Fuji Electric

PORTABLE TYPE ULTRASONIC FLOWMETER

Basic Instruction Manual

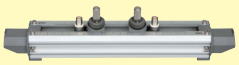
without printer

with printer

■ Detector: Transit time detector

Outer appearance		Type
Small		FSDP2
Medium		FSDP1
Large		FSDP0

■ Detector: Flow velocity distribution measurement detector

Outer appearance		New type	Old type
Small diameter		FSSD1	FSD22
Small type		FSSD3	FSD12
Extendable type		FSSC	—
High temp.		FSSH	FSD32
Large diameter		FSSE	FSD51

Contents

Fuji Electric Co., Ltd.

TN5A3429a-E

Thank you for purchasing our product. This Basic Instruction Manual outlines the proper operation procedure.
Please take a few moments to read this manual thoroughly before use and read the Instruction Manual on the enclosed CD as well.

1. Does the bore diameter of pipe being measured correspond with the sensor type?

Transit time detector				
Detector	New type	Old type	Diameter (mm)	Temp. range (°C)
Small diameter	FSSD1	FSD22	13 to 100	-40 to 100
	FSSD3	—	13 to 300	-40 to 100
Small type	—	FSD12	50 to 400	-40 to 120
Extendable type	FSSC	—	50 to 1200	-40 to 120
Large diameter	FSSH	FSD32	50 to 400	-40 to 200
High temp.	FSSE	FSD51	200 to 6000	-40 to 80

Flow velocity distribution measurement detector			
Detector	Type	Diameter (mm)	Temp. range (°C)
Small	FSDP2	40 to 200	-40 to 100
Medium	FSDP1	100 to 400	-40 to 80
Large	FSDP0	200 to 1000	-40 to 80

Note:

Table of flow transmitter and old/new detector combination

Flowmeter Revison No.	Detecter (New type)					Detecter (Old type)			
	FSSD1	FSSD3	FSSC	FSSH	FSSE	FSD22	FSD12	FSD32	FSD51
FSC-1	○	○	×	○	○	○	○	○	○
FSC-2 and after	○	○	○	○	○	○	○	○	○

○: Applicable
×: Non Applicable.
Transmitter software is updated.
Software updates are available on our website.
http://www.fujielectric.com/products/instruments/products/flow_ultra/FSC_FLD_FSD.html

2. Is there enough straight pipe portion on the upstream and downstream side of the sensor mounting position?

- The place where a strait pipe portion is 10D or more on the upstream side and 5D or more on the downstream side.
- The place where no factors to disturb the flow (pumps or valves) exists within about 30D on the upstream side.

3. Is the pipe setup (such as, outer diameter, material, thickness) correct?

- Sensor mounting dimension is not calculated correctly. Therefore, errors, such as "Window scanning "(waveform out of the receiving range) and "No received signal" occur.

4. Is the sensor mounted correctly?

- Apply sufficient silicone grease over the whole transmitting surface of the sensor. Otherwise, errors, such as "Received signal is unstable " and "No received signal" occur.
- If the connection between the upstream side and the downstream side are reversed, flow rate is displayed with is minus "-".

5. Did you perform the zero adjustment before start measurement? <See page 4>

- Fill the pipe with the fluid being measured, and perform "ZERO ADJUSTMENT" manually in a situation where the flow is stopped. Otherwise, measurement can not be performed. (If you can not stop the flow, "CLEAR" the adjustment. However, it reduces the accuracy a bit.)

6. Are two or more signal indicators displayed at the top right of the measurement screen? <See page 7>

- If only one or less indicator is displayed, raise the transmission voltage level.

7. Is the range setting of analog output correct? <See page 21>

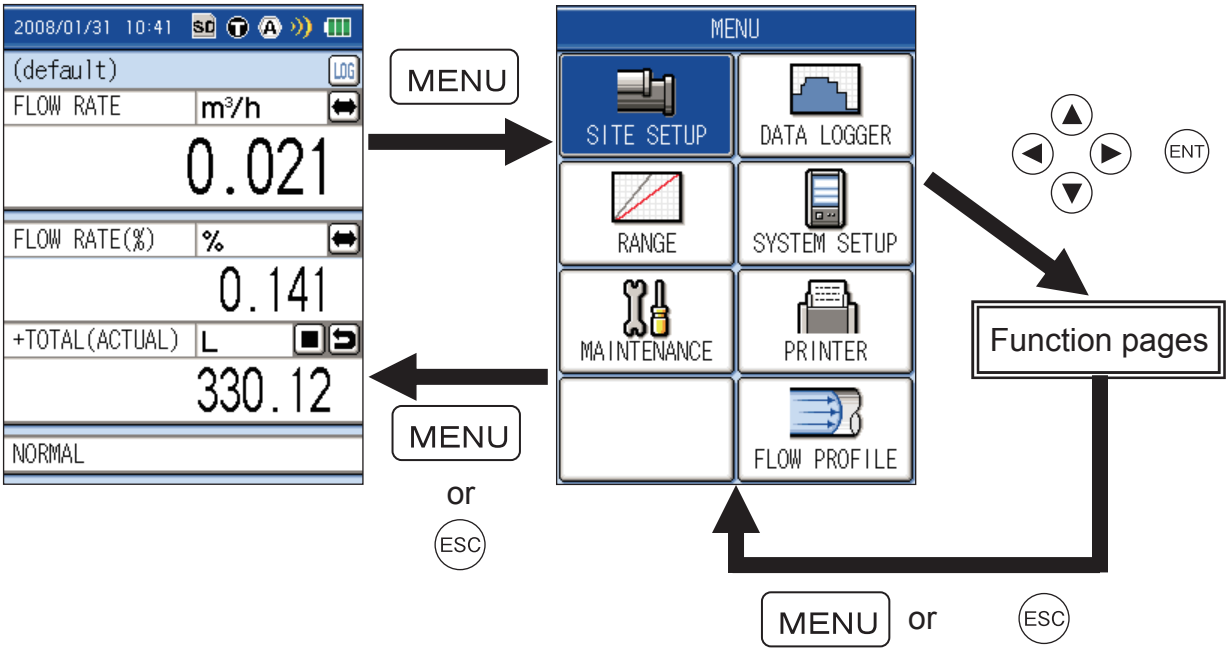
- Even if the analog output is not used, make a proper range setting. Otherwise, "E4: RANGE OVER" occurs.
  (Proper setting: MENU→SYSTEM→ANALOG INPUT/OUTPUT→"NOT USED")
  Factory setting is "NOT USED".

☆ Now preparation for measurement is complete. Make settings of TOTALIZER, DATA LOGGER, and PRINTER if needed.

Is correct flow rate displayed? If an error message appears, move the cursor to "Status display" on the measurement screen press the "ENT" key.
Errors, causes and actions are displayed. Take actions according to the display.

1. Preparation for measurement

(1) Measurement procedure



Power ON

PIPE PARAMETER setting → Make a setting in reference to "2. From [Input of piping specifications] to [Mounting of sensor]".

Sensor mounting

Start measurement

End of measurement / Power OFF

To Measurement screen

Selection of sensor mounting location and treatment

CAUTION!

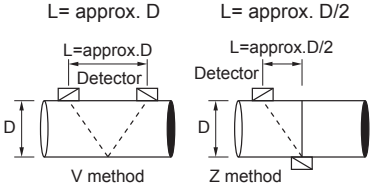
1. Selection of sensor mounting location

1) Place where a straight portion is 10D or more on the upstream side and 5D or more on the downstream side.
2) Place where no factors to disturb the flow (such as pump and valve) within about 30D on the upstream side.
3) Pipe should be always filled with fluid. Neither air bubbles nor foreign materials are contained in the fluid.

2. Selection of a mounting method

Employ V method for mounting a small diameter sensor and a small sensor (standard), and Z method for the following cases.

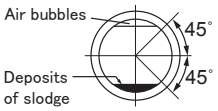
- Mounting space needs to be saved (about one half of the V method's mounting space)
- Pipe has mortar lining.
- A thick film of scale may have been formed on the inner surface of a pipe because it is old.



L: Mounting dimensions

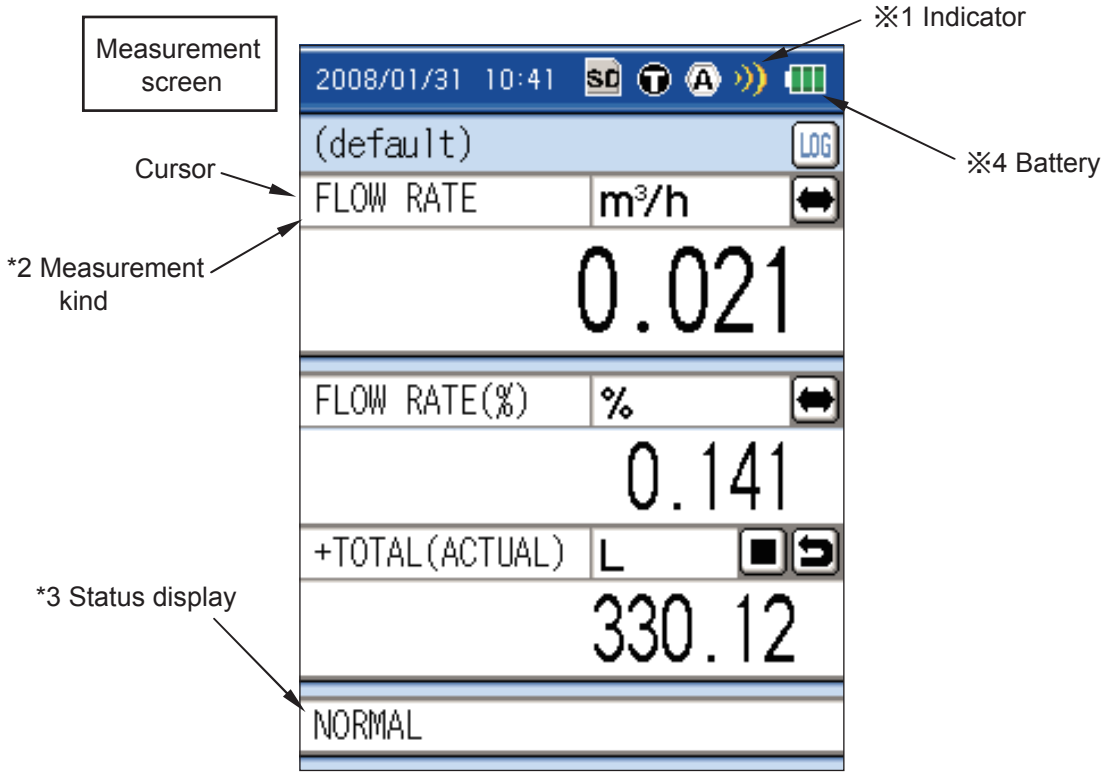
3. Treatment of sensor mounting surface

- Remove pitting, rust, unevenness, etc. with thinner or sand paper from the pipe portion where the detector is to be mounted [Width: (L)+200mm Length: entire outer circumference].
- If the piping outer circumference is wound with jute, remove it before taking the above treatment.
- Horizontal piping: Mount a sensor at an angle of ± 45° or smaller from the level.
- Vertical piping: Mount a sensor on an arbitral position on the outer circumference.



4. How to mount pipes of a small size sensor (standard) and a small diameter sensor (see p.44 in the Instruction Manual)

1) Loosen the lock nut and slide so as to meet the mounting dimension, and then tighten the nut.
2) Apply silicone grease on the transmitting surface of the sensor.
3) Fix the both ends (saddles) of the sensor by cloth belts.
4) Make sure the sensor has been mounted in parallel with the pipe axis and mounting dimension is correct.
   Then turn the element holder clockwise until the sensor comes in close contact with the pipe. (Clockwise: Element is retracted. Counterclockwise: Element is pressed.)



CAUTION!

1) Did you remove paint and rust on the piping surface?
2) Did you apply sufficient grease on the sensor surface?
3) Is there no air bubbles in the pipe?
4) Even if raise the transmission voltage, number of indicators does not increase due to, such as rust, scale and peeled lining in the pipe. Change the installation site.
5) If raise the transmission voltage, consumption of battery for operation measurement increases a bit. (No problem with measurement)

*1 Indicator …… Shows the intensity of ultrasonic receiving signal in four levels. If signal decay is less than one, raise the transmission voltage. [See page 7]

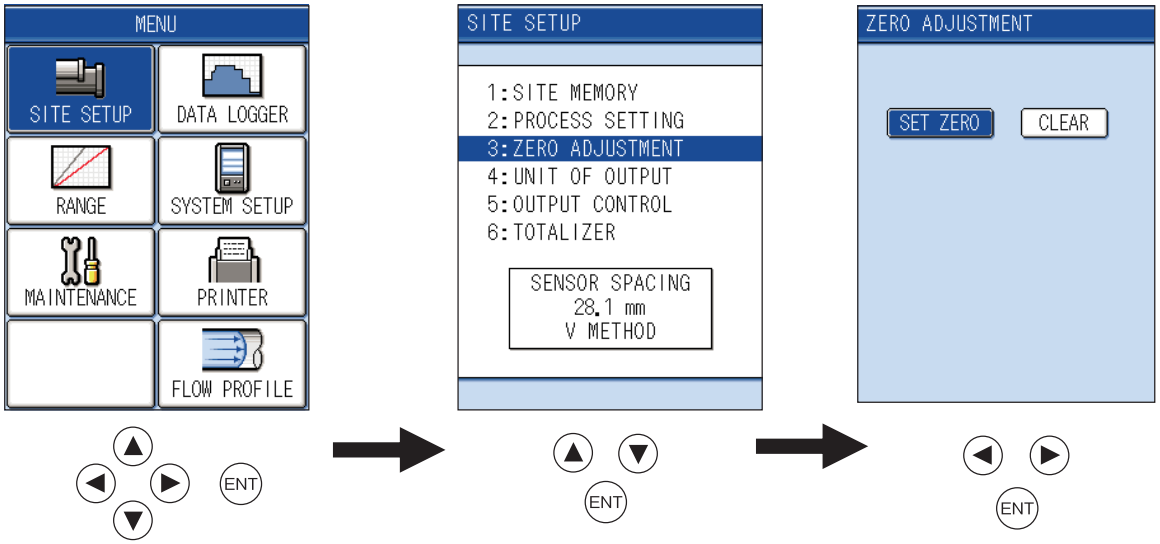
*2 Measurement kind … Kind of measurement on the measurement screen can be changed. Move the cursor to the desired item and press the (ENT) key. Then the selection screen appears.

Select from VELOCITY, FLOW RATE, FLOW RATE (%), +TOTAL, -TOTAL,.
ANALOG INPUT1, AND ANALOG INPUT2.

*3 Status display …… If "NORMAL" is displayed with the sensor connected to a cable (for mounting only), there is no problem. If other messages are displayed, move the cursor to the Status display, and press the (ENT) key. Then the screen for corrective action appears. If there are several pages, [►] is displayed in the lower right of the screen. Refer to displayed corrective actions and "12. ERROR AND REMEDY" in the Instruction Manual.

*4 Battery …… Displays the remaining battery charge. Connect a attached AC power adapter to charge a battery.
· If the power of instrument is OFF, about three hours is required for charge.
· If the power of instrument is ON, trickle charge is performed.

(2) Perform zero adjustment in a situation where the flow is stopped.

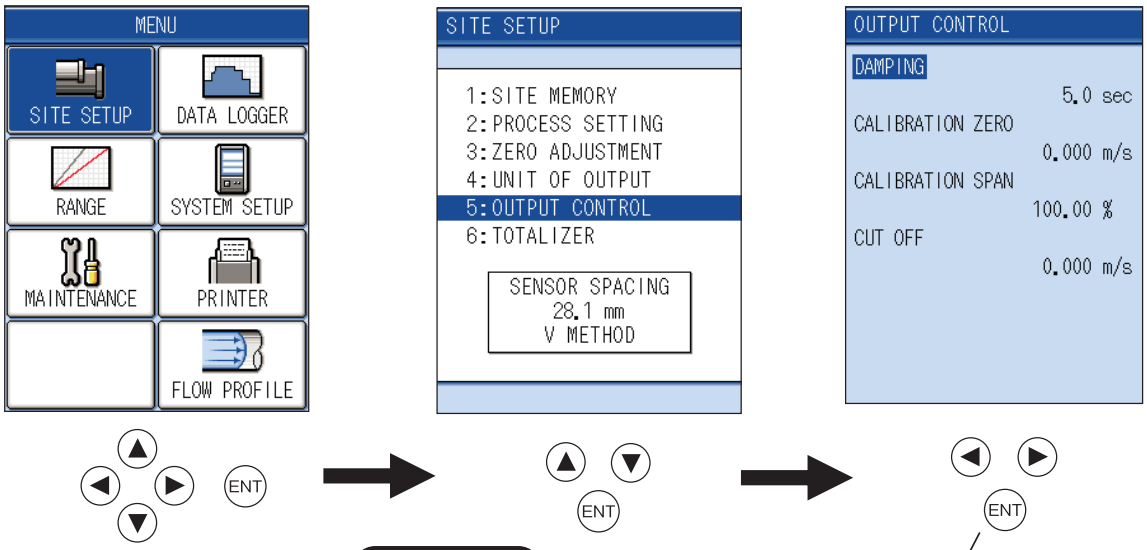


* "SET ZERO" should be performed in a situation where the flow is stopped, and "CLEAR" cancels adjustment.

CAUTION!

When PROCESS SETTING (ex. From NORMAL MODE to ANTI-DISTURBANCE MODE) is changed, make sure to perform zero adjustment (See page 94 in the Instruction Manual for details).

(3) Adjustment of indication fluctuation and CUT OFF

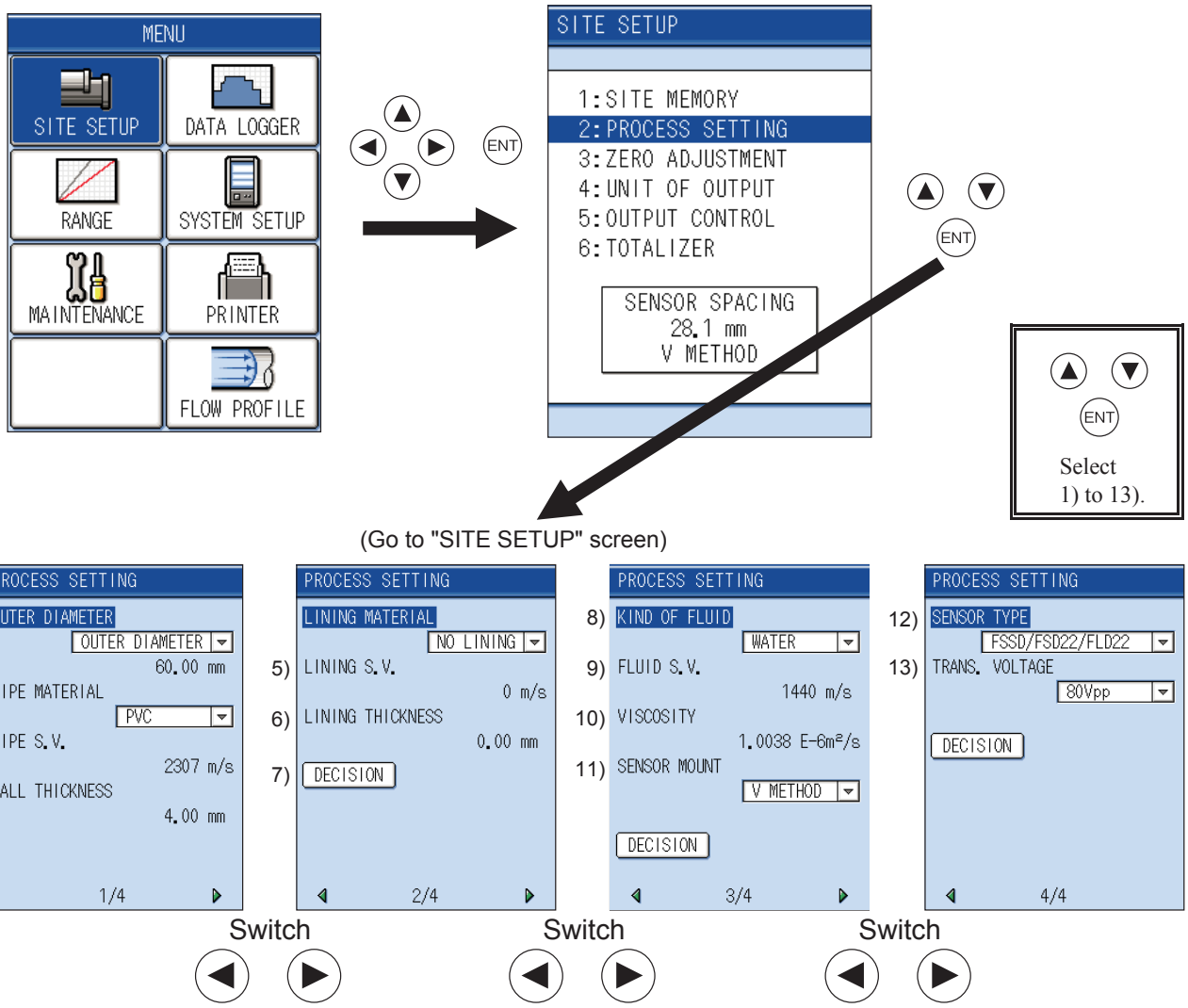


CAUTION!

* Output calibration
If this value is changed, output shifts according to the change.
For example, if 0.0% is set to SPAN, instantaneous flow rate does not change as 0.0.

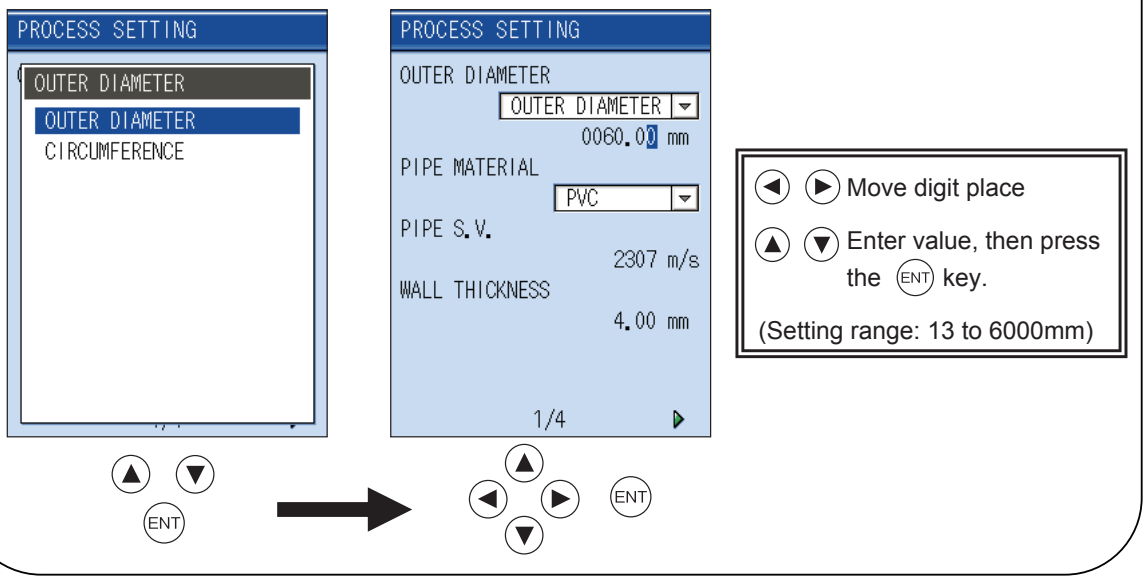
Indication fluctuation → NORMAL, DAMPING 3.0 to 5.0 sec.
Output calibration → NORMAL, CALIBRATION ZERO: 0.000m/s, CALIBRATION SPAN: 100.00%.
CUT OFF → NORMAL, 0.010 to 0.030m/s.

2. From "Input of piping specifications" to "Mounting of sensor"

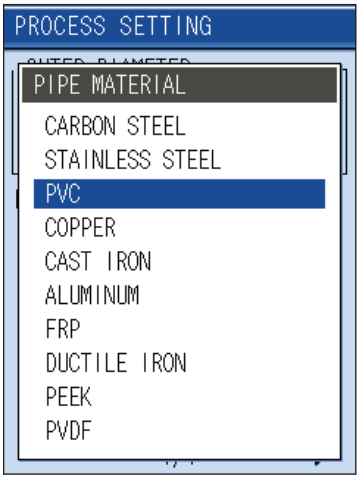


1) OUTER DIAMETER of piping

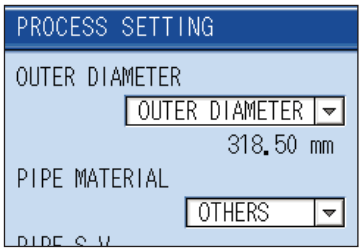
… Select OUTER DIAMETER or CIRCUMFERENCE, and input its dimension.



2) PIPE MATERIAL



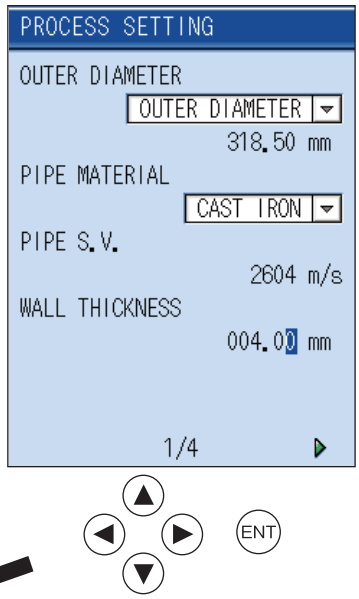
3) PIPE SOUND VELOCITY



If set PIPE MATERIAL to "OTHERS", enter the value to "PIPE S.V.".

(Setting range: 1000 to 3700m/s)

4) WALL THICKNESS

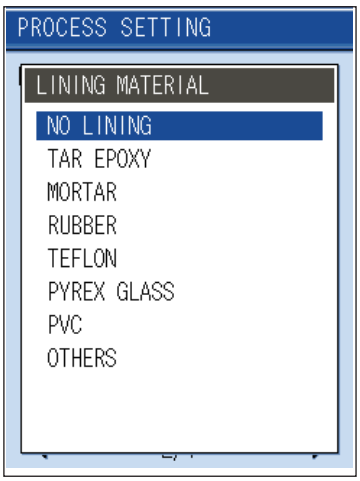


(Setting range: 0.01 to 100.00mm)

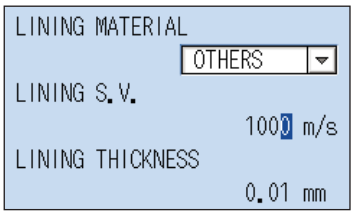
◀ ▶ Move a digit place

▲ ▼ Enter a value, then press the ENT key.

5) LINING MATERIAL



6) LINING SOUND VELOCITY



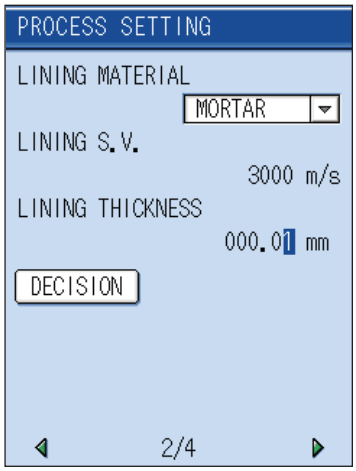
If set PIPE MATERIAL to "OTHERS", enter the value to "LINING S.V.".

(Setting range: 1000 to 3700m/s)

◀ ▶ Move a digit place

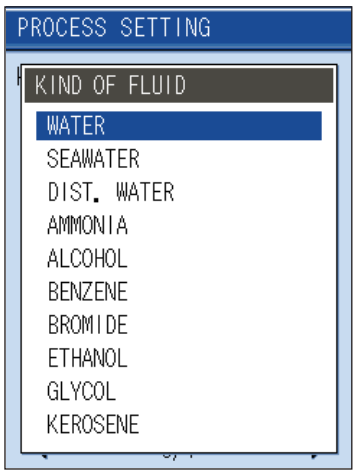
▲ ▼ Enter a value, then press the ENT key.

7) LINING THICKNESS

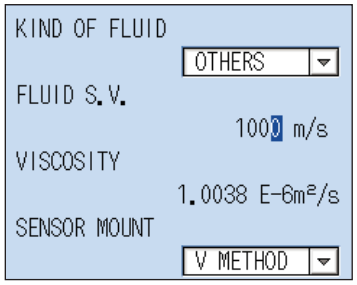


(Setting range: 0.01 to 100.00mm)

8) KIND OF FLUID



9) FLUID SOUND VELOCITY



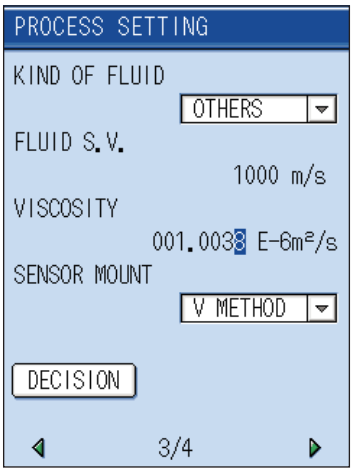
If set "OTHERS" to KIND OF FLUID, enter the value to "FLUID S.V.".

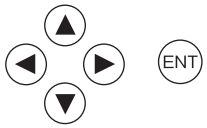
(Setting range: 500 to 2500m/s)

◀ ▶ Move a digit place

▲ ▼ Enter a value, then press the ENT key.

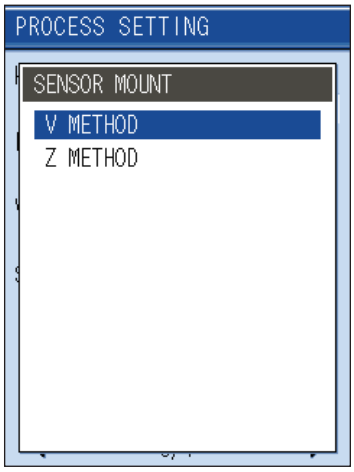
10) VISCOSITY





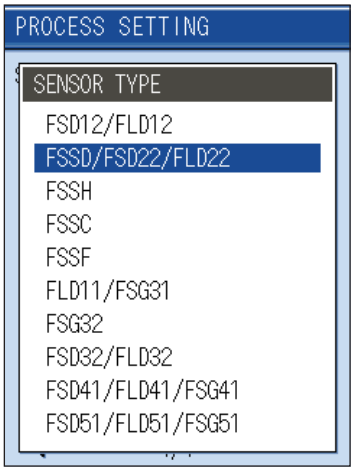
(Setting range: 0.001 × 10^{-6} to 999.999 × 10^{-6})

11) SENSOR MOUNT

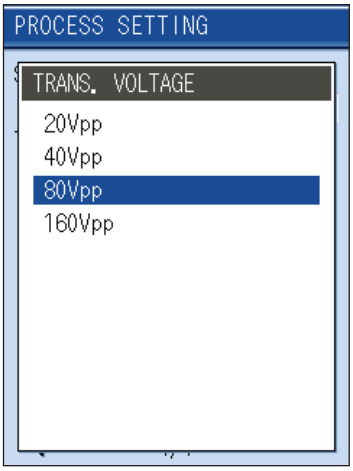


Select V method generally.
Select Z method for the following cases.
· Not enough mounting space
· High turbidity
· Weak wave receiving
· Thick scale inside a pipe

12) KIND OF SENSOR



13) TRANSMISSION VOLTAGE



Raise the transmission voltage so that 2 or more indicators turn on.
Set 40 or 80Vpp for general use.

14) DISPLAY OF MOUNTING DIMENSIONS

After you finish the site setting on establish site screen, "Decision" is reversed from white to blue by pressing ENT key.

Display the message "After sensor installation, please adjust "Zero point", turn back to "SITE SETUP" screen.

At the last line the "SENSOR SPACING" value is display. Install the sensor according to the mounting dimension is as displayed on the last time.

Reference "Data of various fluids"

* Sound velocity and density various fluids

Name of liquid	T°C	ρg/cm³	Vm/s
Acetone	20	0.7905	1190
Aniline	20	1.0216	1659
Alcohol	20	0.7893	1168
Ether	20	0.7135	1006
Ethylene glycol	20	1.1131	1666
n-octane	20	0.7021	1192
o-xylene	20	0.871	1360
Chloroform	20	1.4870	1001
Chlorobenzene	20	1.1042	1289
Glycerin	20	1.2613	1923
Acetic acid	20	1.0495	1159
Methyl acetate	20	0.928	1181
Ethyl acetate	20	0.900	1164
Cyclohexane	20	0.779	1284
Dithionic acid	20	1.033	1389
Heavy water	20	1.1053	1388
Carbon tetrachloride	20	1.5942	938
Mercury	20	13.5955	1451
Nitrobenzene	20	1.207	1473
Carbon disulfide	20	1.2634	1158
Chloroform	20	2.8904	931
n-propyl alcohol	20	0.8045	1225
n-pentane	20	0.6260	1032
n-hexane	20	0.654	1083
Light oil	25	0.81	1324
Transformer oil	32.5	0.859	1425
Spindle oil	32	0.905	1342
Petroleum	34	0.825	1295
Gasoline	34	0.803	1250
Water	13.5	1.	1460
Sea water (salinity: 3.5%)	16	1.	1510

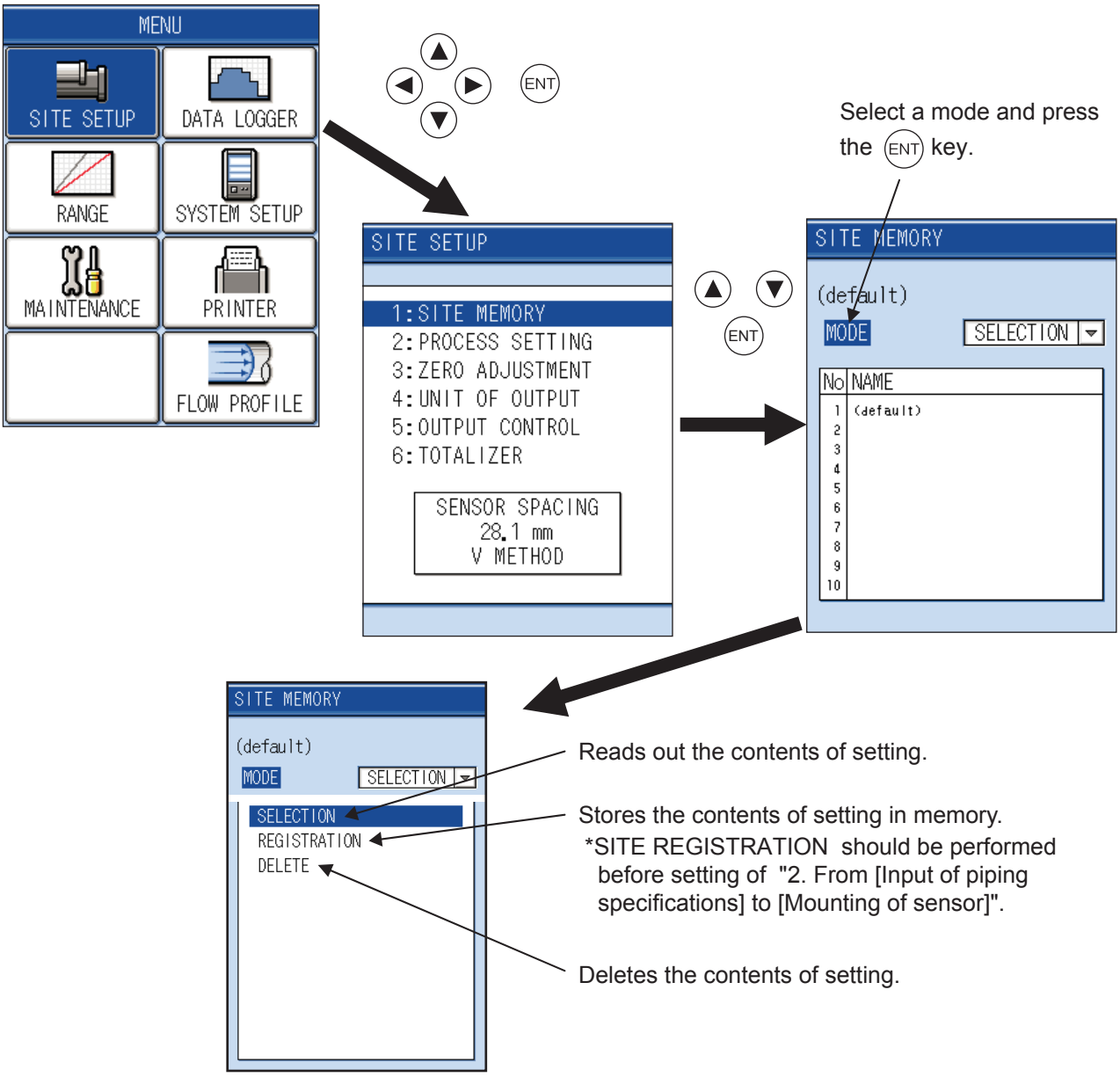
* Sound velocity per piping material

Material	Vm/s
Steel	3000
Ductile cast iron	3000
Cast iron	2604
Stainless steel	3141
Copper	2260
Lead	2170
Aluminum	3080
Brass	2050
Vinylchloride	2307
Acrylics	2644
FRP	2505
Mortar	3000
Tar epoxy	2505
Polyethylene	1900
Teflon	1240
Rubber	1510
Ryrex glass	3280

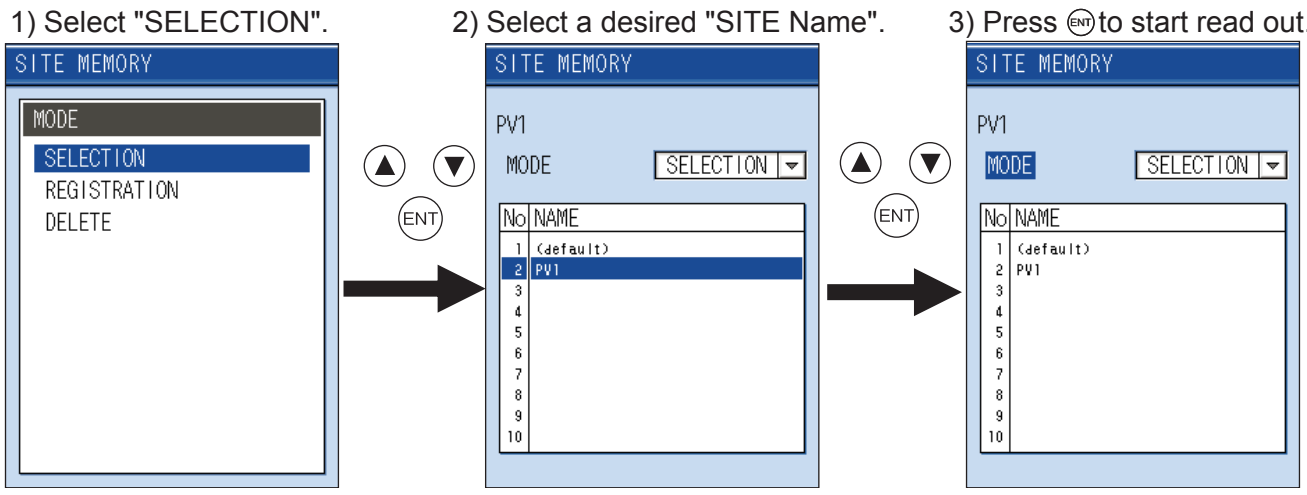
* Dynamic viscosity coefficient of various fluids

Name of liquid	T°C	ρg/cm³	Vm/s	v (×10⁻⁶m²/s)
Acetone	20	0.7905	1190	0.407
Aniline	20	1.0216	1659	1.762
Ether	20	0.7135	1006	0.336
Ethylene glycol	20	1.1131	1666	21.112
Chloroform	20	1.4870	1001	0.383
Glycerin	20	1.2613	1923	1188.5
Acetic acid	20	1.0495	1159	1.162
Methyl acetate	20	0.928	1181	0.411
Ethyl acetate	20	0.900	1164	0.499
Heavy water	20	1.1053	1388	1.129
Carbon tetrachloride	20	1.5942	938	0.608
Mercury	20	13.5955	1451	0.114
Nitrobenzene	20	1.207	1473	1.665
Carbon disulfide	20	1.2634	1158	0.290
n-pentane	20	0.6260	1032	0.366
n-hexane	20	0.654	1083	0.489
Spindle oil	32	0.905	1324	15.7
Gasoline	34	0.803	1250	0.4 to 0.5
Water	13.5	1.	1460	1.004(20°C)

3. How to register and read out set data

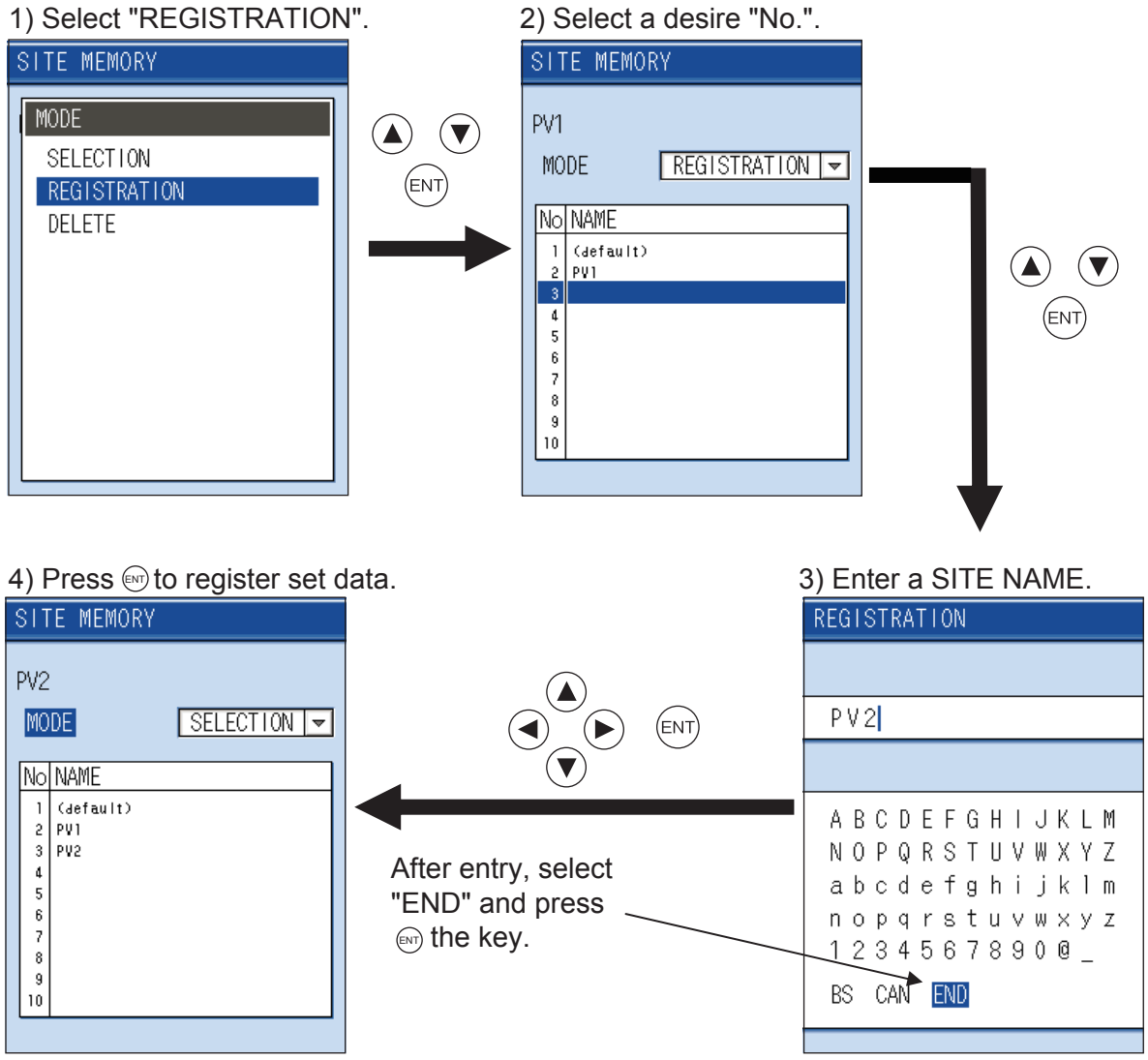


(1) How to read out set data from SITE MEMORY

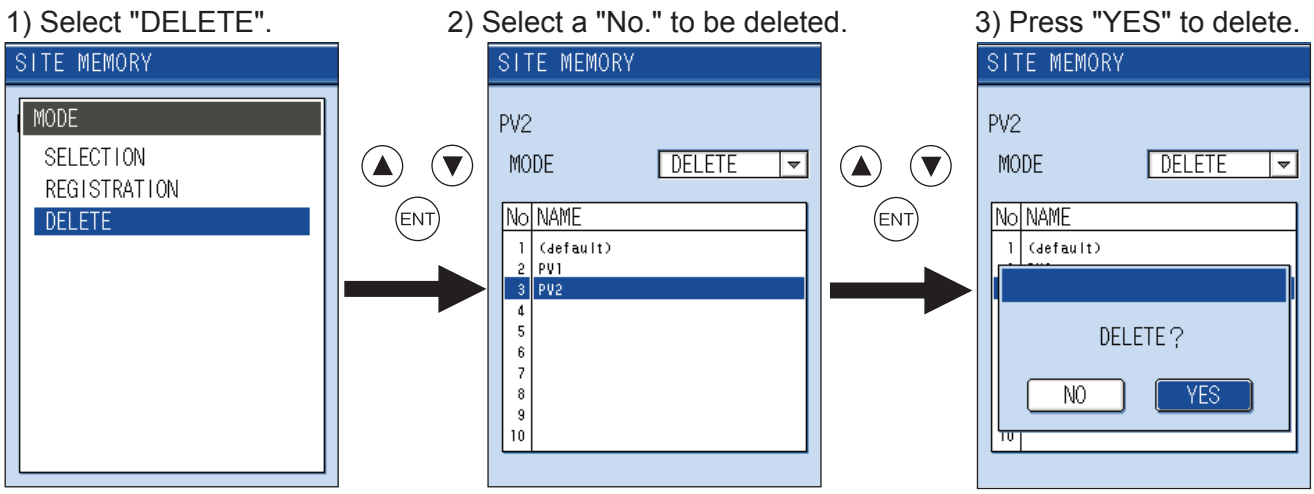


(2) How to register site data to the memory

* SITE REGISTRATION should be performed before setting of "2. From [Input of piping specifications] to [Mounting of sensor]".



(3) How to delete set data from SITE MEMORY

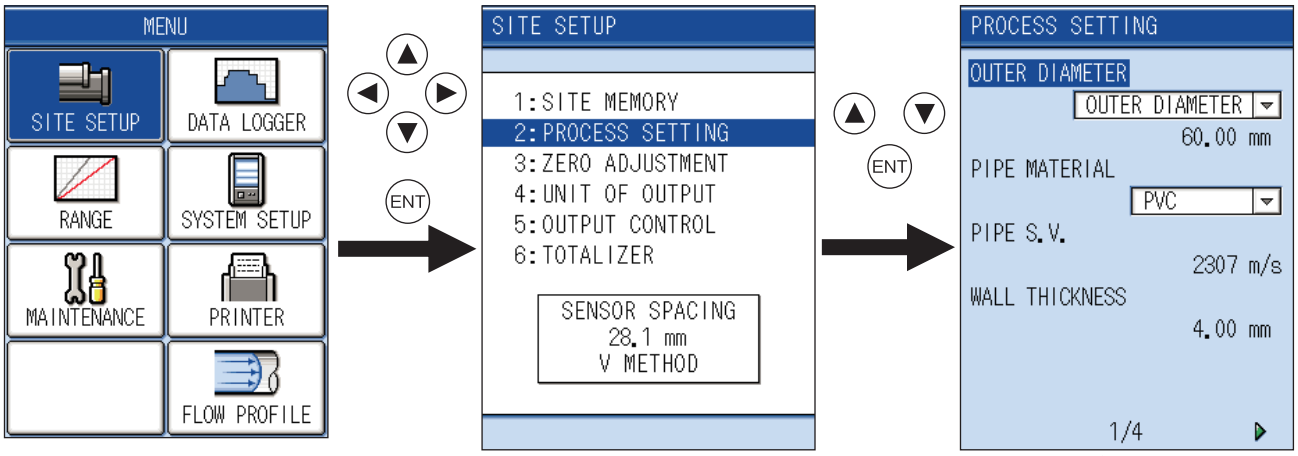


4. Measurement of fluid which sound velocity is unknown

1) Select "SITE SETUP" from "MENU".

2) Select "PROCESS SETTING".

3) Set each item.



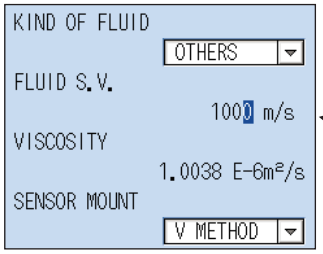
Refer to the section "Input procedure of PIPE PARAMETER" for details.

4) Measurement of unknown fluid

Set the sound velocity and dynamic viscosity coefficient of approximate fluid (soluble fluid is water) provisionally. (Refer to "Data of various fluids" in page 8)

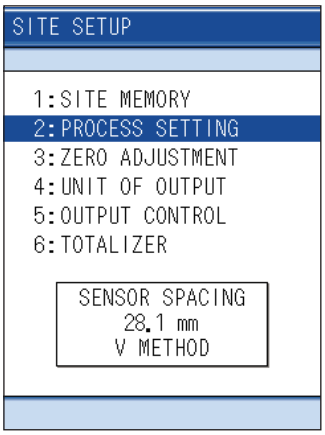
If sound velocity is unclear, set the sound velocity provisionally within the range between 500 to 2500m/s in a staircase pattern.

2500(×0.84)→2100(×0.84)…in the same way→1764→1482→1245→1046→878→738→620→521m/s



For example, when acetic acid concentration is 60%, enter the sound velocity (1159m/s) and dynamic velocity coefficient (1.162 ($\times 10^{-6}m^2/s$)) according to the "Data of various fluids" in page 8.

5) Sensor mounting

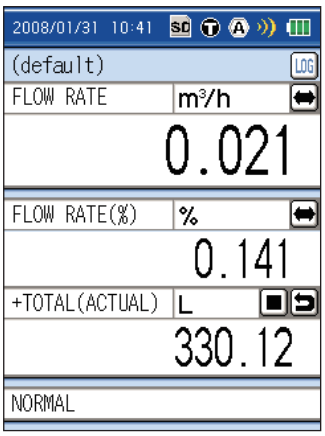


After PIPE PARAMETER input, check dimension and then mount a sensor.

Φ50: 1mm difference is approx. 1% error

Φ500:1mm difference is approx. 0.1% error.

6) Check of receiving signal strength and status display



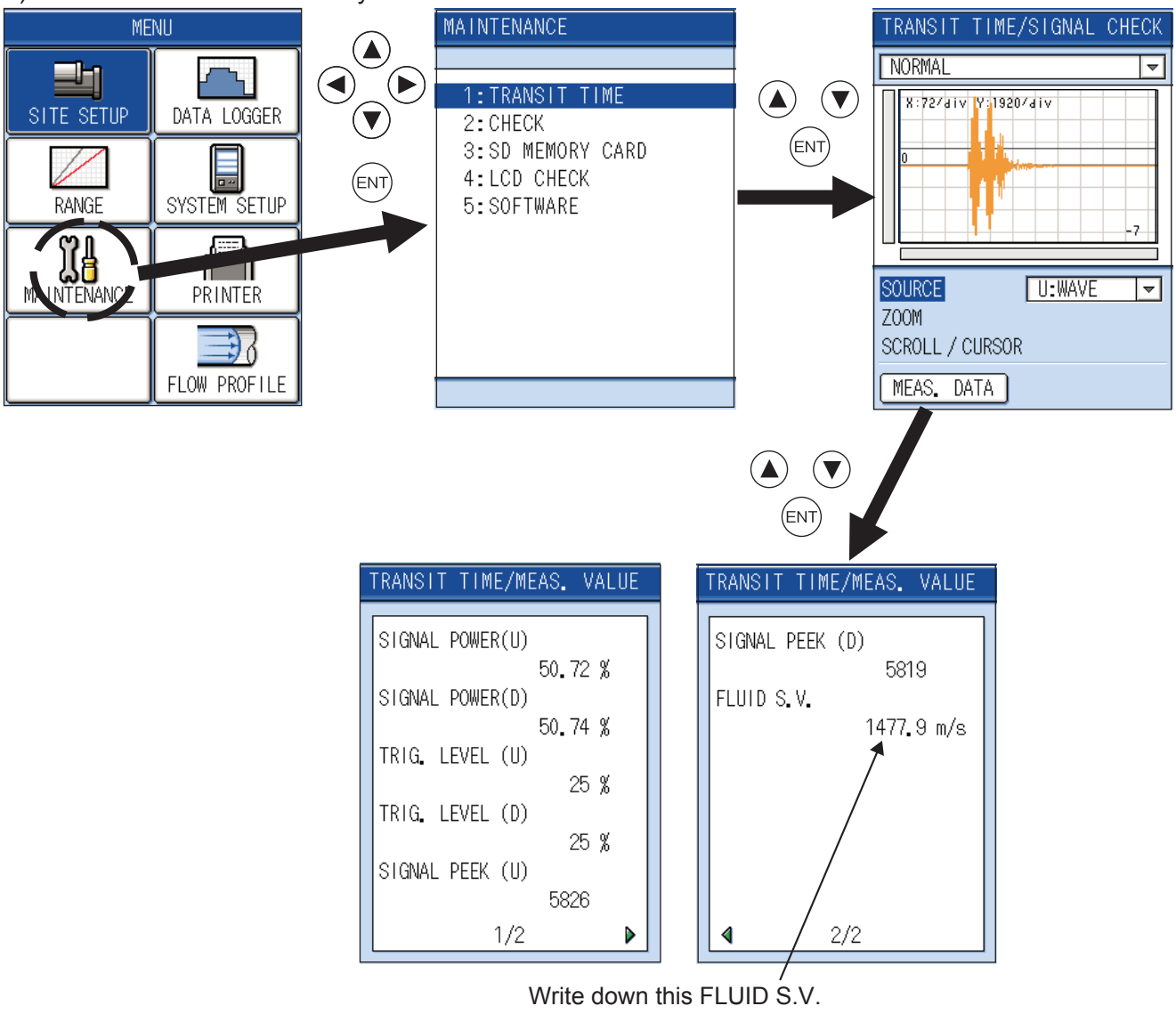
If the following errors occur, repeat the procedure 4) and 5) until "NORMAL" is displayed.

· No received signal

· Window scanning

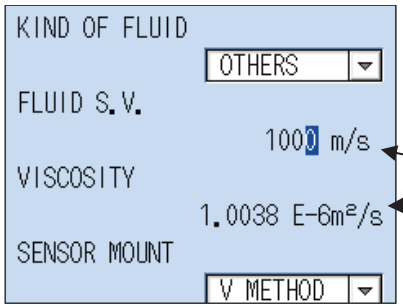
· Received signal is over flow is displayed,

7) Check of fluid sound velocity



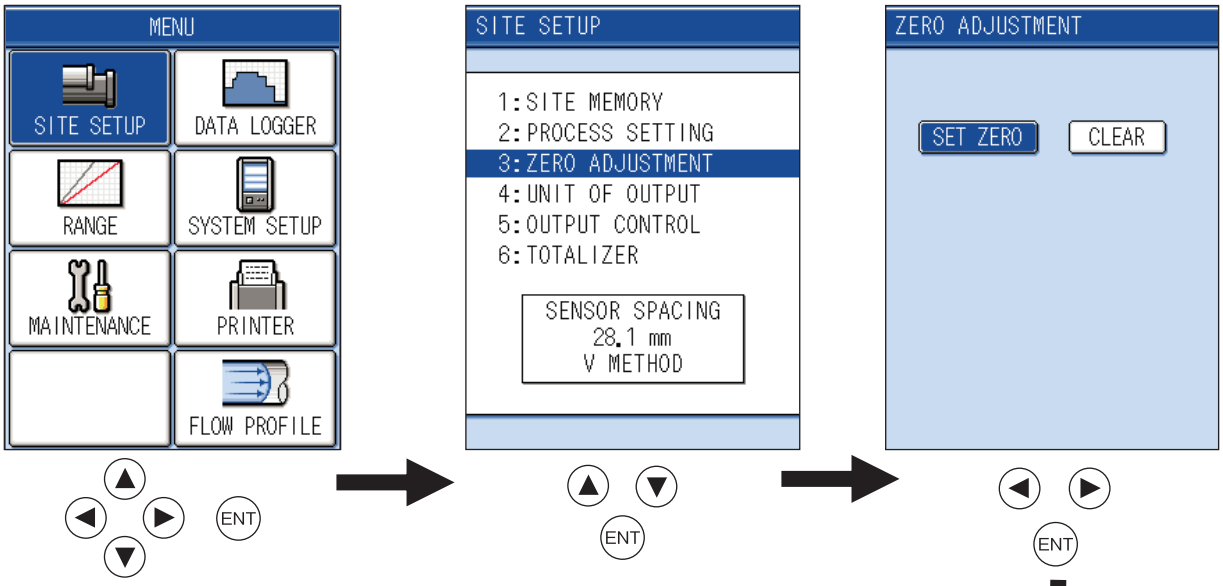
Write down this FLUID S.V.

8) Set the "S.V." and "VISCOSITY" of unknown fluid



Enter the FLUID S.V. written down in the procedure 7) to the FLUID V.S. in the PROCESS SETTING screen.
Set the dynamic viscosity coefficient of unknown fluid and approximate fluid according to "Data of various fluids" in page 8.
(Note that it is not an actually-measured dynamic viscosity coefficient of fluid)

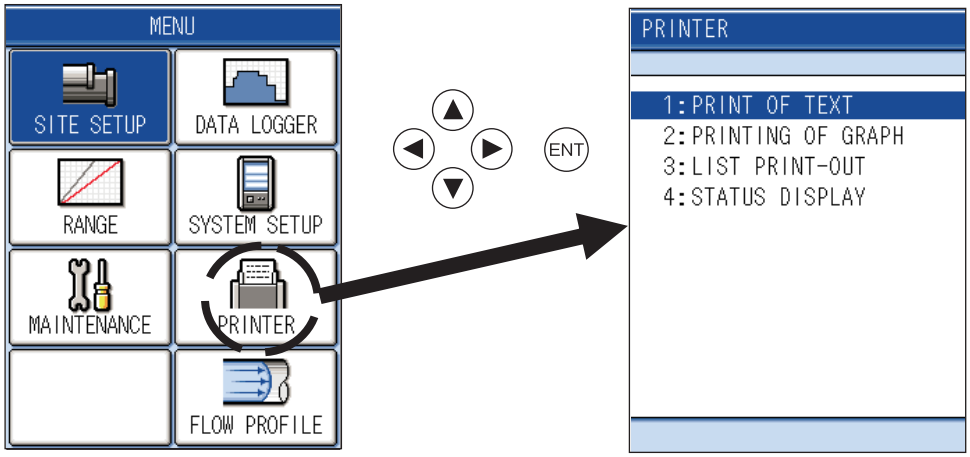
9) Perform zero adjustment in a situation where the flow is stopped.



CAUTION!

Measurement accuracy will be closed to "the sound velocity of known fluid accuracy", because the fluid sound velocity is input correctly. However, the accuracy of dynamic viscosity coefficient will be lowered for an approximate value.

5. Printing mode selection (optional)

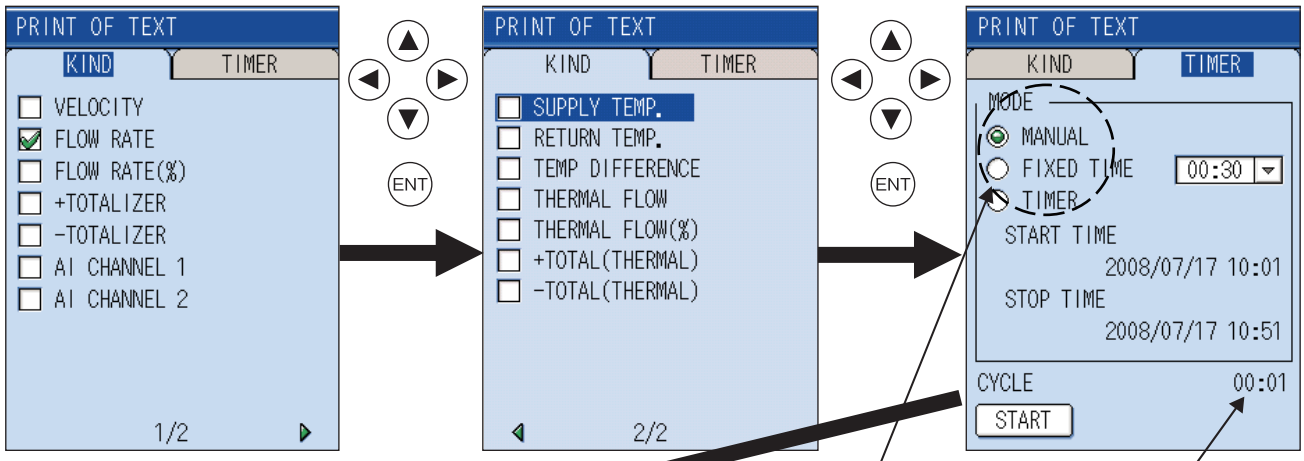


1: Printing of text → Prints text data for selected KIND in industrial value.

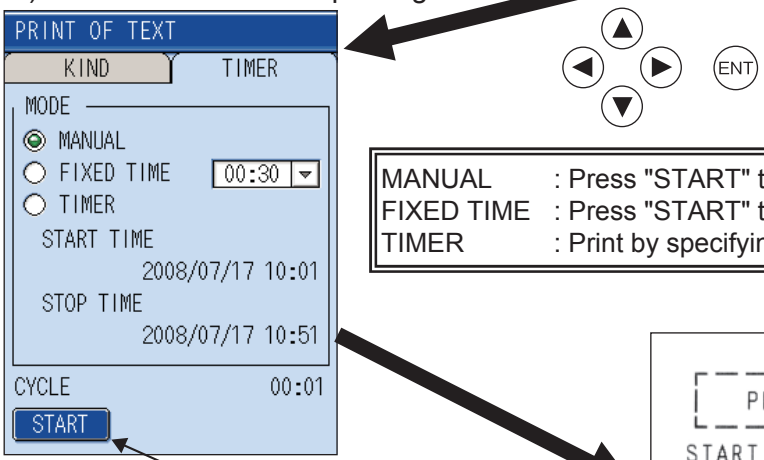
1) Check the box of desired item.

2) Check the box of desired item.

3) Set a TIMER MODE and CYCLE.



4) Press START to start printing.

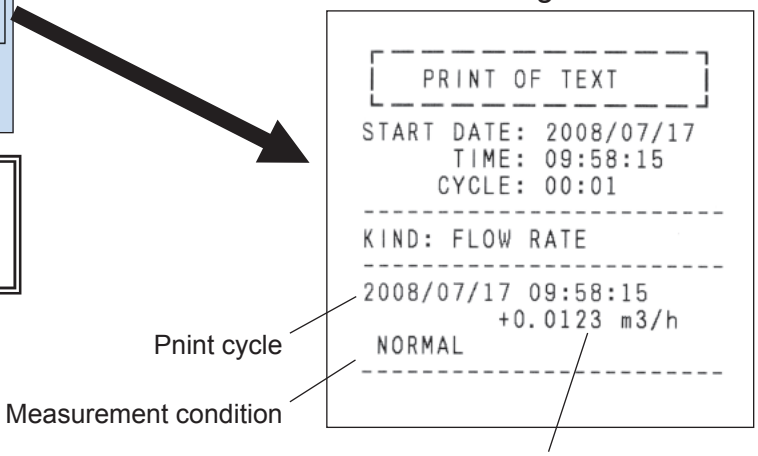


Setting range: 1min. to 24hrs.

MANUAL	: Press "START" to start printing.
FIXED TIME	: Press "START" to perform printing during selected time.
TIMER	: Print by specifying START TIME, STOP TIME, and CYCLE.

When start printing, "START" button will change to "STOP".

Printing of text



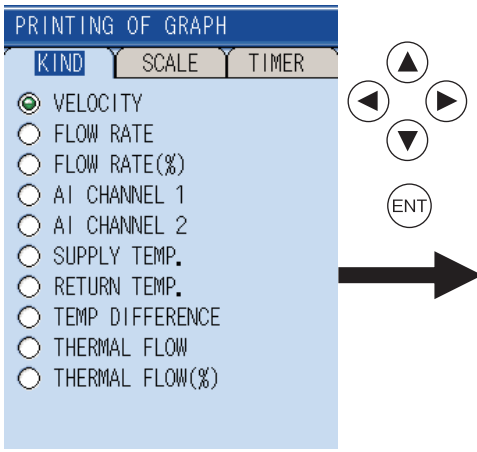
Pnint cycle

Measurement condition

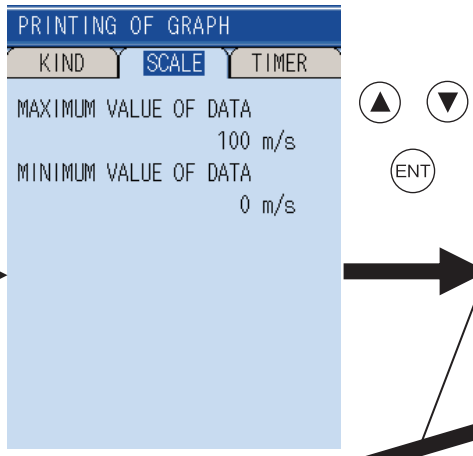
Selected type

2: Printing of graph→ Print data for selected KIND in graph.

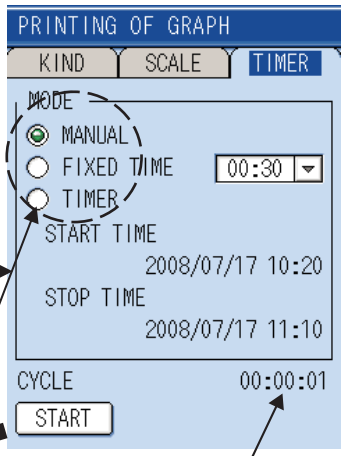
1) Check the box of desired item.



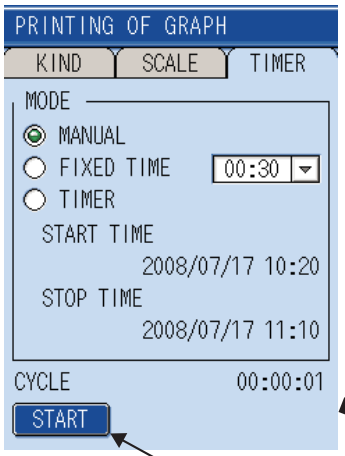
2) Set the min/max value.



3) Set a TIMER MODE and CYCLE.



4) Press START to start printing.

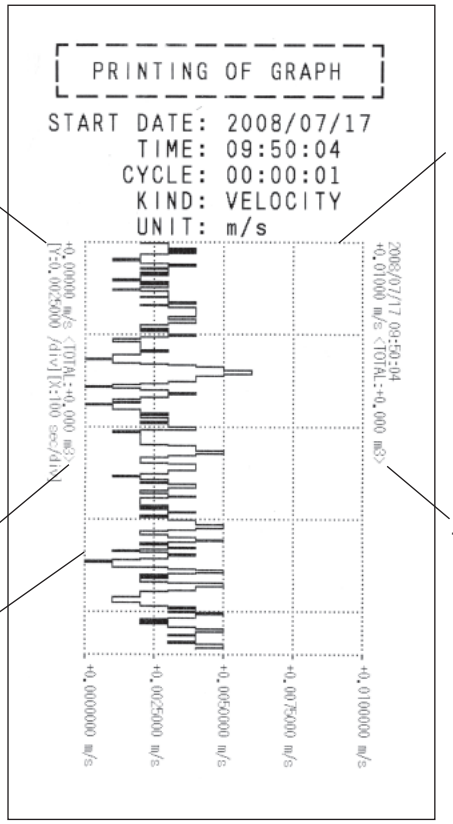


Setting range: 1sec. to 24hrs.

MANUAL : Press "START" to start printing.
FIXED TIME: Press "START" to perform printing during selected time.
TIMER : Print by specifying START TIME, STOP TIME, and CYCLE.

When start printing, "START" button will change to "STOP".

Printing of text



Glancing piling interval

Yaxis

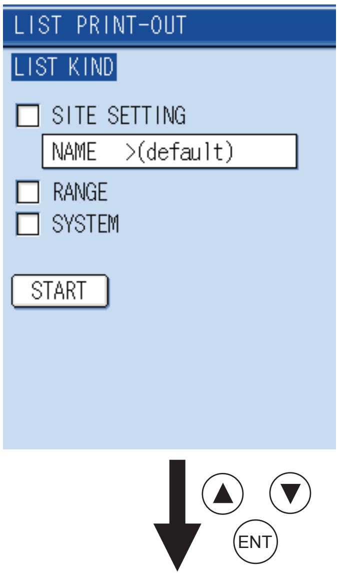
- Flow rate total

+ Flow rate total

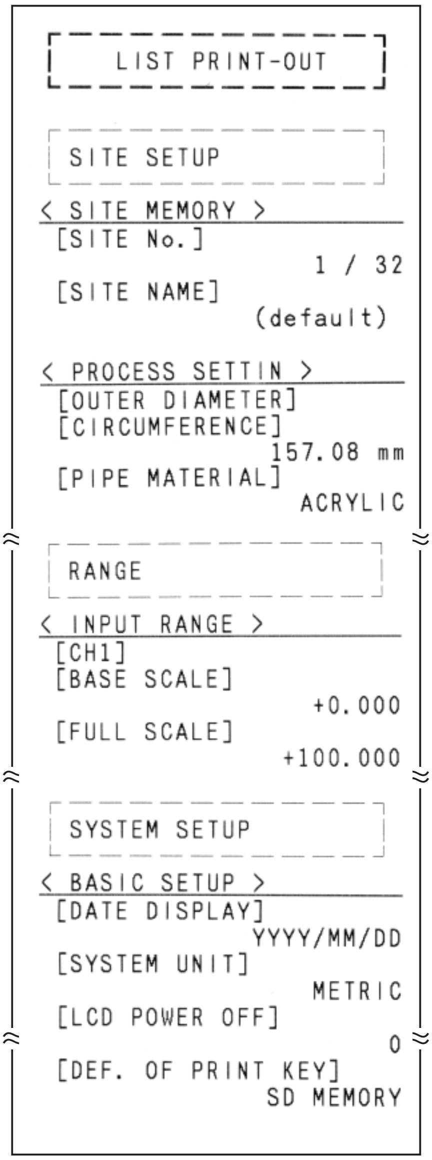
X axis

3: Printing of list → Print a selected list.

Select a "LIST KIND" and press START.

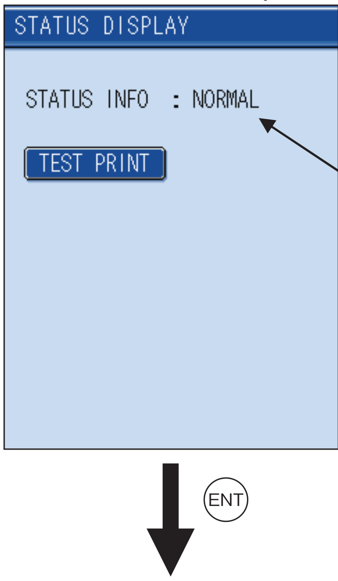


Example of printing list



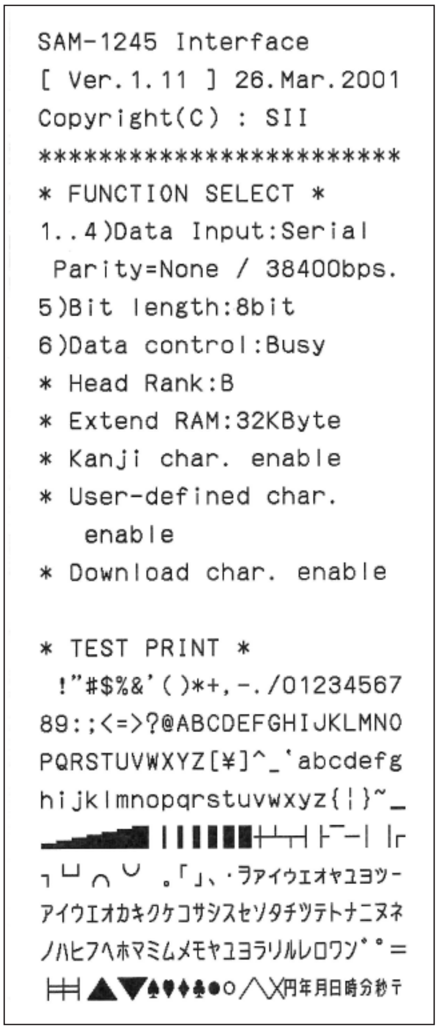
```
LIST PRINT-OUT

SITE SETUP
< SITE MEMORY >
[SITE No.]
                    1 / 32
[SITE NAME]
                 (default)

< PROCESS SETTIN >
[OUTER DIAMETER]
[CIRCUMFERENCE]
               157.08 mm
[PIPE MATERIAL]
                  ACRYLIC

RANGE
< INPUT RANGE >
[CH1]
[BASE SCALE]
                   +0.000
[FULL SCALE]
                 +100.000

SYSTEM SETUP
< BASIC SETUP >
[DATE DISPLAY]
               YYYY/MM/DD
[SYSTEM UNIT]
                   METRIC
[LCD POWER OFF]
                        0
[DEF. OF PRINT KEY]
                SD MEMORY
```

4: STATUS DISPLAY → Display the status of printer and perform test printing.



Status display of the printer

Test print



```
SAM-1245 Interface
[ Ver.1.11 ] 26.Mar.2001
Copyright(C) : SII
************************
* FUNCTION SELECT *
1..4)Data Input:Serial
 Parity=None / 38400bps.
5)Bit length:8bit
6)Data control:Busy
* Head Rank:B
* Extend RAM:32KByte
* Kanji char. enable
* User-defined char.
   enable
* Download char. enable

* TEST PRINT *
 !"#$%&'()*+,-./01234567
89:;<=>?@ABCDEFGHIJKLMNO
PQRSTUVWXYZ[¥]^_'abcdefg
hijklmnopqrstuvwxyz{¦}~_
。「」、・ヲァィゥェォャュョッー
アイウエオカキクケコサシスセソタチツテトナニヌネ
ノハヒフヘホマミムメモヤユヨラリルレロワン゛゜=
```

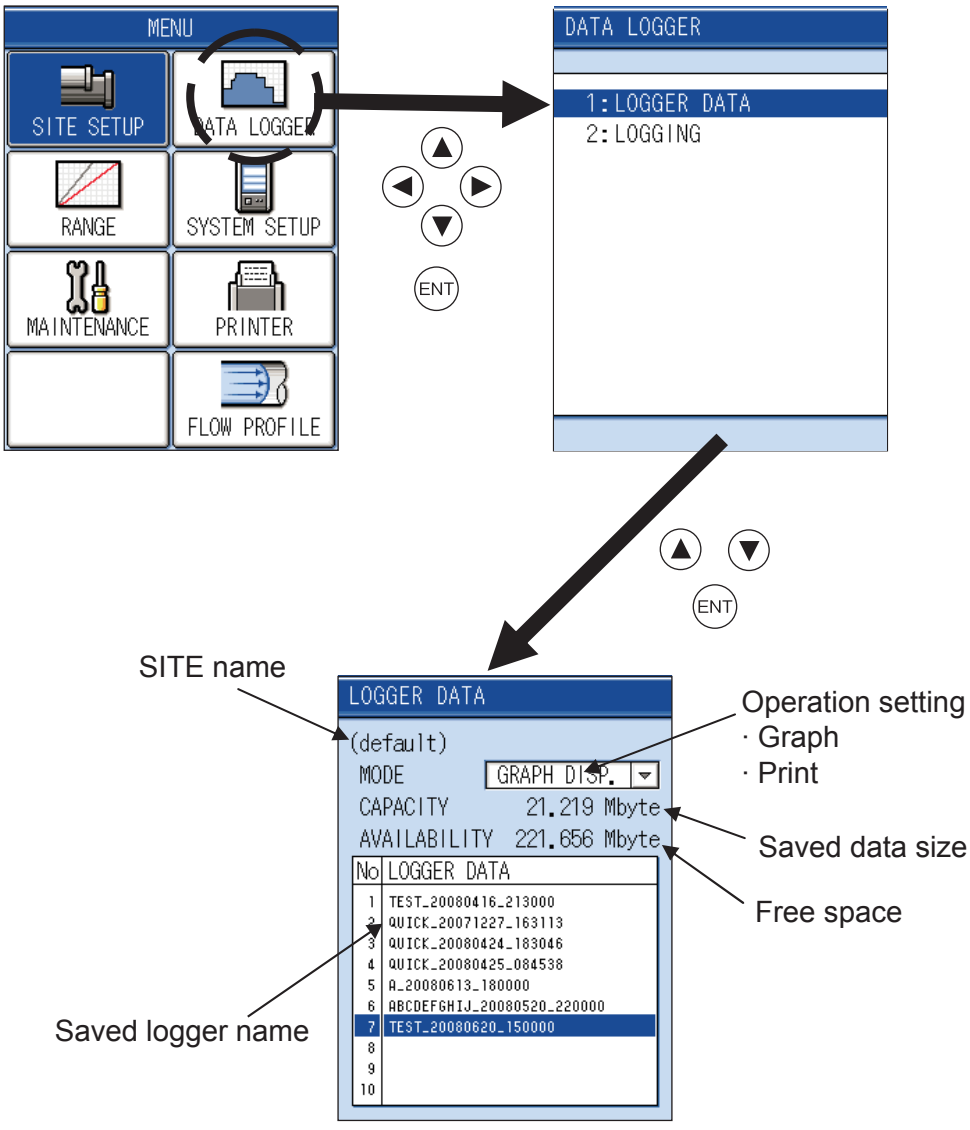
6. Data logger setting

Logging (recording) function setting …This function allows you to display or print out saved data after measurement.

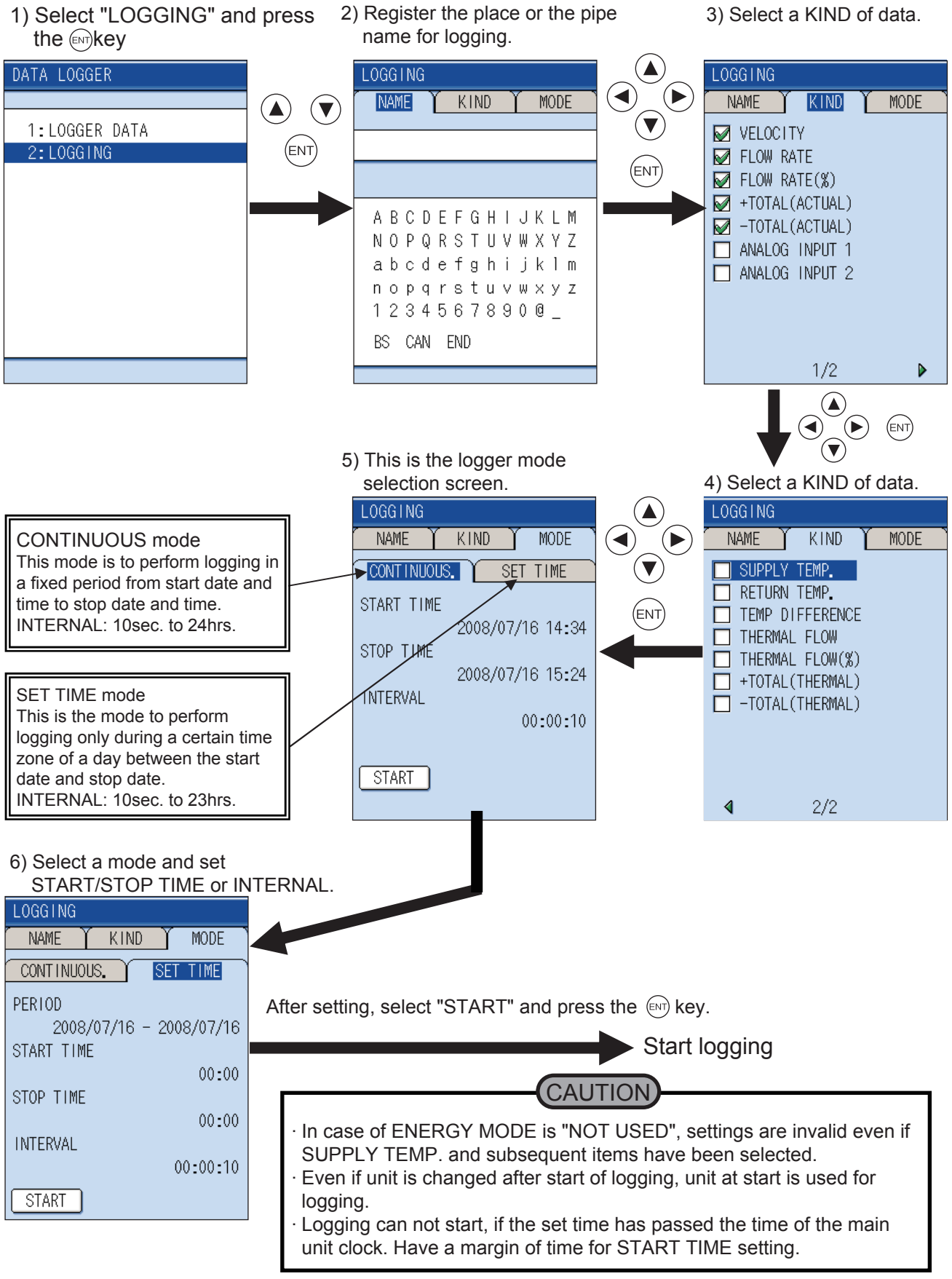
CAUTION

SD card is required to set the logging function.

Recording capacity … SD card (256MB): data for approx. a year can be saved, if saving cycle is 30sec. and data being saved is 14 types.



(1) Logging of measured data

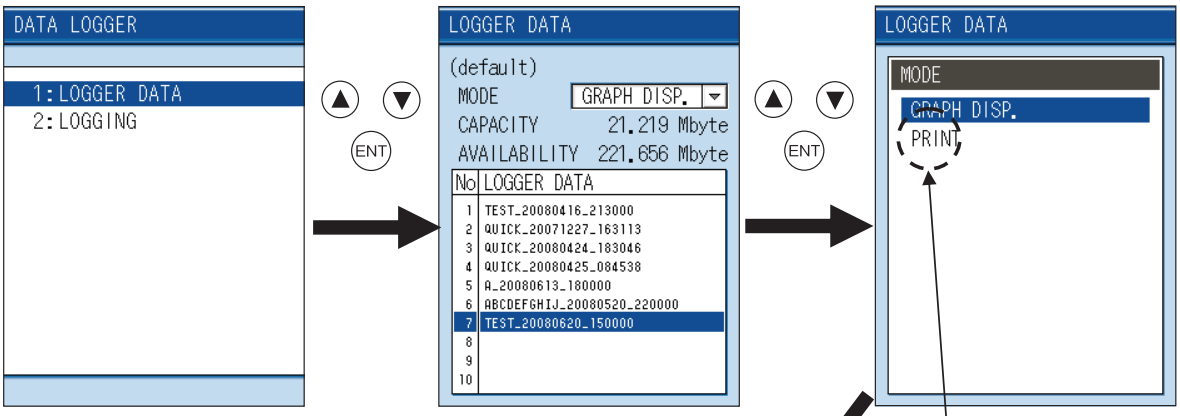


(2) Logged data checking and printing

1) Select "LOGGER DATA" and press the ENT key.

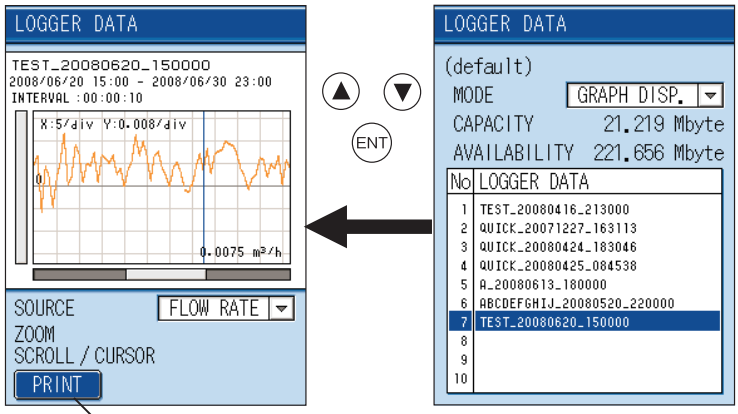
2) Select "MODE" and press the ENT key.

3) Select "GRAPH" and press the ENT key.

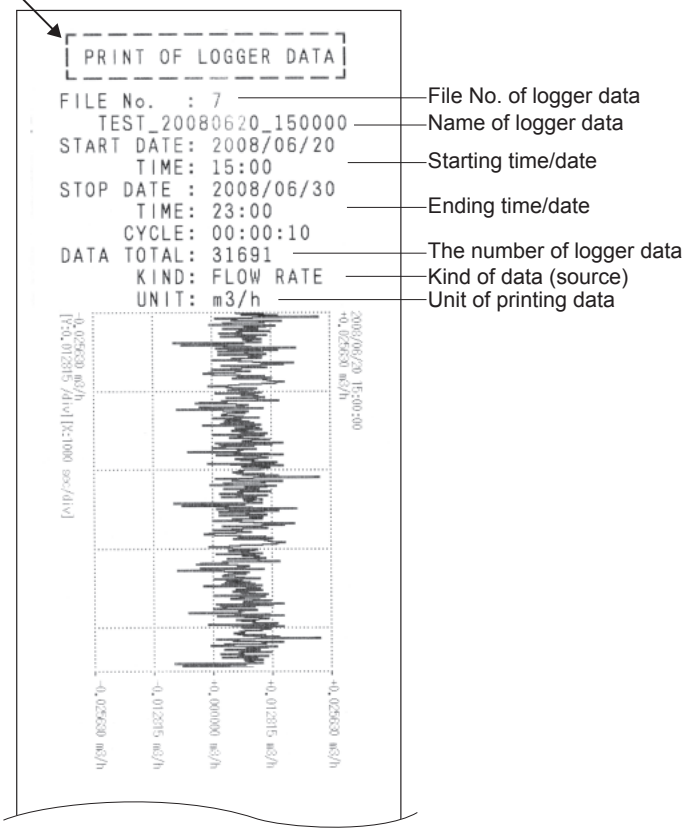


4) Select data to be check and press the ENT key.

5) Press "PRINT" to start printing.



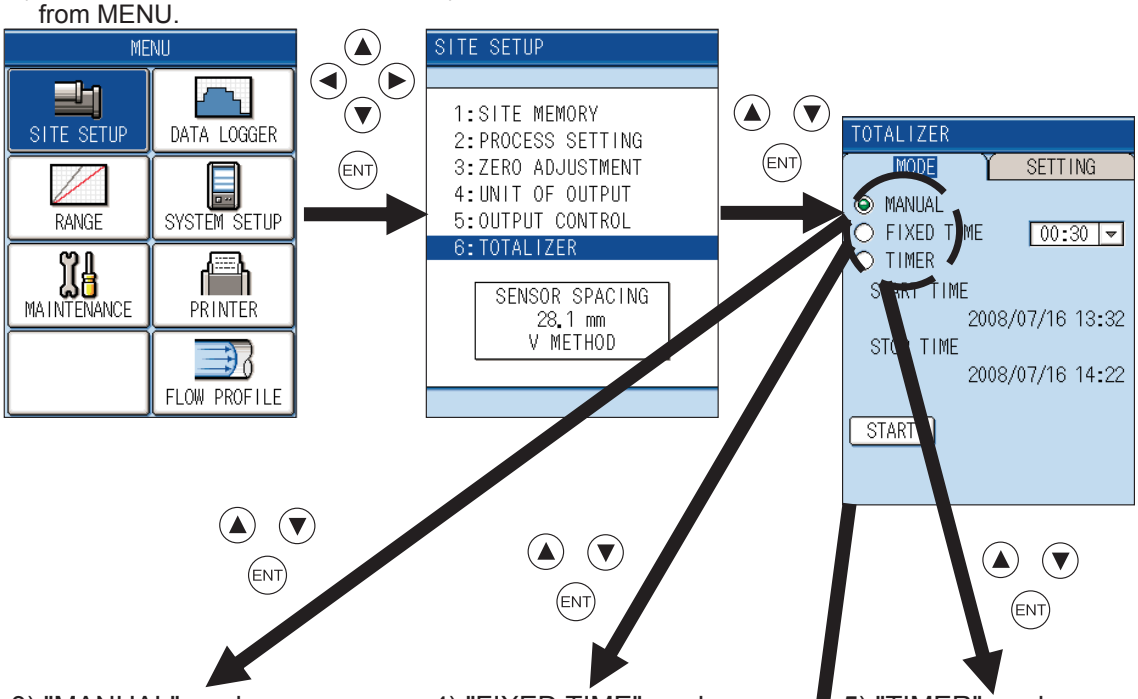
IF PRINT is selected, data is printed out in a text format. Refer to 10.2.4 (2) in the Instruction Manual.



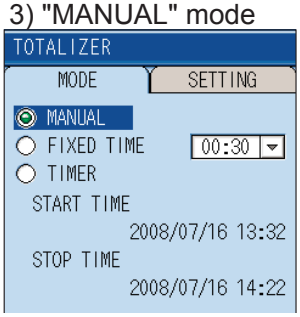
7. How to start and stop totalizing of flow rate

1) Select "SITE SET UP" from MENU.

2) Select "TOTALIZER".

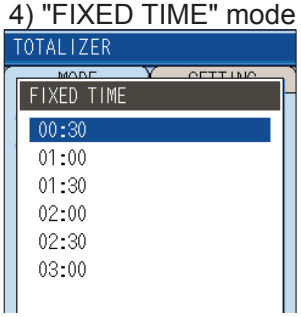


3) "MANUAL" mode



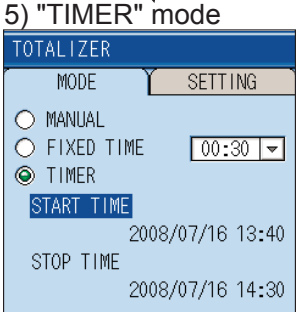
When press "START", totalizing will start, and operation continues until "STOP" is pressed.

4) "FIXED TIME" mode

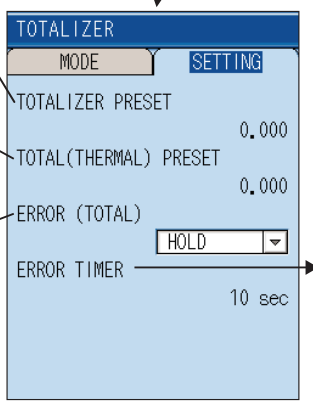


When press "START", totalizing will start. Totalizing is performed only during a selected period and stopped automatically.

5) "TIMER" mode



Set a time to start and to stop, and press "START" to start. Totalizing is performed during a set period.



Presets a flow rate total to restart totalizing. (Setting range: 0.000 to 9999999999)

Presets a total heat quantity to restart totalizing. (Setting range: 0.000 to 9999999999. Refer to 10.3.3 in the Instruction Manual for Energy Mode.)

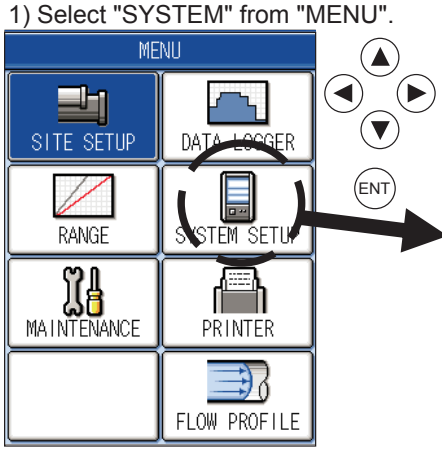
Sets a totalizing process at error occurrence on the measurement status.
HOLD → Stops totalizing.
NOT USED → Uses the flow rate before error occurrence.

Set a time from error occurrence to the start of error processing. (Setting range: 0 to 900sec.)

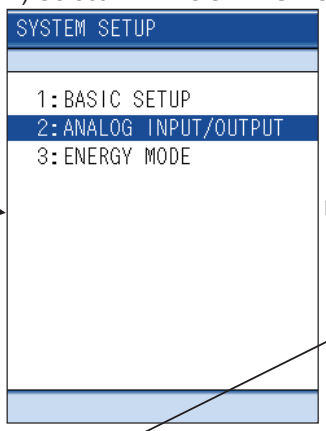
8. Analog input/output setting

(1) Basic set up

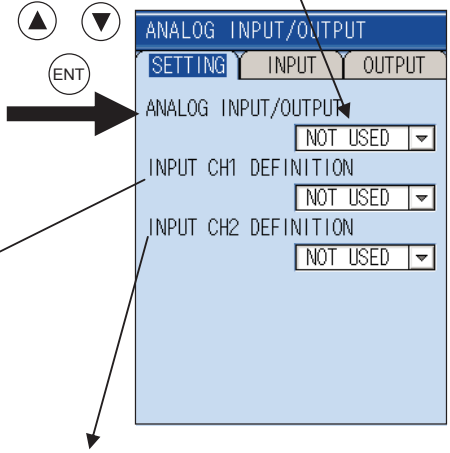
1) Select "SYSTEM" from "MENU".



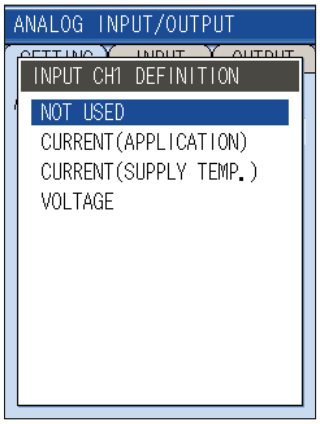
2) Select "ANALOG INPUT/OUTPUT".



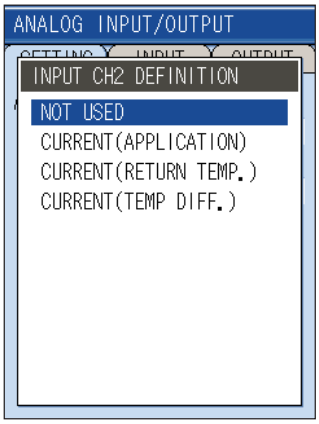
Select "USED" when you use analog input or output.



4) Select an INPUT CH1 DEFINITION.

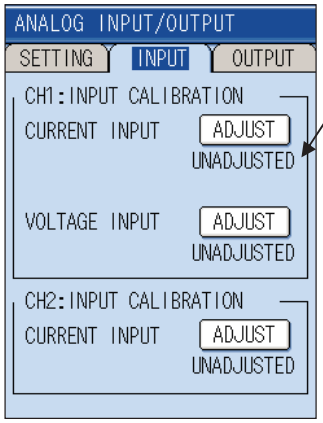


5) Select an INPUT CH2 DEFINITION.



(2) Input channel calibration

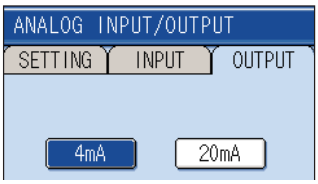
Perform zero/span calibration of input signals.
A current generator is required for calibration.



Display calibration status
Adjusted: Calibrated
Unadjusted: Not calibrated

(3) Output channel calibration

Perform zero/span calibration of output signals.
A current generator is required for calibration.

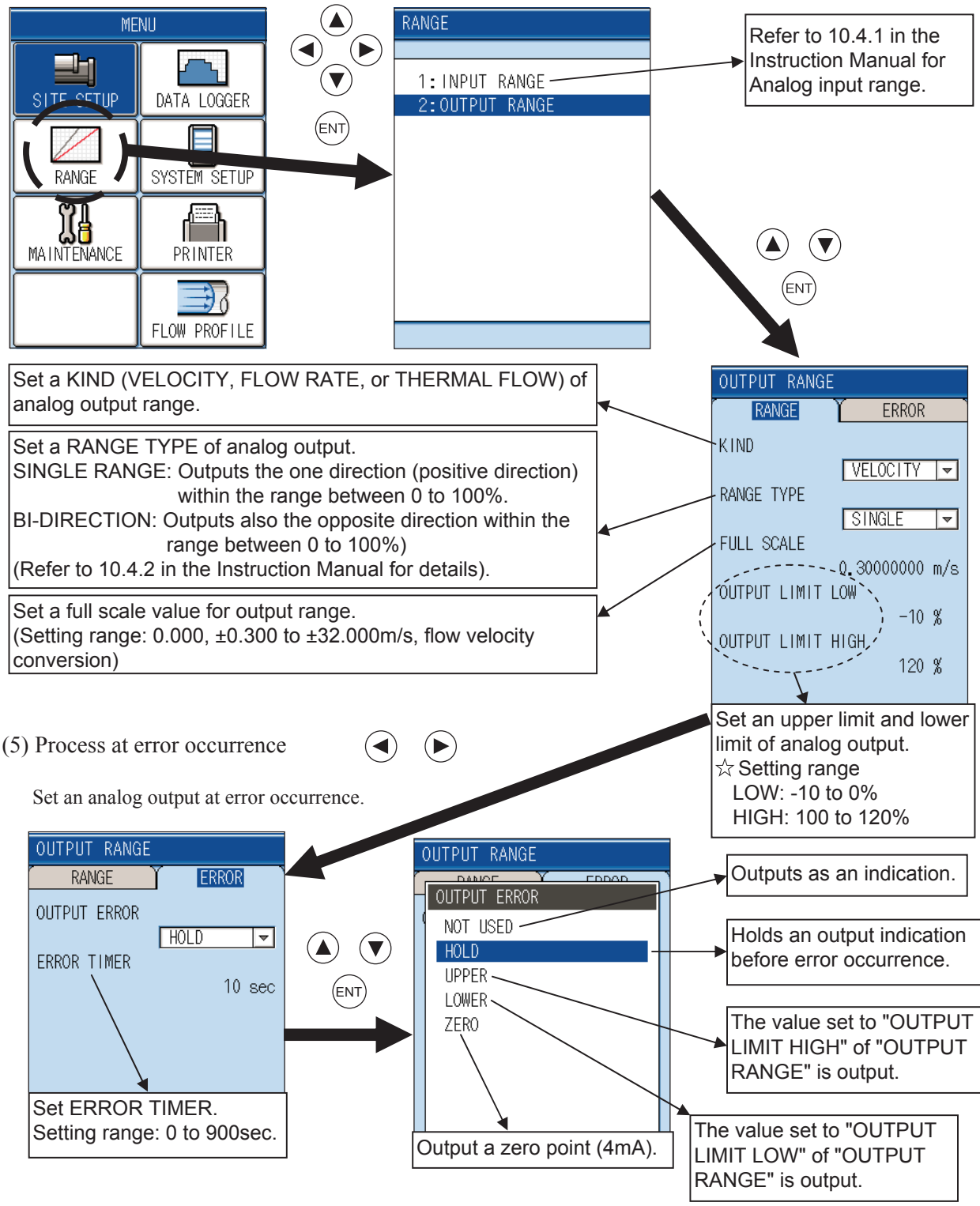


Select 4mA or 20mA.
↓
ENT Determine.
↓
Calibrate to 4mA or 20mA
↓
ENT Determine.

(4) Range setting

1) Select "RANGE" from "MENU".

2) Select "OUTPUT RANGE".

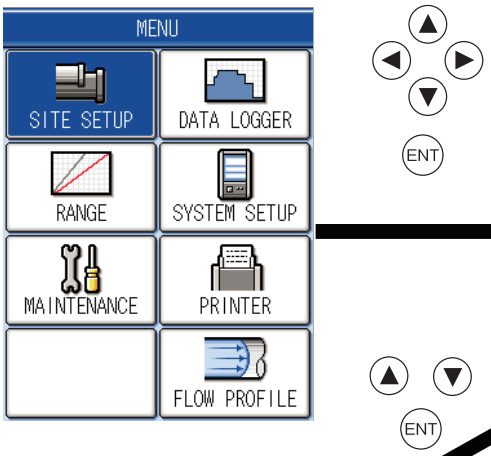


(5) Process at error occurrence

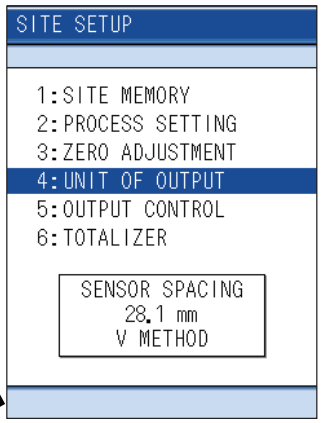
Set an analog output at error occurrence.

(6) Output unit setting

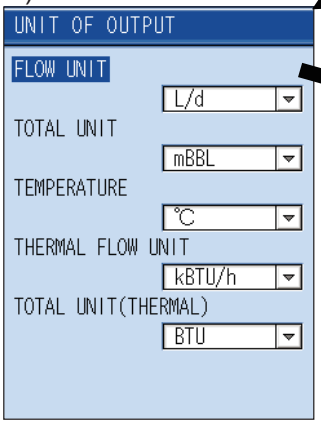
1) Select "SITE SETUP" from "MENU".



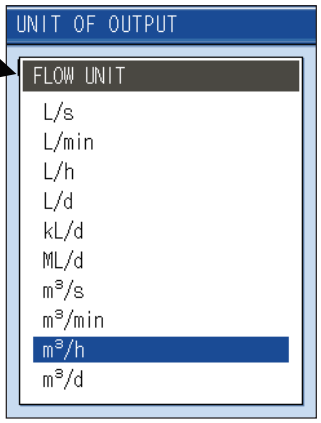
2) Select "UNIT OF OUTPUT".



3) Select a desired item.



4) Select a desired unit and press the ENT key.



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http://www.fujielectric.com/products/instruments/