar and each function button to execute a desired function.

Note) When communication cables are removed and then reconnected, restart the loader software.

8.6.1 Communications

Click “Communication” on the menu bar on the Menu screen, and the following setup screen appears.

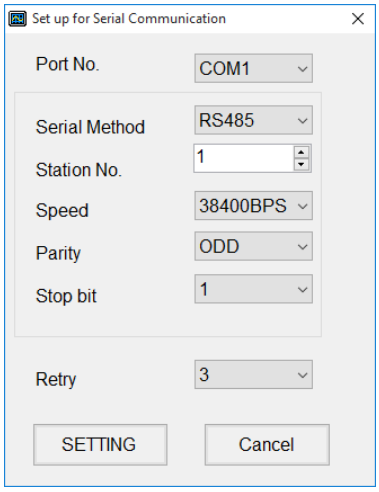


Fig 8-8 <Set up for Serial Communication”

Click [SETTING] to complete the changes. The software will communicate with the flowmeter to obtain the language and unit information. Click [Cancel] if you do not want to save the changes.

Table 8-1 <Serial communication advanced settings>

Item	Content
Port No. (COM port No.)	Select any from COM1 to COM20
Communication Method	Select RS485
Station No.	Select any from 1 to 31.
Speed	Select 9600 BPS, 19200 BPS, or 38400 BPS.
Parity	Select NONE, EVEN, or ODD.
Stop Bit	Select 1 bit or 2 bit.
Retry	Specify in the range of 0 to 5.

*The factory default setting of the transmitter is “RS485/ST1/38400 BPS/odd/1-bit”.

How to check the PC COM port

For Windows 10

- Right-click on the Start button and left-click Device Manager.
- Start the Device Manager.
- Double-click Ports (COM and LPT) in Device Manager.
- Check the available port names and COM port Nos. listed below.

8.6.2 File

On the menu screen, click “File” in the menu bar and then select “File save” or “Open file”.

8.6.2.1 Save file

This function is used to read the parameters set in the flowmeter all at once to the computer side, and then save the read parameters to a specified location in CSV format.

By clicking [Save], the following screen is displayed. Specify the location to which the parameters are to be saved and the file name, and click the [Save] button to upload. By clicking the [Save] button, the parameters set in the flowmeter are read to the computer side, and a CSV file is saved to the specified location. Furthermore, the read parameter values are updated to the cells and list boxes of each PC Loader setting screen (Settings screens from Section 8.7 “Structure of Function” onward).

If you click the [Cancel] button, the parameters will not be downloaded.

Default file name: “param_MMDDYYHHMMSS.csv”

The file name can be changed.

Note) Perform this function when the communication function works normally, otherwise you cannot use this function.

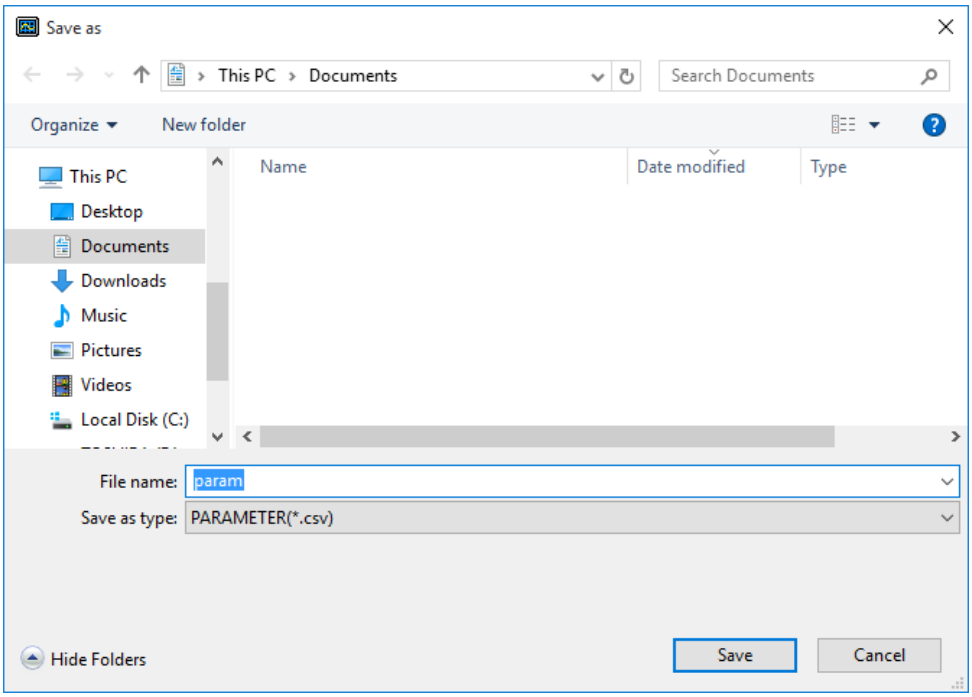


Fig. 8-9 <Save: Save file selection screen>

8.6.2.2 Open file

This function reads the values contained in the CSV file saved to the PC when save file to the cells and list boxes of each PC Loader setting screen (Settings screens from Section 8.7 “Structure of Function” onward).

By clicking Open file, the following screen is displayed. Specify the location and file name of the previously saved file, and click the [Open] button to read the file. The file format is “.csv”. Values are then read to the cells and list boxes of each PC Loader setting screen (Settings screens from Section 8.7 “Structure of Function” onward).

At this point, parameters have not been written to the flowmeter. To write parameters to the flowmeter, click the [SETTING] button at each setting screen to write the parameters. If you click the [Cancel] button, the parameters will not be read.

Note) Perform this function when the communication function works normally, otherwise you cannot use this function.

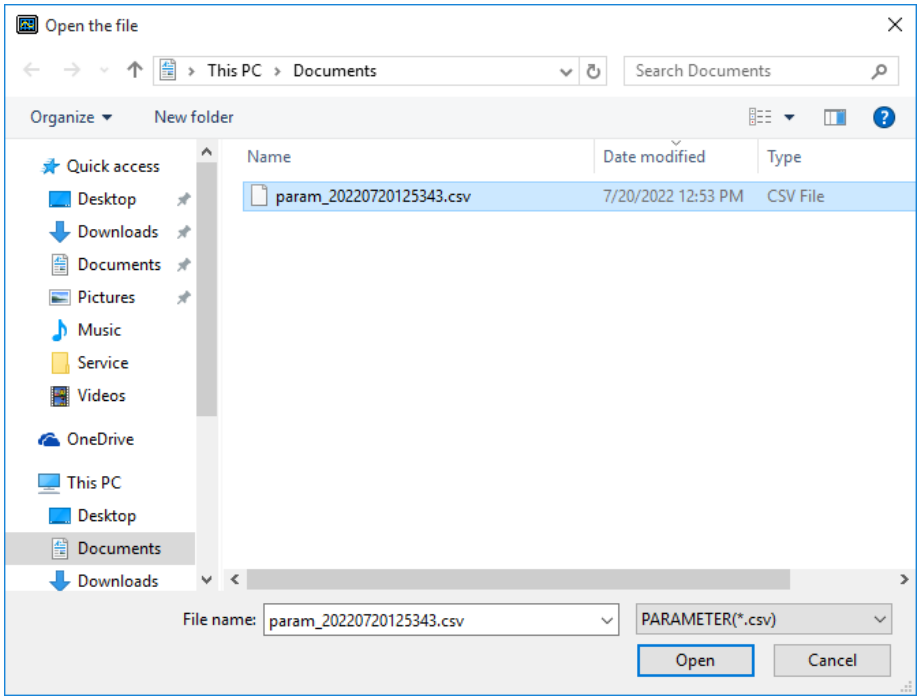


Fig. 8-10 <Open: Read file selection screen>

8.6.3 Version

On the menu screen, by clicking [Version] on the menu bar, the following screen is displayed.

* The version number indicated is a display example.

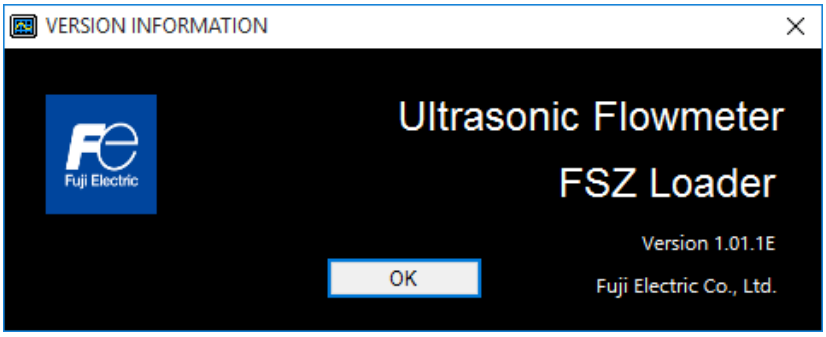


Fig. 8-11 <Version screen>

Click the [OK] button to close the screen.

8.7 Structure of Function

Functions with loader are as follows:

Table 8-2 <Function>

Function	Outline
SYSTEM	Performs version display and system settings.
PROCESS SETTING	Sets piping specifications.
RANGE	Performs range-related settings.
STATUS	Performs status output and total-related settings.
DISPLAY	Performs LED display settings.
MEASURE	Displays trends for flow rates, etc.
TRANSIT TIME	Displays the measurement information.
RAS	Read-in RAS.
MAINTENANCE	Conducts AO adjustment and AO/DO test.
PV Read	Displays measurements for station No. 1 to No. 31.

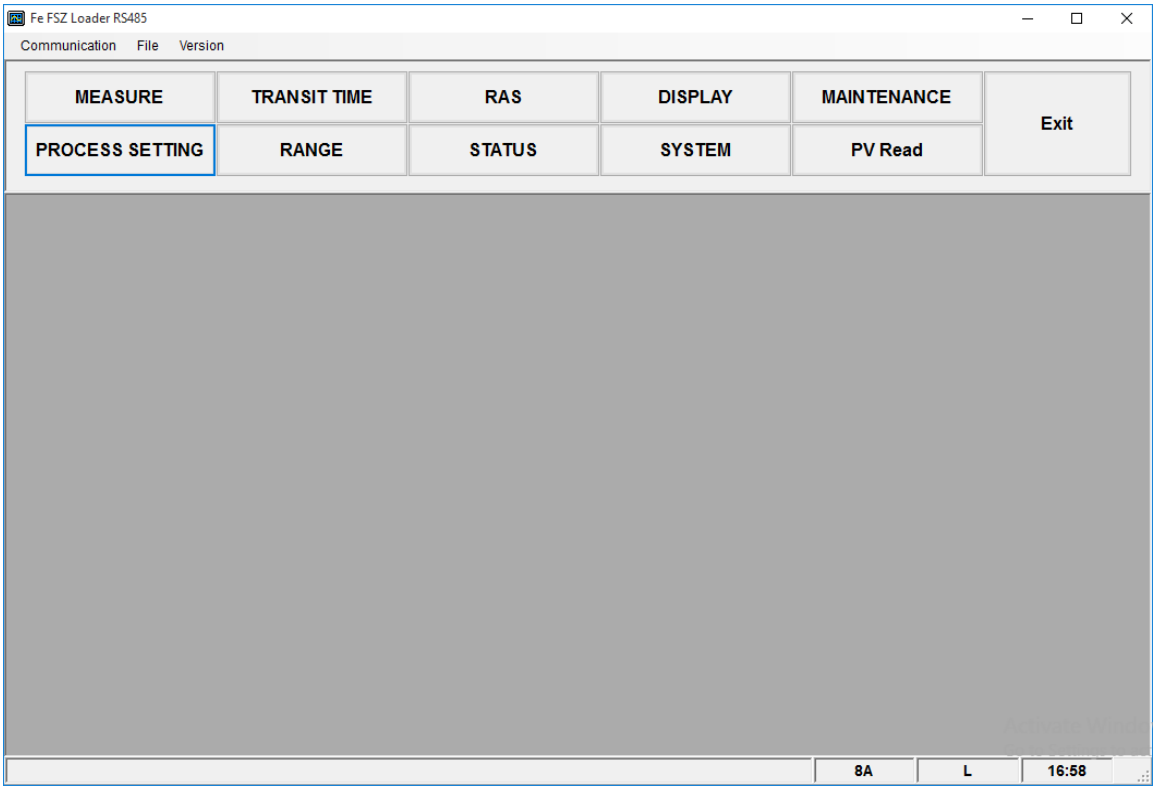


Fig. 8-12 < Menu screen >

8.8 Common Functions on Setting Screen

The [SETTING] button, [READ] button, and [Check ON/OFF] check-box button are common functions on the setting screen.

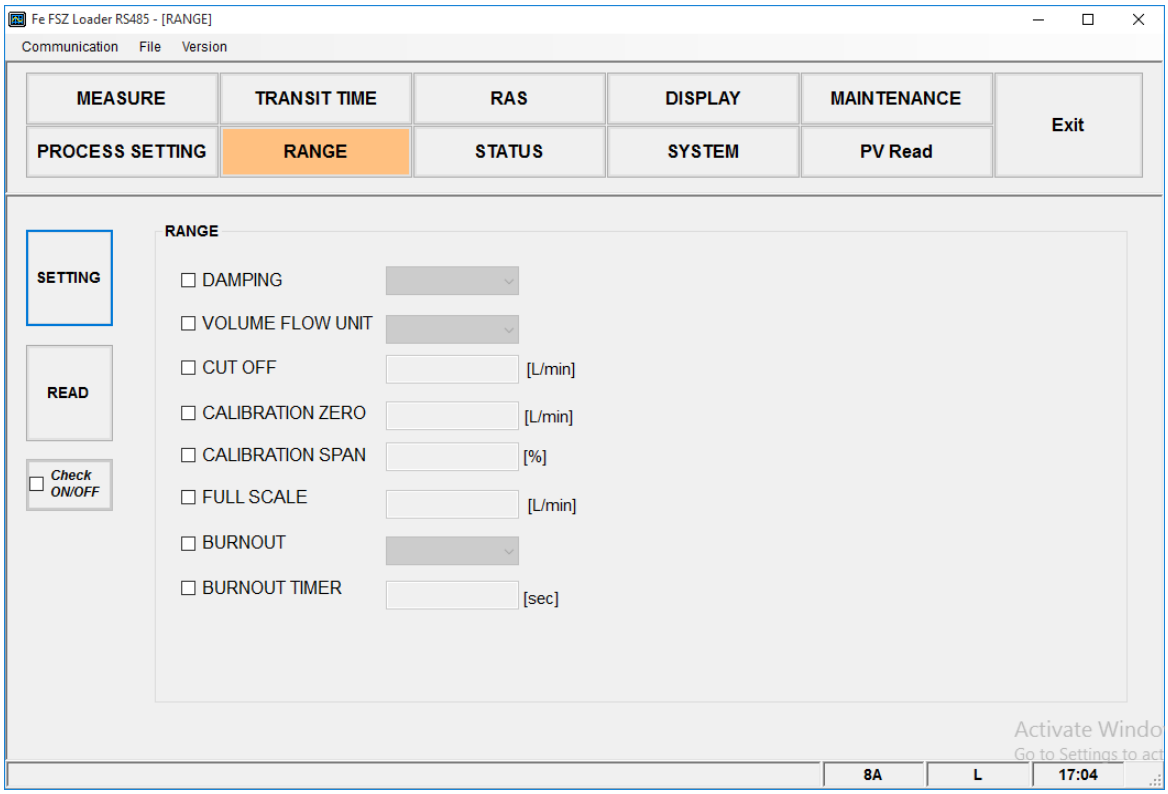


Fig. 8-13 <Example of settings screen>

Select items you want to set and read by checking their check boxes ("☑"). Clear ("☐") the check-box of an item when you do not want to select the item (or you want to unselect it). Version information can only be read-in.

[SETTING] ····· Sends the setting of the selected item (check box set to ("☑") to the flowmeter, reflecting the flowmeter response value on the setting. This is always required when the setting is changed.

[READ] ····· Reads the setting of the selected item (check box set to ("☑") from the flow, reflecting the flowmeter response value on the setting.

[Check ON/OFF] ····· Check the check box ("☑") to select all the items. (The check boxes for all the items are checked ("☑")). Keep the check box blank (☐) to cancel the selection of all the items. (The check boxes for all the items are made blank (☐).

8.9 System Setting

Click the [SYSTEM] button on the menu screen, and the following screen appears.

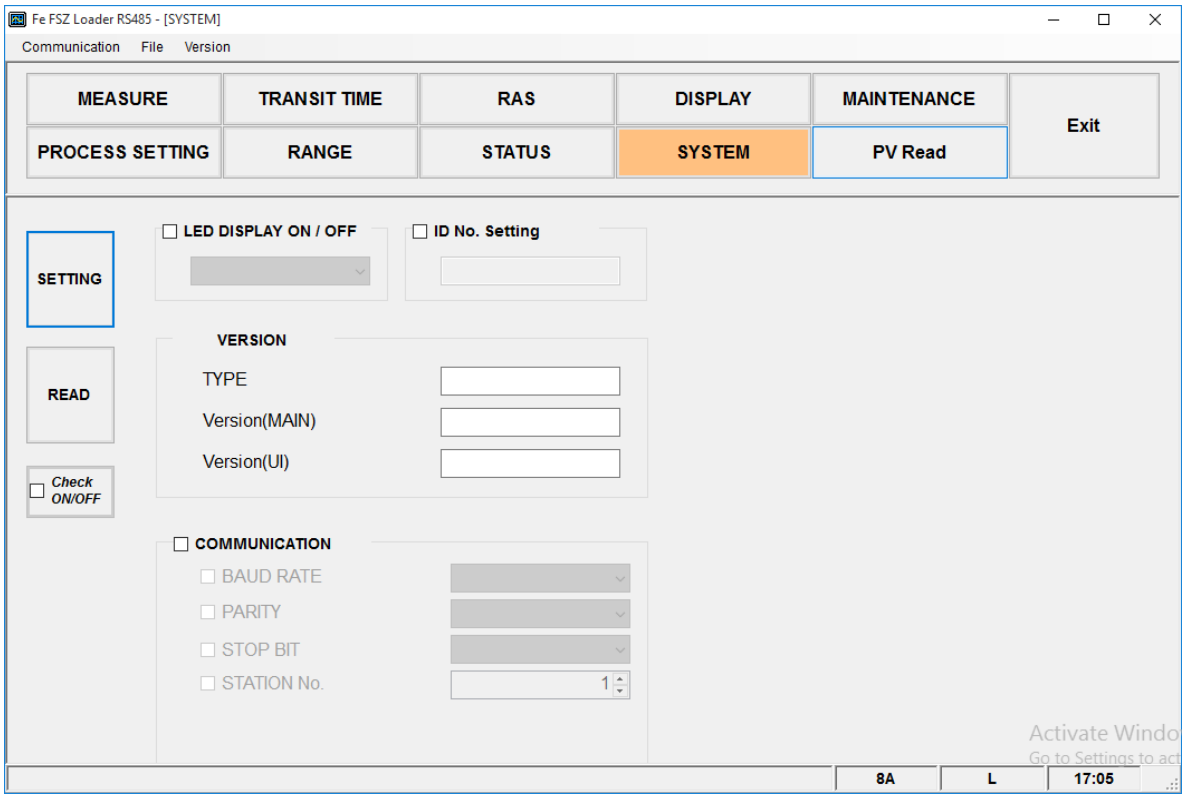


Fig. 8-14 < System setting screen >

For details on system settings, refer to Table 8-3.

Table 8-3 <System settings>

Item		Content
LED display ON/OFF		Select ON (default setting) or OFF.
ID No. Setting		Enter in range of 0000 to 9999. (factory default: 0000)
VERSION		Read only
COMMUNICATION		Note) If the setting is changed, a communication error will occur after the change. Match the settings in “8.6.1 Communications”.
	BAUD RATE	Select from 9600 bps, 19200 bps, or 38400 bps (factory default).
	PARITY	Select from NONE, ODD (factory default), or EVEN.
	STOP BIT	Select from 1 bit (factory default) or 2 bit.
	STATION No.	Enter in range of 1 to 31. (factory default: 1)

8.10 Process Setting

Click the [PROCESS SETTING] button on the Menu screen, and the following screen appears.

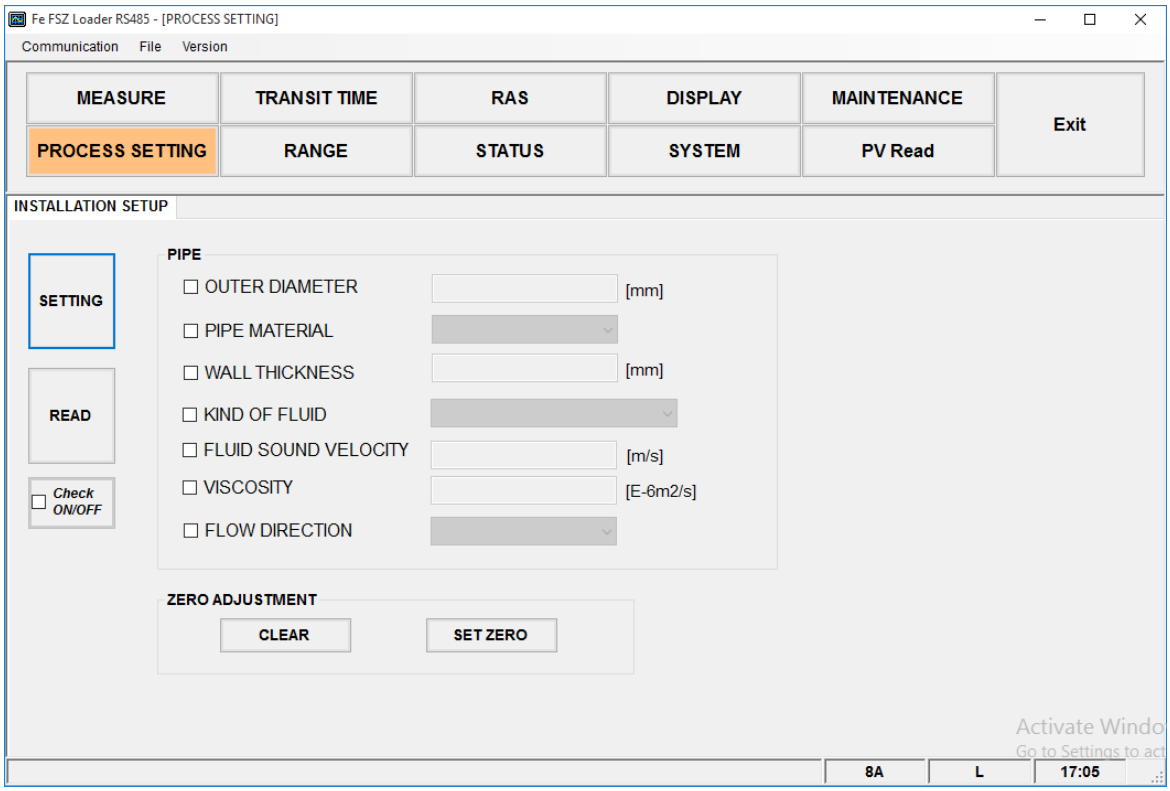


Fig. 8-15 <Installation setting screen>

For details on installation settings, refer to Table 8-4.

- Fluid sound velocity: When the fluid type is fluid sound velocity, the display is valid.

ZERO ADJUSTMENT
[CLEAR].....Clears zero calibration.
[SET ZERO].....Executes zero calibration adjustment.

Table 8-4 <Piping Specifications>

Item	Content
OUTER DIAMETER	Enter in the range from 5.00 to 99.99 mm (two decimal places). (Factory default: FSZ08: 13.80, FSZ15: 21.70, FSZ25: 34.00 [mm])
PIPE MATERIAL	Select from carbon steel, stainless steel (factory default), copper, PVC, PFA, PTFE. (Select PVC for PP, PVDF)
WALL THICKNESS	Enter in the range from 0.10 to 99.9 mm (two decimal places). (Factory default: FSZ08: 2.00, FSZ15: 2.50, FSZ25: 3.00 [mm])
KIND OF FLUID	Select from water (factory default), seawater, or fluid sound velocity.
FLUID SOUND VELOCITY	Enter in the range from 1000 to 2000 m/s (no decimal point). (When the fluid type is “fluid sound velocity”)
VISCOSITY	Enter in the range from 0.001 to 9.999 E-6m^2/s (factory default: 1.004 E-6m^2/s).
FLOW DIRECTION	Select from ←--Right-to-left and --→ Left-to-right.

8.11 Range Setting

Click the [RANGE] button on the Menu screen, and the following screen appears.

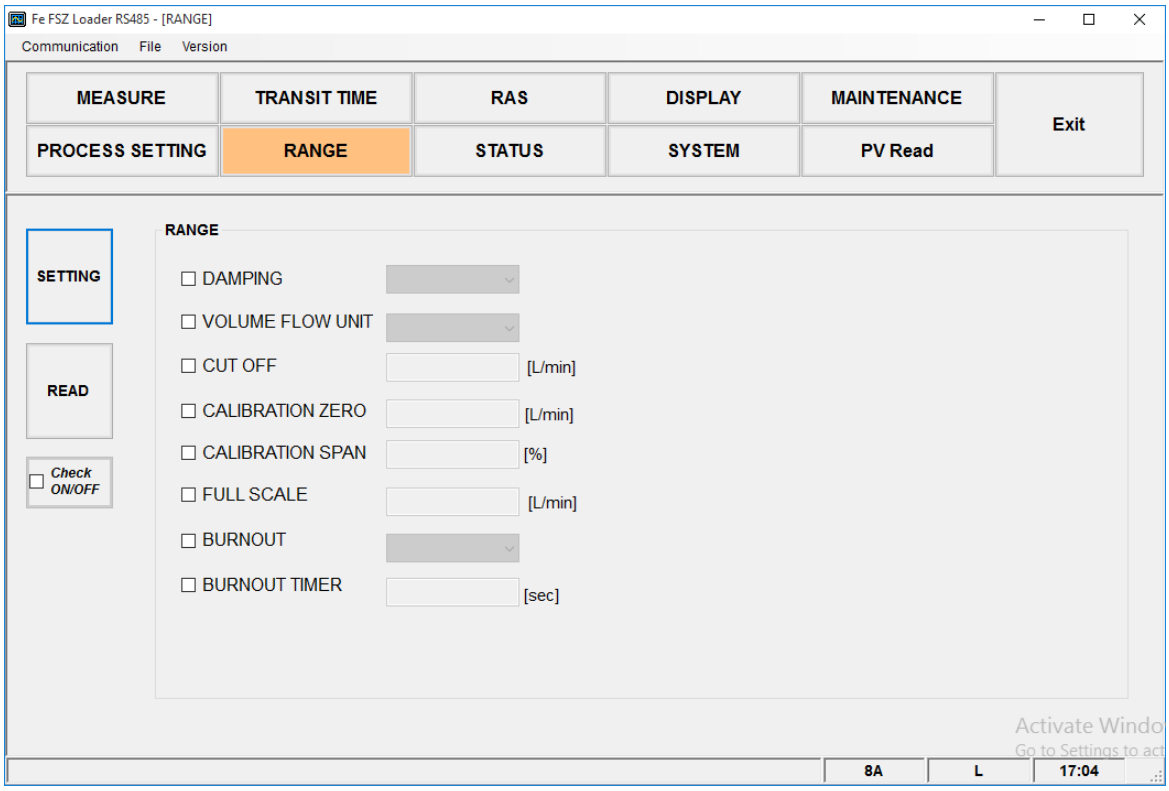


Fig. 8-16 <Range setting screen>

For details of "Range setting," refer to Table 8-5 on the next page.

Table 8-5 <Range setting>

Item	Content
DAMPING	Select from 0 sec, 1 sec, 3 sec, 5 sec, 10 sec, 30 sec, 60 sec and 90 sec.
VOLUME FLOW UNIT	Select L.
CUT OFF	FSZ08: 0.00 to 99.99 [L/min], (factory default 0.15 [L/min]) FSZ15: 0.0 to 999.9 [L/min], (factory default 0.5 [L/min]) FSZ25: 0.0 to 999.9 [L/min], (factory default 1.5 [L/min]) Enter in the 0 to 5 m/s range for flow velocity conversion.
CALIBRATION ZERO	FSZ08: -99.99 to 99.99 [L/min], (factory default 0.00 [L/min]) FSZ15: -999.9 to 999.9 [L/min], (factory default 0.0 [L/min]) FSZ25: -999.9 to 999.9 [L/min], (factory default 0.0 [L/min]) Enter in the ±5 m/s range for flow velocity conversion.
CALIBRATION SPAN	Enter in the 0.0 to 200.00% (factory default: 100%) range up to 2 places after the decimal point.
FULL SCALE	FSZ08: 0.00 to 99.99 [L/min], (factory default 15.00 [L/min]) FSZ15: 0.0 to 999.9 [L/min], (factory default 50.0 [L/min]) FSZ25: 0.0 to 999.9 [L/min], (factory default 150.0 [L/min]) Enter in the 0, 0.3 to 5 m/s range for flow velocity conversion.
BURNOUT (current)	Select from HOLD (factory default), UPPER LIMIT, LOWER LIMIT, and ZERO.
BURNOUT TIMER	Enter in the 10 to 900 sec (factory default: 10 sec) range.

8.12 STATUS

Click the [STATUS] button on the Menu screen, and the following screen appears.

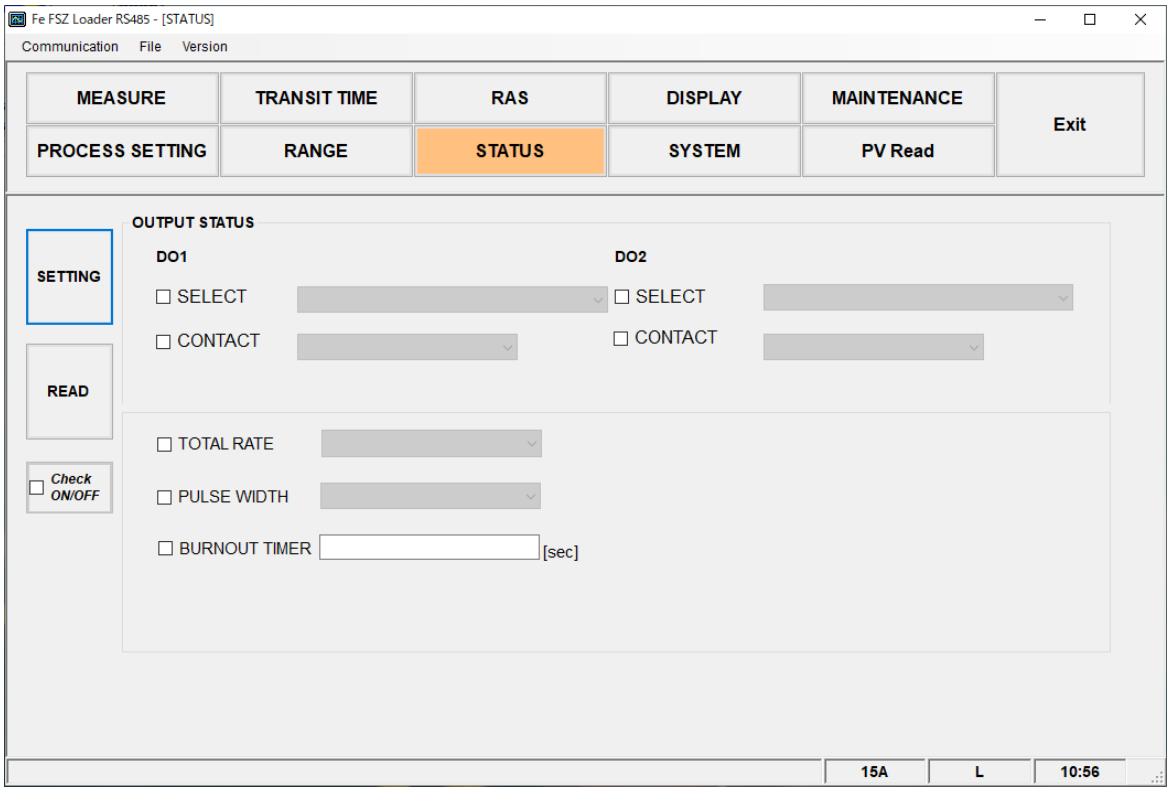


Fig. 8-17 <Status output setting screen>

For details of “Status output setting,” refer to Table 8-6 on the next page.

Table 8-6 <Status output>

Item		Content
DO1	OUTPUT	Select from Not Use (factory default), All Alarms, Hardware Error, Process Error, Range Over/Pulse Range Over, Negative Flow Direction, and Total Flow Pulse.
	CONTACT OPERATION	Select operation ON (factory default) and operation OFF.
DO2	OUTPUT	Select from Not Use (factory default), All Alarms, Equipment Error, Process Error, Range Over/Pulse Range Over, and Negative Flow Direction.
	CONTACT OPERATION	Select operation ON (factory default) and operation OFF.
TOTAL RATE		Select from FSZ08: 0.1, 1, 10, 100, 1000 [L] (factory default 10 [L]), FSZ15: 0.1, 1, 10, 100, 1000 [L] (factory default 10 [L]), and FSZ25: 1, 10, 100, 1000, 10000 [L] (factory default 100 [L]).
PULSE WIDTH		Select from 5 ms, 10 ms, 50 ms, 100 ms, and 200 ms.
BURNOUT TIMER		Enter in the 10 to 900 sec (factory default: 10 sec) range.

8.13 Display Setting

Click the [DISPLAY] button on the Menu screen, and the following screen appears.

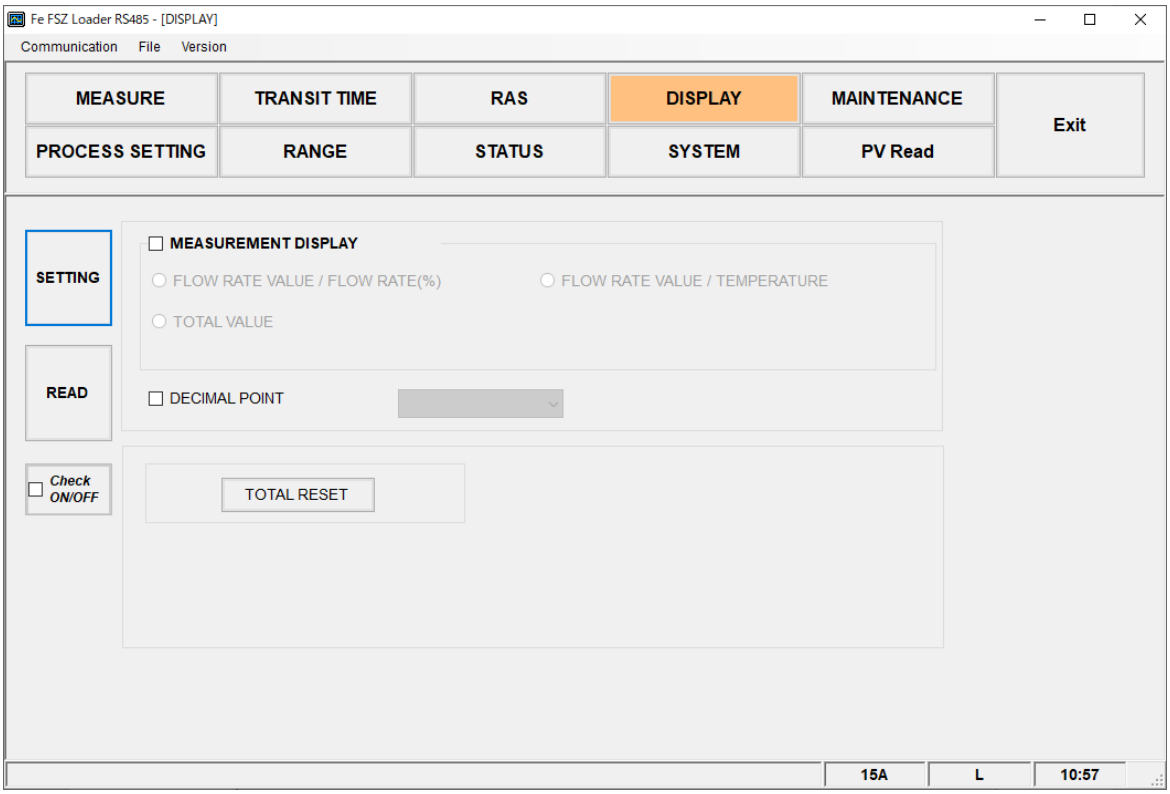


Fig. 8-18 <Display setting screen>

For details on display settings, refer to Table 8-7.

[TOTAL RESET] ····· Clears the total flow rate to zero.

Table 8-7 <Display setting>

Item	Content
MEASUREMENT DISPLAY	Select from FLOW RATE VALUE / FLOW RATE (%), FLOW RATE VALUE / TEMPERATURE, and TOTAL VALUE.
DECIMAL POINT	Select from FSZ08: 0.01, 0.1, 1 (factory default: 0.1), FSZ15: 0.1, 1 (factory default: 0.1), and FSZ25: 0.1, 1 (factory default: 1)

8.14 Measurement

Click the [MEASURE] button on the Menu screen, and the following screen appears.

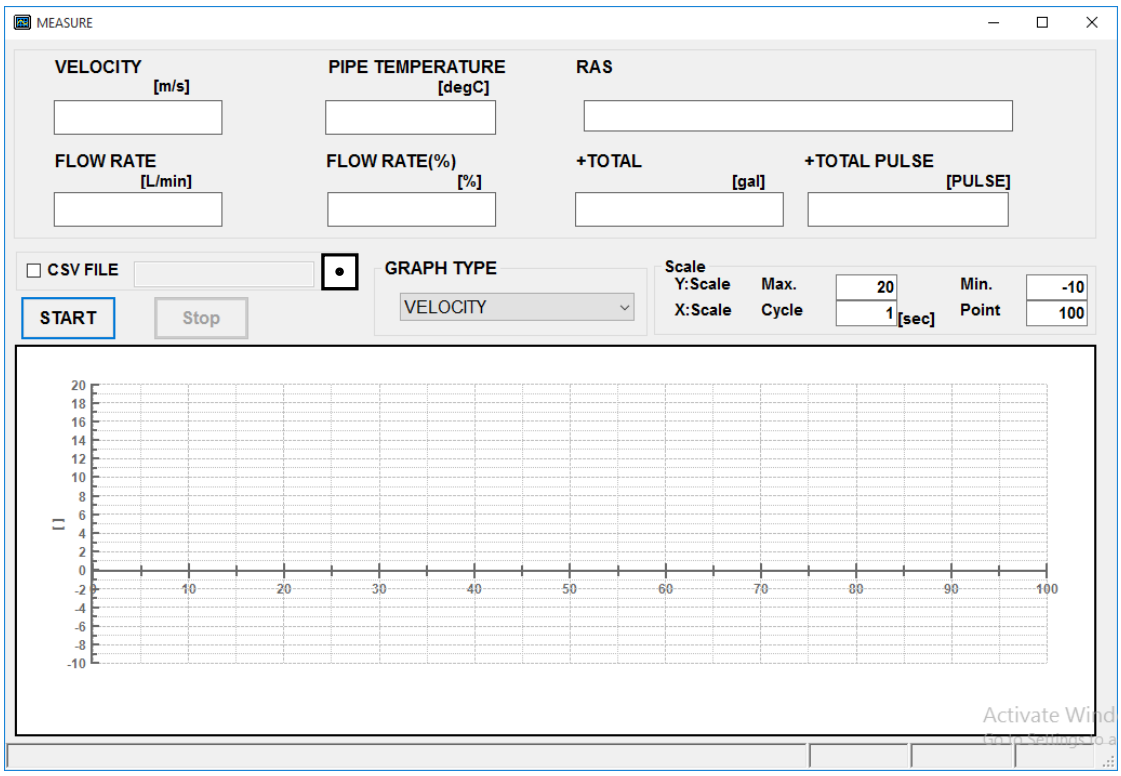


Fig. 8-19 <Measure screen>

Perform the following operations before clicking [START] to begin viewing and recording.

(1) Select the type of graph that corresponds best to what you want to display.
(2) Set the scale. Y scale [Max.][Min.], X scale [Cycle][Point]
(3) Check the CSV FILE check box (“☑”).
(4) Click the [•] button to register the save destination and file name.
(5) Click the [Stop] button to stop viewing and recording.

Note 1) The value displayed in the frame is updated every setting cycle.
Note 2) There are three options for the graph display: [VELOCITY][FLOW RATE][FLOW RATE (%)].
Note 3) The following data is recorded every cycle in the CSV FILE: TIME/VELOCITY/FLOW RATE/FLOW RATE (%)/+TOTAL/+TOTAL PULSE/PIPE TEMPERATURE/RAS/ERROR.
Note 4) CSV FILE data can be collected simultaneously when there are multiple flowmeters. Refer to 8.18 PV for instructions.
Note 5) The CSV FILE will not be created if you select [START] without selecting the CSV FILE check box.

Table 8-8 <Measurement/Detailed Setting>

Item		Content
Moment value	GRAPH TYPE	Select from VELOCITY, FLOW RATE, and FLOW RATE (%).
Scale	Y-Scale	Enter the maximum and minimum values.
	X-Scale	Enter cycles and number of points. Enter cycles in the range from 1 to 3600.

⊡ By clicking this button, a dialog box appears asking where to save the CSV file to. By specifying a folder and entering a file name, a CSV file containing data separated with commas is created.

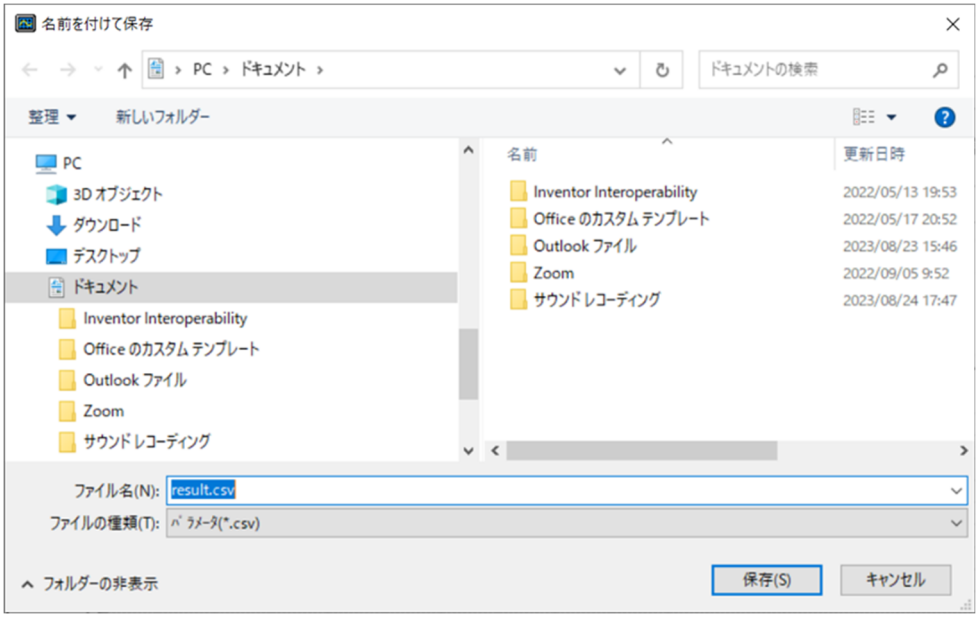
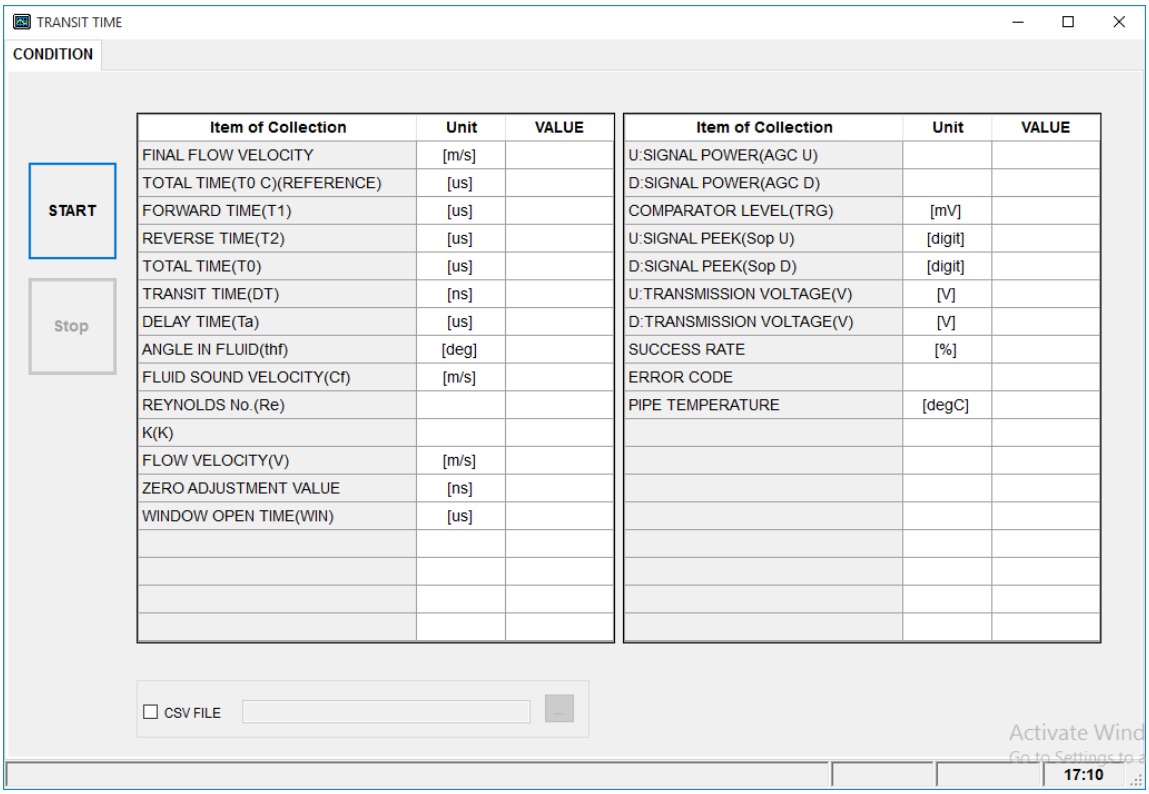


Fig. 8-20 < PC save screen>

Default file name: “result_MMDDYYHHMMSS.csv”
The file name can be changed.
If the saved file exceeds 259202 lines of data, a new file will be automatically created. The new file will be identified with the date and time added to the end of the file name.
Note) A new file is automatically created when the number of data lines is exceeded. Ensure that there is sufficient capacity on your computer hard disk.
e.g.) Setting of file name YYYY MM DD HH MM SS
Year, Month, Day, Hour, Minute, Second

8.15 Transit Time Difference Measurement

By clicking the [TRANSIT TIME] button on the menu screen, [MEASUREMENT INFORMATION] is displayed.



Item of Collection	Unit	VALUE
FINAL FLOW VELOCITY	[m/s]	
TOTAL TIME(T0 C)(REFERENCE)	[us]	
FORWARD TIME(T1)	[us]	
REVERSE TIME(T2)	[us]	
TOTAL TIME(T0)	[us]	
TRANSIT TIME(DT)	[ns]	
DELAY TIME(Ta)	[us]	
ANGLE IN FLUID(thf)	[deg]	
FLUID SOUND VELOCITY(Cf)	[m/s]	
REYNOLDS No.(Re)		
K(K)		
FLOW VELOCITY(V)	[m/s]	
ZERO ADJUSTMENT VALUE	[ns]	
WINDOW OPEN TIME(WIN)	[us]	

Item of Collection	Unit	VALUE
U:SIGNAL POWER(AGC U)		
D:SIGNAL POWER(AGC D)		
COMPARATOR LEVEL(TRG)	[mV]	
U:SIGNAL PEEK(Sop U)	[digit]	
D:SIGNAL PEEK(Sop D)	[digit]	
U:TRANSMISSION VOLTAGE(V)	[V]	
D:TRANSMISSION VOLTAGE(V)	[V]	
SUCCESS RATE	[%]	
ERROR CODE		
PIPE TEMPERATURE	[degC]	

Fig. 8-21 <Measurement information screen>

[START] ····· Starts reading.
[STOP] ····· Stops reading.
[...] ····· Saves read data to a file in CSV format.
Put a check (“☑”) on the CSV FILE check box.
[...] By clicking this button, a dialog box appears asking where to save the CSV file to. By specifying a folder and entering a file name, a CSV file containing data separated with commas is created.
Default file name: “value_MMDDYYHHMMSS.csv”
The file name can be changed.
If the saved file exceeds 259223 lines of data, a new file will be automatically created. The new file will be identified with the date and time added to the end of the file name.
Note) A new file is automatically created when the number of data lines is exceeded. Ensure that there is sufficient capacity on your computer hard disk.

Table 8-9 <Measurement information>

Item	Content	
FINAL FLOW VELOCITY	m/s	
TOTAL TIME (T0 C) (REFERENCE)	μs	
FORWARD TIME (T1)	μs	
REVERSE TIME (T2)	μs	
TOTAL TIME (T0)	μs	
TRANSIT TIME (DT)	ns	
DELAY TIME (Ta)	μs	
ANGLE IN FLUID (thf)	°	
FLUID SOUND VELOCITY (Cf)	m/s	
REYNOLDS No. (Re)		
K (K)		
FLOW VELOCITY (V)	m/s	
ZERO ADJUSTMENT VALUE	ns	
WINDOW OPEN TIME (WIN)	μs	
U:SIGNAL POWER (AGC U)		(Normal range: ≤ 96 (normal), 192 (caution))
D:SIGNAL POWER (AGC D)		(Normal range: ≤ 96 (normal), 192 (caution))
COMPARATOR LEVEL (TRG)	mV	
U: SIGNAL PEEK (Sop U)	digit	(Normal range: 1520 to 2120)
D: SIGNAL PEEK (Sop D)	digit	(Normal range: 1520 to 2120)
U: TRANSMISSION VOLTAGE (V)	V	
D: TRANSMISSION VOLTAGE (V)	V	
SUCCESS RATE	%	
ERROR CODE		
PIPE TEMPERATURE	degC	

8.16 RAS

Click the [RAS] button on the Menu screen, and the following screen appears.

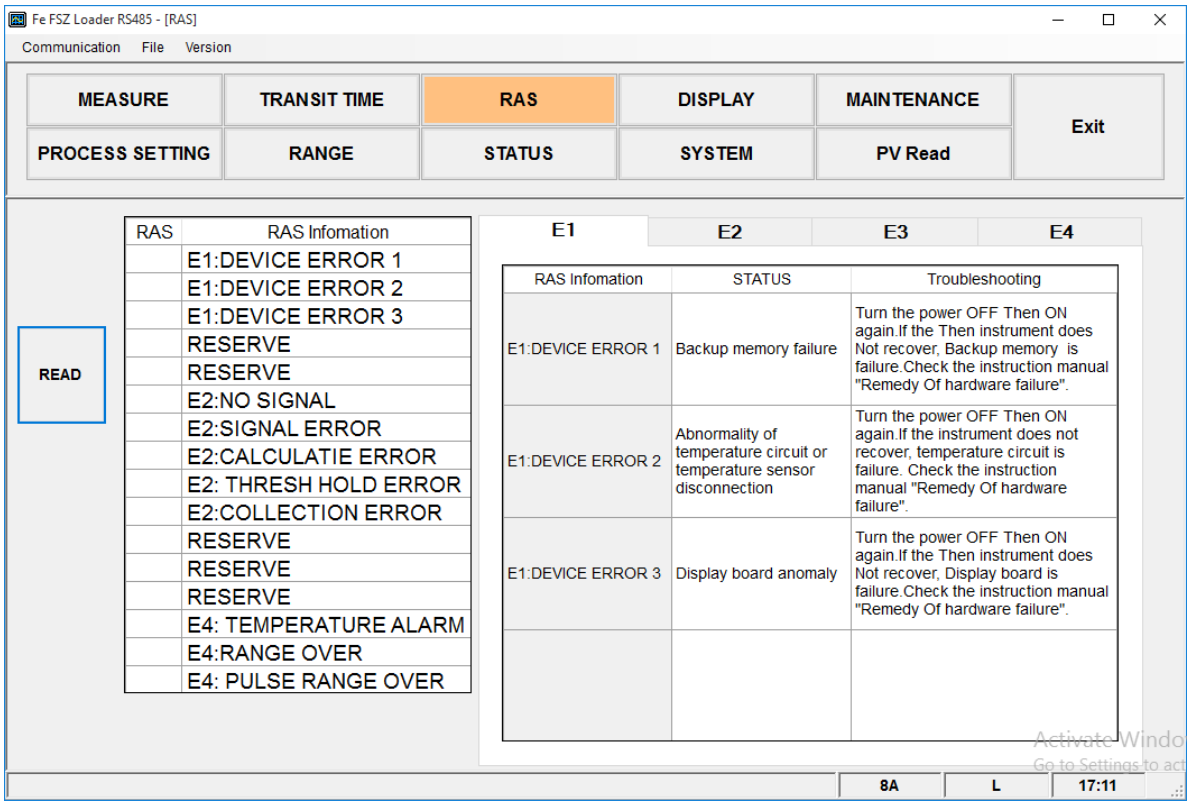


Fig. 8-22 < RAS screen >

[READ] ····· Displays RAS information (16 items from 0/1 to 0/16).

[E1] tab ····· Displays the category “E1” error status and error handling method.
[E2] tab ····· Displays the category “E2” error status and error handling method.
[E3] tab ····· Unused
[E4] tab ····· Displays the category “E4” error status and error handling method.

8.17 Maintenance

Click the [MAINTENANCE] button on the Menu screen, and the following screen appears.

Note) If [Setting] and [Read] are executed on this screen, the instrument is in the Maintenance mode for flowmeter. Be sure to reset the Maintenance mode of flowmeter by clicking the [Release] button.

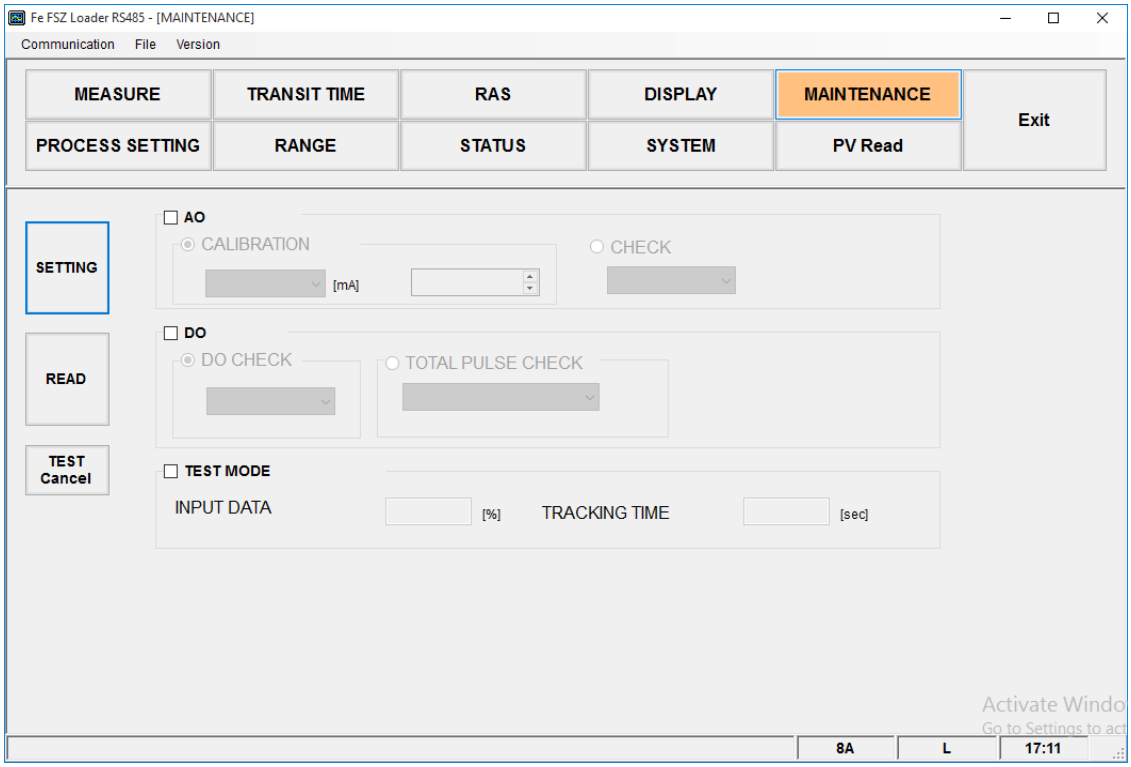


Fig. 8-23 < Maintenance screen >

See Table 8-10 < Maintenance/setting > on the next page for details of the maintenance.

[TEST Cancel]····· Cancels the AO/DO/Test mode.

*Note) Be sure to press the [TEST Cancel] button when maintenance is completed.

Table 8-10 < Maintenance/setting >

Item	Content
AO calibration	When 4 mA is selected, without decimal point, Enter in the range from 3552. When 20 mA is selected, without decimal point, Enter in the range from 18050. Select "4 mA" or "20 mA" and then click [READ]. The adjusted value is listed in the right pane. Connect an ammeter and use it for adjustment. Click the [SET] button to change the adjusted value.
AO CHECK	Select from 0.8 mA, 4 mA, 8 mA, 12 mA, 16 mA, 20 mA, and 23.2 mA.
DO CHECK	Select ON or OFF.
DO TOTAL PULSE CHECK	Select STOP or START(1PULSE/S).
TEST MODE	Check the check box (☑) to enter the test mode. Exit the test mode if either input data or tracking time is entered and the check box is blank (□).
INPUT DATA	Without decimal point, Enter in the ±120% range.
TRACKING TIME	Without decimal point, Enter in the range from 0 to 900 sec.

8.18 PV

Click the [PV] button on the Menu screen, and the following screen appears.

⚠ CAUTION

・Do not start or operate the other application while the measurement is in progress. The measurement may not be successful.

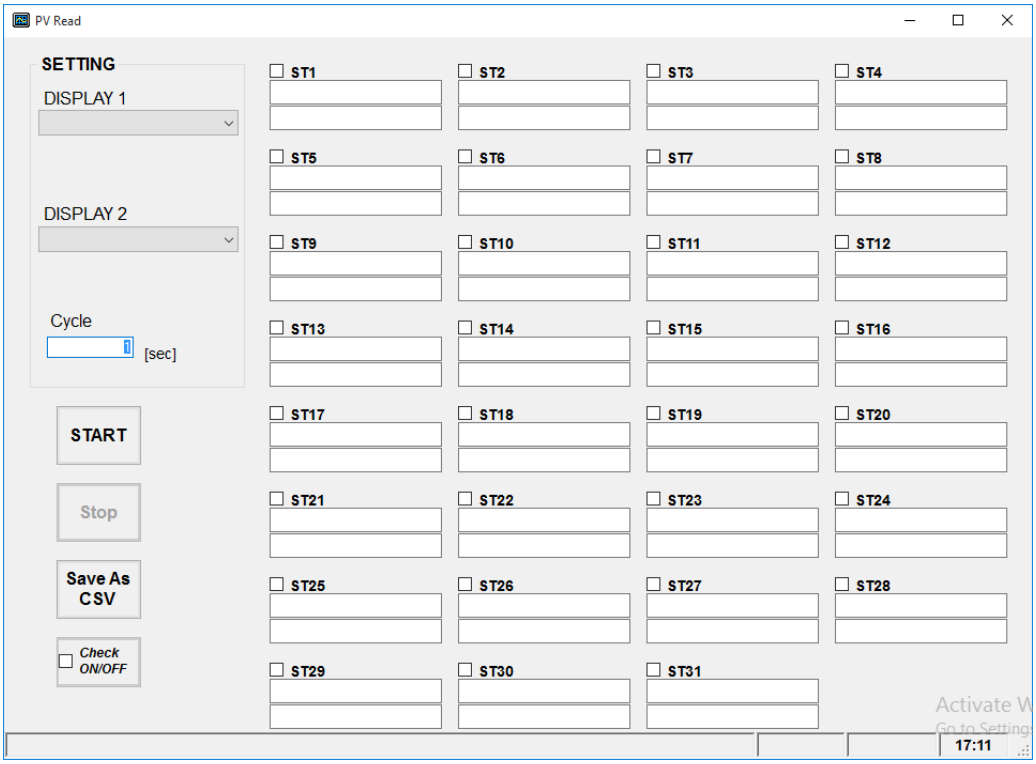


Fig. 8-24 < PV screen >

Select the station No. to be measured by checking the check box of the desired item (“☑”). Make the check box of the items not to be selected (or to be canceled) blank (“☐”).

The number of measurable units can be calculated by the following expression:

Number of measurable units = Cycle (sec) / 0.5 sec

See Table 8-11 for details of PV.

[START]····· Starts the measurement of the selected device (☑). When setting of saving file is completed with [Save as CSV] button, [Start] button will be enabled to click.

[Stop] ····· Stops communication.

[Save as CSV] ····· Saves measurement data for each device to a file in CSV format.
By clicking this button, a dialog box appears asking where to save the CSV file to. By specifying a folder and entering a file name, a CSV file containing data separated with commas is created.
Default file name: "pvdata_MMDDYYHHMMSS.csv"
The file name can be changed.
If the saved file exceeds 259205 lines of data, a new file will be automatically created. The new file will be identified with the date and time added to the end of the file name. Note) A new file is automatically created when the number of data lines is exceeded. Ensure that there is sufficient capacity on your computer hard disk.
e.g.) Setting of file name YYYY MM DD HH MM SS
Year, Month, Day, Hour, Minute, Second

[Check ON/OFF]····· Check the check box (☑) to select all the items. (The check boxes for all the items are checked (☑).) Keep the check box blank (☐) to cancel the selection of all the items. (The check boxes for all the items are made blank (☐).)

Table 8-11 < PV Setting >

Item		Content
DISPLAY 1	Type	Select from VELOCITY, FLOW RATE, FLOW RATE (%), + TOTAL, + TOTAL PULSE, PIPE TEMPERATURE, and RAS.
DISPLAY 2		Same as the selection of Display 1
Cycle		Enter in range of 1 to 60 sec.

8.19 End

Click the [End] button on the Menu screen, and the following screen appears.

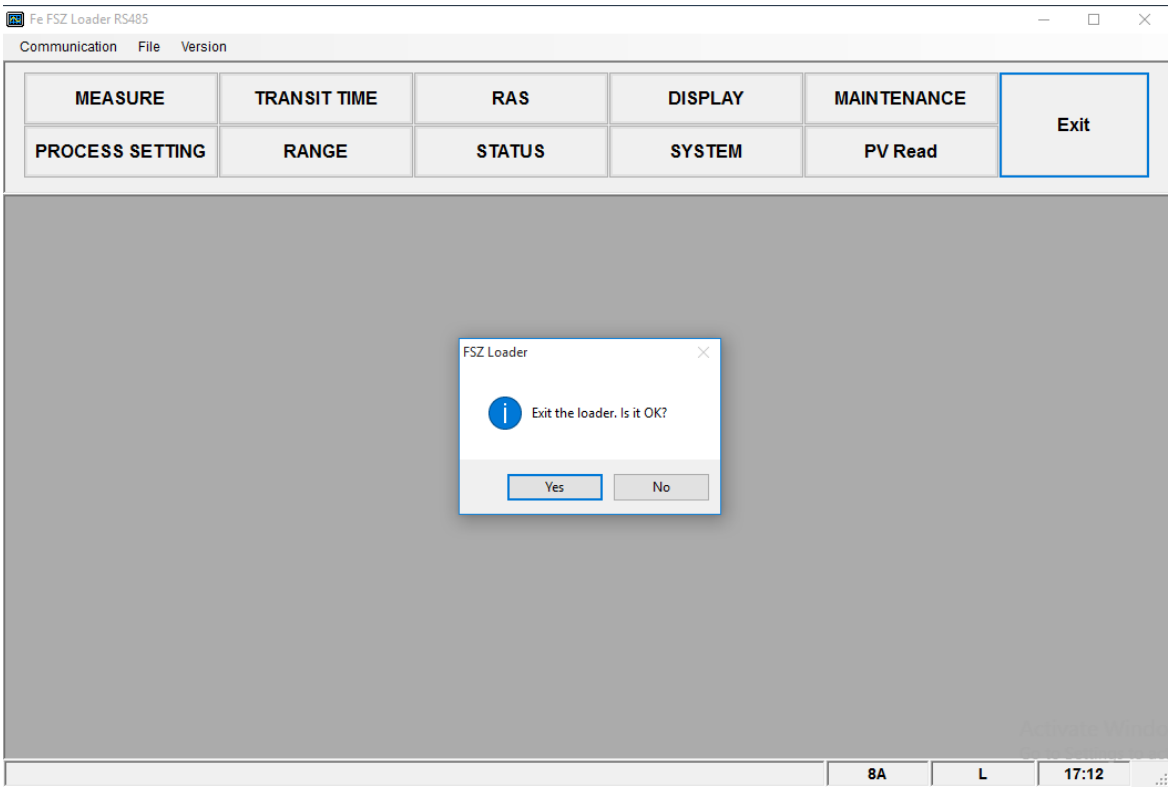


Fig. 8-25 < Menu screen >

By clicking the [End] button or [☒]button, a message appears asking whether to exit PC Loader. To exit, click [Yes]. To cancel, click [No].

8.20 Uninstalling of Software

Uninstall the software using the standard Windows OS program uninstall procedure.

To uninstall the software, select [Programs and Features] from the Windows Control Panel, and then click the [Uninstall] button.

The software will no longer appear in the Start menu, and the desktop shortcut will also be deleted.

9. TROUBLESHOOTING

If the communication is unavailable, check the following items.

☐ Whether all devices related to communication are turned on.

☐ Whether connections are correct.

☐ Whether the number of connected instruments and connection distance are as specified.

☐ Whether communication conditions coincide between the master station (host computer) and slave stations.

- ☐ Transmission speed: ☐ 9600 bps
  ☐ 19200 bps
  ☐ 38400 bps
- ☐ Data length: 8 bit
- ☐ Stop bit: ☐ 1 bit
  ☐ 2 bit
- ☐ Parity: ☐ odd
  ☐ even
  ☐ none

☐ Whether send/receive signal timing conforms to Section5.6 in this manual.

☐ Whether the station No. designated as send destination by the master station coincides with the station No. of the connected device.

☐ Whether more than one instrument connected on the same transmission line shares the same station No.

☐ Whether the station No. of instruments is set at other than 0.
If it is 0, the communication function does not work.

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