

INSTRUCTION MANUAL

TF-4000 series

Thermal Mass Flowmeter

IM-ES779-0E DEC. 2003

Ver 3.4 2003.10.7 CRCcheck

This instruction manual is for TF-4000 Thermal Mass Flowmeter.

It is recommended to read through before installation and operation.

Web : Address

<http://www.tokyokeiso.co.jp>



1. NOTATION RULES

Safety symbols

This manual classifies safety notes using the following symbols:

WARNING

If this indication is disregarded and this instrument is operated incorrectly, serious injury or fatal accident may result.

CAUTION

If this indication is disregarded and this instrument is operated incorrectly, injury or property damage may result.

General information symbols

This operation manual classifies general information notes using the following symbols:

NOTES

Indicates procedures or information required to operate this product.

Reference

Indicates information that should be understood to enable this product to be operated safely and comfortably.

(-POO)

The indicated page contains information other than notes that should be referenced.

2. OPERATIONAL NOTES

General notes

WARNING

This product is delivered after Manufacturing and adjustment. Inspections have been conducted based on the optimum quality control method for industrial instruments. If any attempt is made to modify or change this instrument, it may fail to perform as intended, or incompatibility or accidents may result. Do not modify or change this instrument in any way. If it is necessary to modify or change it, contact Tokyo Keiso Co.

CAUTION

Be sure to operate the instrument within the ranges of the specifications for fluid pressure and temperature listed in the Approval drawing. If the instrument is operated out of these ranges, it may become defective or be damaged.

CAUTION

During transportation and storage, ensure to prevent moisture, dirt or sand from entering the instrument as such will cause damage or render the instrument defective.

CAUTION

Use this product only as an Industrial instrument.

Material

CAUTION

The material of this product is described in the approval drawing. Although we make every effort to select the optimal material for the customer's specifications, it may not be perfect due to the presence of foreign matter. Thus, you are responsible for checking for anticorrosivity and compatibility.

Maintenance and inspections

WARNING

When removing this product from your process for maintenance or inspection, make sure there is no object to be measured remaining in the instrument. If the object is corrosive or toxic, the operator may be adversely affected.

CAUTION

The frequency and contents of the maintenance and inspection of this product vary depending on the operational conditions. See the relevant selection of this manual or check the actual operational conditions.

WARNING

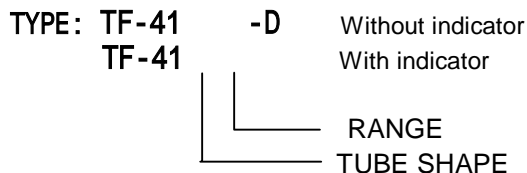
Control Safety

Although this product is delivered after manufacturing, adjustment and inspections have been conducted based on the optimum quality control method for industrial instruments, an unexpected defect may occur. If this product is used for process control that may result in a critical safety problem, take all necessary actions to maintain safety.

3. SCOPE OF DESCRIPTION

This instruction manual covers TF-4000 series Thermal Mass Flowmeter.

4. SCALE RANGE AND MODEL CODE



5. STANDARD SPECIFICATION

Measuring object all kind of gases (Expect gases containing more than 10% of H₂ or He and mixture of H₂ or He and CnHm)
Operating pressure -0.07 to 0.98Mpa
Gas temperature 0 to 60°C

Ambient Temperature and Humidity
0 to 60 , Less than 90% RH

Temperature range of accuracy warranty
25 ± 10

Range ability 1:20
Accuracy ± 2% F.S.

Response 90% within 0.5s
Temp. Change effect
Within 0.1% F.S. /°C

Indication 7 segments LED, 5digit + 2 alarm lamps (H+L alarm)

Data indication 0.00-9.99,
10.0-999.9,
1000-1050

Output Analog DC 0 to 5V
Impedance; Less than 50

Pulse 0.1%F.S.min(L)
Open collector

High alarm output
Turn on above setting value, Open collector

Low alarm output
Turn on below setting value, Open collector

RS485 Half-duplex communication, ID, Portrait alteration is possible

Setting function
RS485 or Switch of indicator (4 keys)
Setting value for H and L alarm, Scaling, Offset, RS485 ID address, Baud rate

Installation Horizontal

Flow direction Refer to the arrow mark of a detector.

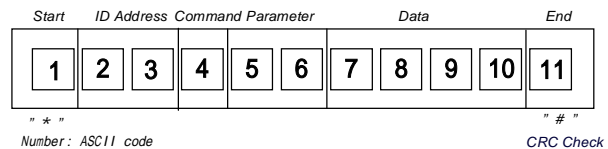
Power supply DC12V ± 10%, Approx.210mA

Test press. 1.0MPa(Atmospheric pressure)

CE marking EN55011, EN-50082-2

Interface RS485

Selection of baud rate;
2400, 4800, 9600
Half-duplex, Non-parity, 8 bits
1 start bit
1 stop bit

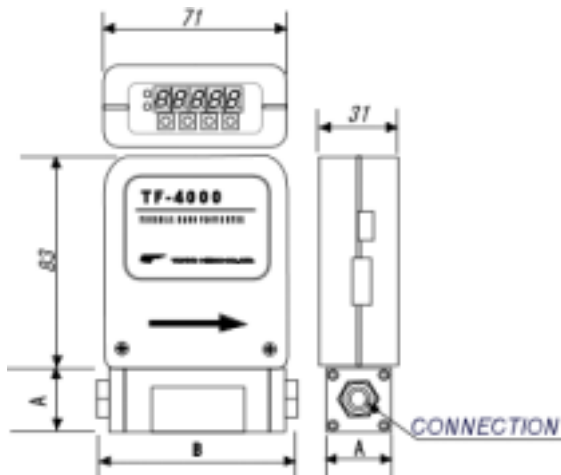


Data Length: 0-12byte variables
Accessory; 9-core shield cable for DSUB9p 1m (for power supply and Output)
2-core shield cable for RS485 1m

Instruction manual (enclosed in package)

6 . DIMENSION

TF-4000D

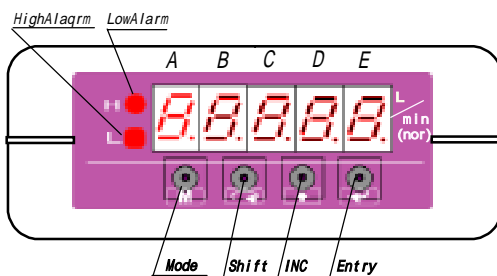


Mass & Dimension

Unit (mm)

MODEL	TF-4110	TF-4120	TF-4130	TF-4140
A	25	32	38	45
B	76	76	112	136
Connection	Rc1/4	Rc3/8	Rc1/2	Rc3/4
Mass	350g	500g	850g	1150g

7. NAME OF EACH PART



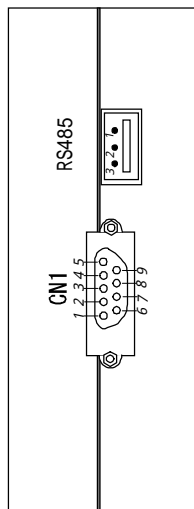
Connector

RS485

- 1 Signal +
- 2 Signal -
- 3 Shield

Connector for power supply

- 1 Signal OUT +
- 2 Signal OUT
- 3 High Alarm
- 4 Low Alarm
- 5 Pulse OUT
- 6 COM
- 7 COM
- 8 Power Supply +
- 9 Power Supply -



8. PRODUCT OUTLINE

TF-4000 series is a compact flowmeter for gas measurement, based on the know-how accumulated

for the well-acknowledged TF series.

The platinum sensor, which has the satisfactory results conventionally, is used, and PID temperature control and measurement are made by the new digital method.

The temperature difference between two resistors is constantly controlled not to be fluctuated.

The faster the flow velocity becomes, the more the heat is taken, and the heat capacity taken depends on the flow rate.

Internal operation is performed from this value and the flow rate is computed.

9. ACCEPTANCE

Confirm the following on arrival of product. In case any discrepancy / defects are found, contact your sales agent immediately.

- Type / Model of product
- Free from any damage during transportation
- Accessory, if any

10. STORAGE

Observe the following for selection of storage location

- Free from corrosive atmosphere
 - Free from dirty environment with dust.
 - Free from dew condensation or freezing
 - Free from rain water
 - Free from mechanical shock and vibration
- Ambient temperature -10 to +50

11. INSTALLATION

1) Installation environment.

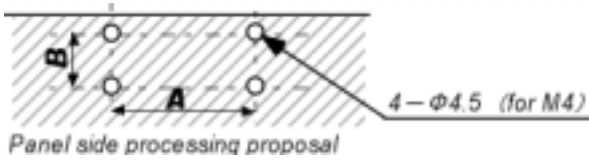
Avoid the environments such as high voltage, high current, high magnetic field, direct rays, and the place getting wet with water.

2) Recommending the horizontal flow direction.

3) Secure the length of straight run as much as possible when the revolving flow is expected.

4) If a solid and a fiber substance are contained in fluid, a sensor will be damaged and it may result in causing the malfunction. Take measure to take out the solid and fiber substance at the upstream side. If the mist is contained in gas, it may cause the damage of sensor.

5) When this equipment is mounted on the panel and used, install it using the holes made at the bottom of main body. Refer to the bottom view as shown below.



Model	TF-4110	TF-4120	TF-4130	TF-4140
A	64	64	50	70
B	10	10	10	10

6) Pay attention not to screw too much. Otherwise, it may result in damaging the main body.

12 WIRING AND ADJUSTMENT

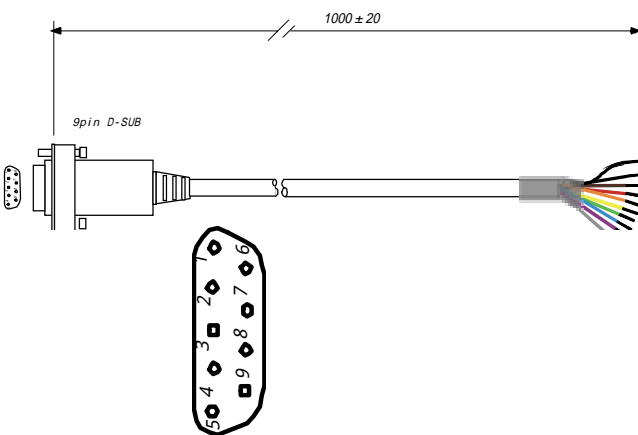
- 1) Carry out wiring with the power supply OFF.
- 2) 2 sets of connectors are attached to the main body. Connect the attached cable with a power supply and various apparatus.

RS485Cable



Connector PIN NO	Color	Signal
1	Red	Data +
2	Black	Data -
3	Thick Black	Shield

Signal and Power Supply Cable



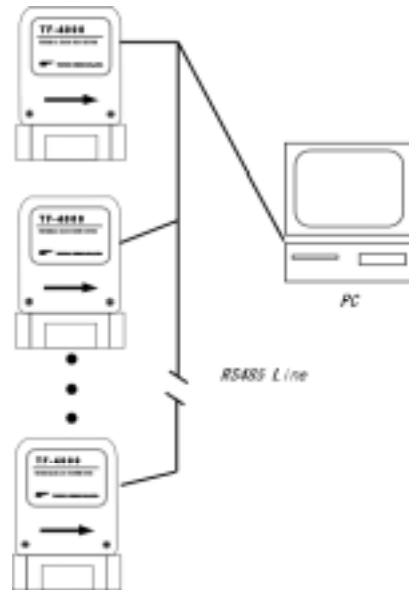
Wiring Description

Connector PIN NO	Color	Signal
1	Brown	Voltage output +
2	Red	Voltage output GND
3	Orange	Open collector 1 High Alarm
4	Yellow	Open collector 2 Low Alarm
5	Green	Open collector 3 Pulse out
6	Blue	Open collector COM
7	Purple	Open collector COM
8	Black	Power Supply(+)
9	Gray	Power Supply(-)
	Thick Black	Shield

- 3) There can be no harm in cutting a cable if it is long.
- 4) Both structure of a main body and a portion to pull out a cable are not waterproof. Be careful of the short circuit in the wiring system by adhesion of water.
- 5) Connect a shield timely according to a noise state.

12-1 Basic system of connection

The basic example of the connection of computer and power source with TF-4000 is shown. RS485 is used for connection. When there is no RS485 at the computer side, RS232C - RS485 converters are to be used.



12-2 Piping connection

In order to make stable measurement of flow rate, the piping connection shall be conducted, paying attention to the following:

- 1) When carrying this equipment, hold it firm and do not give a shock to it.
- 2) Get rid of the cutting oil and dust inside the pipe completely after threading. Be sure to do the flushing of the pipe inside before the connection. Don't connect it to the pipe in which the mist is contained.
- 3) When the atmosphere is inhaled with a vacuum pump, install a filter on the upstream side of this equipment and carry out a dust countermeasure.
- 4) Tapered screw is to be used for the piping connection. Fasten it not to leak. At this time, prevent a sealing material from protruding to the pipe inside and the inside of the joint.
- 5) Select a joint in a suitable connection according to the flow rate, and make piping connection in the

same size.

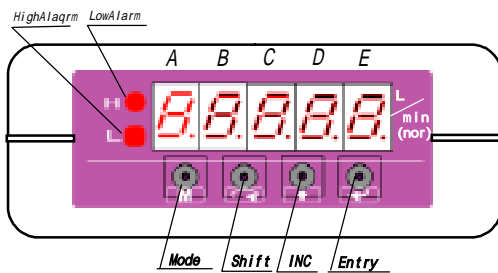
- 6) Direction of installation: Recommending the horizontal installation. Use the screw holes at the bottom when fixing. The connection is to be made in the "arrow" direction to which the gas flows.
- 7) Recommending installing the bypass piping in order to make maintenance and check easier.

12-3 Adjustment

This unit has the self-calibration function inside the circuit. Since the calibration is repeated periodically, there is no section to be adjusted from the outside. "L/min(nor)" is used as the measuring unit. When checking the standard, convert it into the standard condition of 1atm at 0 and check. Since it is based on 25 as a working environment, perform a real check in the gas environment at this temperature.

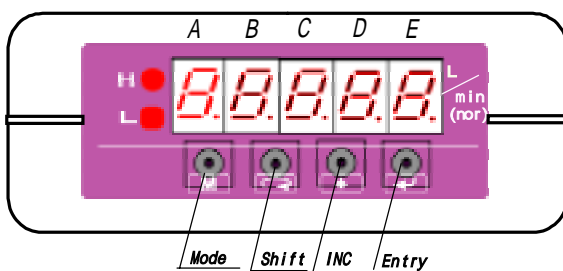
13. SETTING

13-1 Indication function



- 1) "A" Indicator
 - Display of setting items: 0, 1, 2, 3, 4, 5, 6, H, L, a, b, l, & r
 - Overflow display at the time of flow measurement
- 2) Indicator from "B" to "E"
 - Display of measured value and preset value etc.
- 3) Display of "High" and "Low" alarm
 - Lighting up when exceeding the preset "High" and "Low" value.

13-2 Switching function



M MODE

When setting up the function, press "MODE+SHIFT" simultaneously for 3 seconds to move.

This mode is used for memorizing the set data temporarily and then advancing the set item.

SHIFT

When setting up the function, press "MODE+SHIFT" simultaneously for 3 seconds to move.

When raising the digit of a preset value, it shifts to E, D, C, and B.

INC

This mode is used when increasing the blinking numerical value or making a mark judge.

ENTRY

If this is used when making a setup complete, data will be memorized and a display will be returned to "measurement mode".

13-3 Setting list

Function setting and a setup at the time of delivery

Setting item No	Contents	DISPLAY				
		A	B	C	D	E
0	High Alarm	H.	9	9	9	9
1	Low Alarm	L			0.	0
2	Scaling : a (a X + b)	a.	1.	0	0	0
3	Offset : b (a X + b)	b		0.	0	0
4	RS485 I D	I.			0	0
5	Baud rate	r.	2	4	0	0

If there is the abnormality in the set memorized value due to the big noise or abnormality of power source, set up in accordance with the above-mentioned procedure.

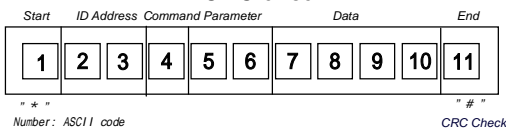
*Select the baud rate of 2400, 4800, and 9600 to set up.

14. INTERFACE FUNCTION

This equipment is possible to make communication with the digital equipment like personal computer by RS485. Measurement data and a setting condition can be known by communication. Make serial communication condition agree with the computer side, prior to setting up. ID address is 00 at the time of delivery. When connecting two or more units, make connection after setting up ID address appropriately by a switch in order to avoid duplicating.

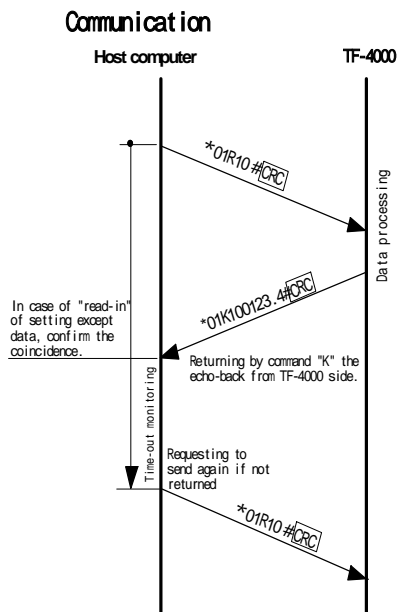
1) Communication conditions

Interface RS485 Selection
 Half-duplex, Non-parity
 8 bits, 1 start bit, 1 stop bit
 CRC check



Start code
 ID address 00 to 99
 Command W Request to write in from PC
 R Request to read in from PC
 K Echo-back from RR-900
 Parameter 00 to 09 (Used at manufacturing side)
 10 to 46 (Partially omitted)
 ("NoUse" message except the above)
 Data 8 digits (maximum)
 "End" code "#"
 CRC Error check of data transmission

2) Communication method



3) Data form

Data is 8 bits.

Communication data form

Byte	Contents	
Start byte	" * " (Astarisk)	
ID address	0 0 - 9 9	
Command	Read/Write/Echo	
Parameter number	1 0	R ,K Flowrate read only
	1 1	R ,K Totalized pulse read
	1 2	R, W, ,K High alarm
	1 3	R, W, ,K Low alarm
	1 4	R, W, ,K Scaling a;ax+b
	1 5	R, W, ,K Offset b;ax+b
Parameter number	1 6	R, W, ,K Error Message 8 digits read only 1 Flowrate > High alarm 2 Flowrate < Low alarm 3 Flowrate > Max. measuring value 4 Flowrate < Low-cut
	3 7	R, W, ,K RS-485 ID code
	3 8	R, W, ,K Baud rate 2 4 0 0 , 4 8 0 0 , 9 6 0 0
	Data	0 - 8 Byte
Stop	" # " (a sharp)	
Error check	C R C	

In case of the parameter where "write-in" is possible, it is possible to change the set-up after changing it to "switch setting".

"Echo" is the response from TF-4000 side.

Example of calculation type of "CRC"

```

1 unsigned char crc;
2 unsigned char i16;
3 crc=0xff;
4 length=strlen(TransmitStr);
5 for(i16=0;i16<length;i16++){
6   crc^=*TransmitStr;
7   TransmitStr++;
8   crc&=0x7f;

```

When inputting any other parameter numbers except the number as shown here, the various data may happen to be outputted. Be sure to use the above-mentioned code alone.

15. OPERATION

15-1 Preparation for operation

Confirm the following points before turning on the power after completion of piping and wiring.

- 1) The condition of installation (Refer to "11. INSTALLATION")

- Installation environment is right.
- Screws are to be tightly fastened.
- The connection part is to be tightened.
- The flow direction of gas is in accordance with the direction as shown by the arrow.

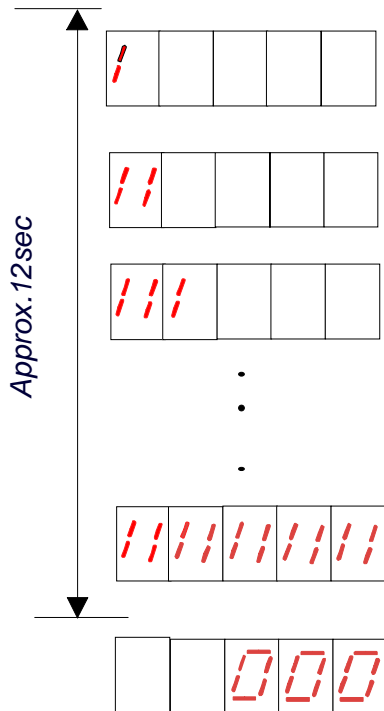
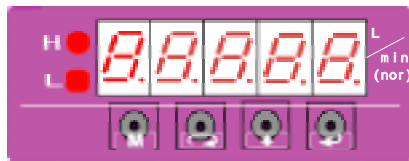
2) The condition of wiring (Refer to “12. WIRING AND ADJUSTMENT”)

- Supply voltage and capacity are correct.
- The socket housing is to be securely fitted to the connector.
- There are no errors in power supply and wiring.

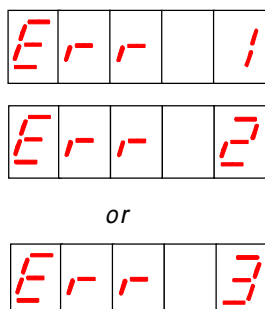
15-2 Operation

1) After turning on the power, the “warm-up” time for 1 minute is required.

The indication is made as follows after turning on the power.



In case the trouble occurs inside this equipment, contact factory as the following indication is made:



2) Increase the line pressure gradually and flow the gas. The signal according to the flow rate is obtained.

3) Set up temperature and pressure within the value as specified in the specification.

4) Be sure not to flow the impurity or what leads to the dirt.

16 MAINTENANCE AND INSPECTION

16-1 Inspection items

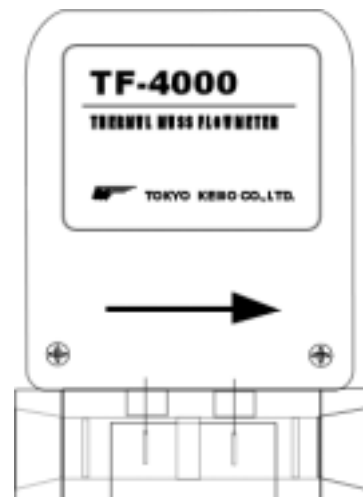
High accuracy for a long time, check the following items such as:

- 1) Check the corrosion of piping and fittings, and the clean gas shall be always flowed.
- 2) When the flow rate output value is smaller than the given flow rated, it may be that there is the possibility that the dust adheres in the flow path. Turn off the power, remove the cable socket, and inspect and clean the inside of the flow path after removing the body from the piping.

When the flow rate output is not displayed, the mist may have mixed in the flow path, and also the adhesion of iron powder to a sensor or circuit board may have short-circuited. Turn off the power, remove the cable socket, remove the main body from the piping and then inspect the fittings and also the inside of the flow path to see if the iron powder adheres. As the sensor or circuit board may have been damaged, contact factory.

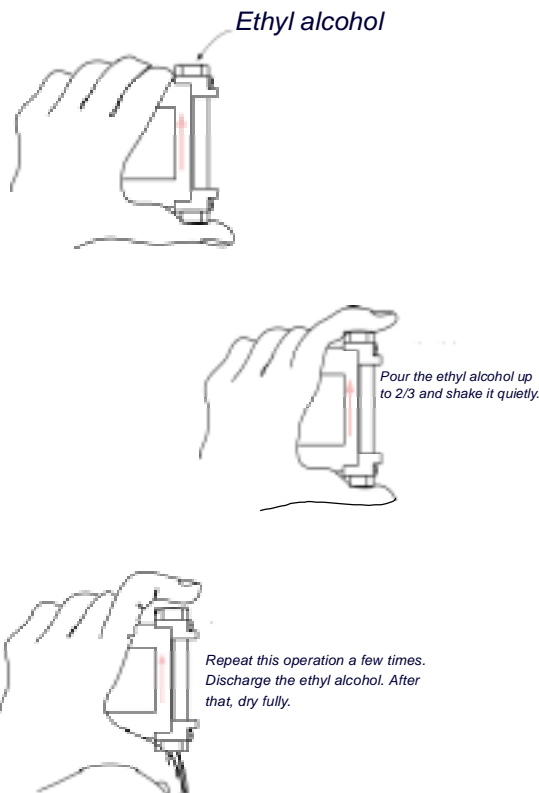
16-2 Cleaning and Washing

When the dust sticks in the flow path and the inside of the detector gets dirty, the cleaning and washing shall be made in accordance with the following procedure



- 1) Purge fully the dust with clean dry gas in low pressure (Air, N₂ gas etc.) from the downstream side and blow it away.
 - 2) When the inside of the detector is dirty, thoroughly clean it with ethyl alcohol. Be sure not to use any other organic solvents than the ethyl alcohol. Otherwise, it may result in corroding O-ring etc.
- Make the upstream side downward, and block it with finger. Pour the ethyl alcohol up to about 2/3 from the downstream side and remove the finger after stirring the ethyl alcohol fully, and discharge it from the bottom.
 - Repeat this operation a few times.
 - Purge fully the dust with clean dry gas (Air, N₂ gas etc.) and dry fully.

Confirm, by the visual observation, that there is no dirt in the flow path.



16-3 Spare parts

When the spare parts are required, contact factory, and specify Mfg. No. And name of spare parts.

17. MANAGEMENT OF TROUBLE

If a trouble happened, contact our sales agency or us after checking condition.

18. SERVICE NETWORK

Contact following for service and spare parts supply, etc.

TOKYO KEISO CO., LTD.

Overseas Department

Shiba Toho Build.

1-7-24, Shibakoen, Minatoku, Tokyo, 105-8558

TEL: 3-3431-1625

FAX: 3-3433-4922

TLX: 02425378TICJ

E-mail

address:overseas.sales@tokyokeiso.co.jp

Or

Your agent in your locality

19.WARRANTY

Unless otherwise stipulated, the quality warranty for this product shall be as follows: -

Duration:

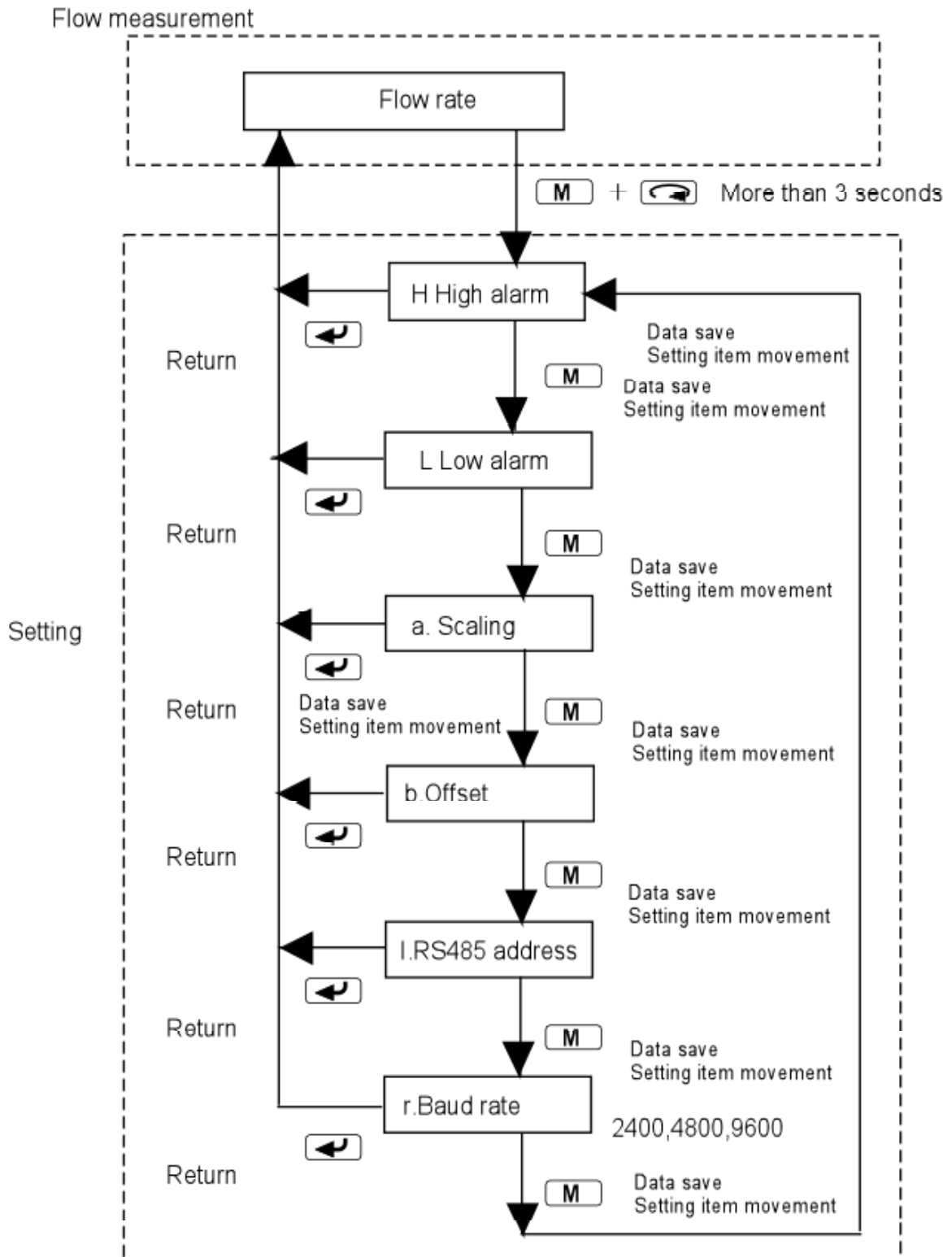
Whichever is shorter, 18months after delivery or 12months after start-up of operation.

Range of Warranty:

Any damages arising from our mistakes in design, manufacture and/or selection of materials.

Enforcement of warranty:

Our warranty work shall be fulfilled when new parts have been replaced or repairs have been done. We shall not be responsible for any secondary damages arising from the defects of this product.



Attached Data 2

Communication with computer

NO.	PC Send (Read)	TF-4000 Echo	PC Send (Write)	TF-4000 Echo	Data Bytes	Remarks
<u>10</u>	*00R11#C	*00K11xxxx.xx#C			0~8	Flowrate
<u>11</u>	*00R11#C	*00K11xxxxx.xx#C	*00W11#C	*00KZero#C	0~8	Total (Read), Zero (Write)
<u>12</u>	*00R12#C	*00K12xxxx.xxx#C	*00W12xxxx.xxx#C	*00K12xxxx.xxx#C	0~8	High alarm
<u>13</u>	*00R13#C	*00K13xxxx.xxx#C	*00W13xxxx.xxx#C	*00K13xxxx.xxx#C	0~8	Low alarm
<u>14</u>	*00R14#C	*00K14x.xx#C	*00W14x.xx#C	*00K14x.xx#C	0~8	Scaling:a
<u>15</u>	*00R15#C	*00K15xxx.x#C	*00W15xxx.x#C	*00K15xxx.x#C	0~8	Offset: b
<u>16</u>	*00R16#C	*00K16xxxxxxxxx#C			8	Error message
<u>37</u>	*00R37#C	*00K37xx#C	*00W37xx#C	*00K37xx#C	0~8	RS-485 ID Address
<u>38</u>	*00R38#C	*00K38xxxx#C	*00W38xxxx#C	*00K38xxxx#C	0~8	Baud rate