INSTRUCTION MANUAL

THERMAL MASS FLOW METER

MODEL : KC-2600 Series

GOLDEN RULES

Gas & Liquid type

Insertion type

Inline type

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Warnings and Cautions

Warning! Agency approval for hazardous location installations varies between flow meter models. Consult the flow meter nameplate for specific flow meter approvals before any hazardous location installation.

Warning! Hot tapping must be performed by a trained professional. U.S.regulationsoftenrequirea hot tap permit.
The manufacturer of the hot tap equipment and/or the contractor performing the hot tap is responsible for providing proof of such a permit

Warning! All wiring procedures must be performed with the power Off.

Warning! To avoid potential electric shock, follow National Electric Code safety practices or your local code when wiring this unit to a power source and to peripheral devices.
Failure to do so could result in injury or death.
All AC power connections must be in accordance with published CE directives.

Warning! Do not power the flow meter with the sensor jumper wires disconnected.
This could cause over-heating of the sensors and/or damage to the electronics.

Warning! Before attempting any flow meter repair, verify that the line is de-pressurized.

Warning! Always remove main power before disassembling any part of the mass flow meter.

Caution! Before making adjustments to the Smart Electronics device, verify the flow meter is not actively monitoring or reporting to any master control system. Adjustments to the electronics will cause direct changes to flow control settings.

Caution! All flow meter connections, isolation valves and fittings for hot tapping must have the same or higher pressure rating as the main pipeline.

Caution! Changing the length of cables or interchanging sensors or sensor wiring will affect the accuracy of the flow meter. You cannot add or subtract wire length without returning the meter to the factory for re-calibration.

Caution! When using toxic or corrosive gases, purge the line with inert gas for a minimum of four hours at full gas flow before installing the meter.

Caution! The AC wire insulation temperature rating must meet or exceed 71℃ (158℉).

Caution! Printed circuit boards are sensitive to electrostatic discharge. To avoid damaging the board, follow these precautions to minimize the risk of damage :

• before handling the assembly, discharge your body by touching a grounded, metal object
• handle all cards by their edges unless otherwise required
• when possible, use grounded electrostatic discharge wrist straps when handling sensitive components

Chapter 1 Introduction

Series KC-2600 Smart-Programmable Thermal Mass Flow Meters

Golden Rules Series KC-2600 Smart Insertion Thermal Mass Flow Meter provides a reliable solution for gas and liquid flow measurement applications.

Low-flow sensitivity, fast response and outstanding range ability have made this model the instrument of choice for many critical gas and liquid flow applications.

For stable and reliable mass flow reading, the meter's rugged Smart-IN™ sensor automatically corrects for changes in gas temperature and pressure which eliminates the need for separate temperature and pressure transducers.

The versatile microprocessor-based transmitter integrates the functions of flow-range adjustment, meter validation and diagnostics in a probe-mounted or remotely-mounted housing. Mass flow rate and totalized flow, as well as other configuration variables are displayed on the meter's optional 2 x 16 LCD display.

The gauge indicates output, pulse and electric current. The programmable transmitter is easily configured via RS-485 and Golden Rules Smart Interface software or through three push buttons built into the device.

The Series KC-2600 is suitable for insertion into pipes or ducts from three inches up to 72 inches.

The Series KC-2600 Thermal Mass Flow Meter's simple installation combines with an easy-to-use interface that provides quick set up, long term reliability and accurate mass flow measurement over a wide range of flows and conditions.

Using This Manual

This manual provides information needed to install and operate the Series KC-2600 Smart Insertion Thermal Mass Flow Meter.

The four chapters of this manual cover these areas :

- Chapter 1 includes the introduction and product description
- Chapter 2 provides installation and wiring instructions
- Chapter 3 describes system operation and programming
- Chapter 4 covers troubleshooting and repair

The product specifications are found in Appendix A.

We use caution and warning statements throughout this book to draw your attention to important information.

This statement appears with information that is important to protect people and equipment from damage. Pay very close attention to all warnings that apply to your application.

This statement appears with information that is important for protecting your equipment and performance. Read and follow all cautions that apply to your application.

Receipt of System Components

When receiving a Golden Rules Thermal mass flow meter, carefully check the outside packing carton for damage incurred in shipment.
If the carton is damaged, notify the local carrier and submit a report to the factory or distributor.
Remove the packing slip and check that all ordered components are present. Make sure any spare parts or accessories are not discarded with the packing material.
Do not return any equipment to the factory without first contacting Golden Rules Customer Service.

Technical Assistance

If you encounter a problem with your flow meter, review the configuration information for each step of the installation, operation and setup procedures.
Verify that your settings and adjustments are consistent with factory recommendations.
Refer to Chapter 4, Troubleshooting, for specific information and recommendations.
If the problem persists after following the troubleshooting procedures outlined in Chapter 4, contact Golden Rules by fax or by E-mail (see inside front cover).
For urgent phone support you may call (+82) 032-817-1240 between 09:00 a.m. and 18:00p.m.PST.
When contacting Technical Support, make sure to include this information :

- The flow range, serial number and Golden Rules order number (All marked on the meter nameplate)
- The software version (Visible at start up)
- The problem you are encountering and any corrective action taken
- Application information (Gas, liquid, Pressure, Temperature and piping configuration)

The Series KC-2600 Principle of Flow Sensing

KC-2600 Series
Thermal Mass sensor

The Mass flow probe, proper to Golden Rules ensures the excellent accuracy, strength and rdliability of the industrial flowmeter.
In the Mass flow sensor, if it's composed of two sensing parts, one is a flow velocity sensor, and the other temperature sensor that automatically corrects according to the change of gas or liquid Tempeature.

the new element consists of two temperature platinum resistors in one chip. while high ohm resistor is used to measure the base temperature, the low ohm resistor is used as heater. By using the bridge circuit, each different resistance value of two elements and each different self-heat are produced. The self-heat depends on the supply voltage, mass flow, medium where the sensor is placed. the high voltage increases the self-heat, and the higer flux increases the cooling. If the self-heat is continued by appropriate controller, the mass flow can be measured as the voltage will increase with high flow rate.

Chapter 2 Installation

Installation Overview

The Series KC-2600 flow meter is factory calibrated to the specific pipe size shown on the meter's Certificate of Calibration. The factory Calibration eliminates the task of calculating the average flow across the pipe to determine the correct insertion depth. Simply insert the flow meter sensor to the centerline position of the pipe.
(If the pipe size differs from the meter's calibrated size, return the meter to the factory for re-calibration.)

Warning!
Agency approval for Hazardous location installations Varies between flow meter models. Consult the flow meter nameplate for specific flow meter approvals before any hazardous location installation.

When selecting an installation site, make sure that :

1. Line pressure and temperature will not exceed the flow meter rating. Temperature should not vary more than 100℃ (200℉) around the calibration temperature. Line pressure should not vary more than 50 psi (3.4 bar) around the calibrated pressure.

2. The location meets the required minimum number of pipe diameters upstream and downstream of the sensor head (see Figure 2-1 on the next page).

3. Safe and convenient access with adequate clearance. Also, verify the meter is located where the gas is clean and dry and the meter is calibrated for the gas to be measured.

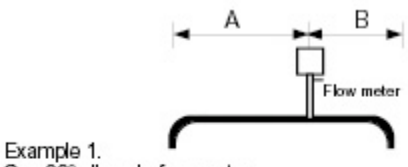
4. When using a CSA, FM or Ex approved flow meter, verify that the cable entry into the instrument meets the specific standard required for that approval.

5. For remote installations, verify the supplied cable length is sufficient to connect the flow meter sensor to the remote electronics.
(Do not extend or shorten the supplied cable between the probe and the electronics.)

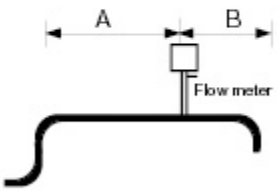
Also, before installation check your flow system for anomalies such as :
• Leaks
• Valves or restrictions in the flow path that could create disturbances in the flow profile that might cause unexpected flow rate indications.
• Heaters that might cause rapid excursions in the measured temperature.

Unobstructed Flow Requirements

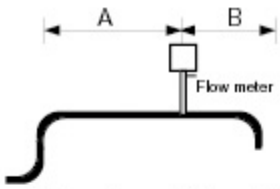
Select an installation site that will minimize possible distortion in the flow profile. Valves, elbows, control valves and other piping components may cause flow disturbances.
Check your specific piping condition against the examples shown below.
In order to achieve accurate and repeatable performance install the flow meter using the recommended number of straight run pipe diameters upstream and downstream of the sensor.



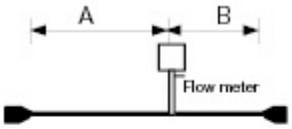
Example 1.
One 90° elbow before meter



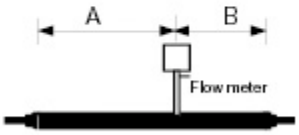
Example 2.
Two 90° elbows before meter in one plane



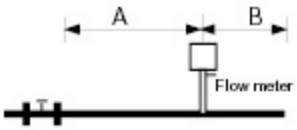
Example 3.
Two 90° elbows before meter out of plane (if three 90° bends present, double recommended length)



Example 4.
Reduction before meter



Example 5.
Expansion before meter



Example 6.
Regulator or valve partially closed before meter (If valve is always wide open, base length requirements on fitting directly preceding it)

Example	A – Upstream(1) Requirements	B – Downstream(2) Requirements
1	10 ~ 7D	5 ~ 3D
2	15 ~ 10D	5 ~ 3D
3	20 ~ 15D	10 ~ 5D
4	10 ~ 7D	5 ~ 3D
5	20 ~ 15D	10 ~ 5D
6	20 ~ 15D	5 ~ 3D

(1) Number of diameters (D) of straight pipe required between upstream disturbance and the flow meter.
(2) Number of diameters (D) of straight pipe required downstream of the flow meter.

Figure 2-1. Recommended Pipe Length Requirements for Installation

Installing the Flow Meter

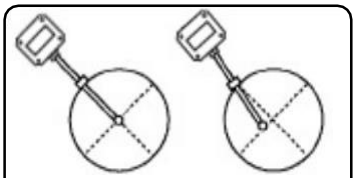
When positioning the flow meter, refer to the flow direction indicator attached to the probe. For proper operation, install the meter with the flow direction indicator pointing downstream in the direction of flow.

Installing the meter opposite this direction will result in inaccurate flow measurement

Cold Tap Installation

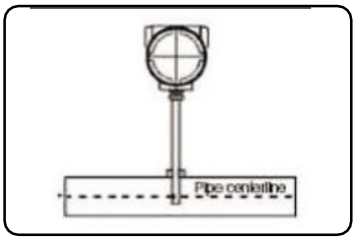
> **Caution!**
>
> When using toxic or corrosive gases, purge the line with inert gas for a minimum of four hours at full gas flow before installing the flow meter.

1. Confirm that the installation site meets the minimum upstream and downstream pipe diameter requirements shown in Figure 2-1.
2. Turn off the flow of process gas. Verify that the line is not pressurized.
3. Use a cutting torch or sharp cutting tool to tap into the pipe. The pipe opening must be at least 0.88 inches in diameter. (Do not at- tempt to insert the sensor probe through a smaller hole.)
4. Remove all burrs from the tap. Rough edges may cause flow profile distortions that could affect flow meter accuracy. Also, obstructions could damage the sensor assembly when inserting into the pipe.



Correct Alignment Incorrect Alignment

5. Mount the compression or flange fitting on the pipe. Make sure this connection is within ±5° perpendicular to the pipe centerline as shown at left.
6. When installed, cap the fitting. Run a static pressure check on the connection. If pressure loss or leaks are detected, repair the connection and re-test.
7. Insert the sensor probe through the compression or flange fitting into the pipe. The correct insertion depth places the sensor at the pipe's centerline. Do not force into the pipe.



8. Align the sensor head using the flow direction indicator. Adjust the indicator parallel to the pipe pointing downstream in the direction of flow.
9. Tighten the fitting to lock the flow meter in position. (When a compression fitting is tightened, the position is permanent unless using Teflon ferrules.)
10. If needed, adjust the optional display to the desired orientation.

Hot Tap Installation

When positioning the flow meter, refer to the flow direction indicator attached to the probe. For proper operation, install the meter with the flow direction indicator pointing downstream in the direction of flow. Installing the meter opposite this direction will result in inaccurate flow measurement.
Low pressure hot taps cannot exceed 100 psig (7 barg) maximum.
High pressure hot taps cannot exceed 1000 psig (70 barg) maximum.
Make sure the pipe pressure does not exceed these limits before beginning this procedure.

Warning!
Hot tapping must be performed by a trained professional.
U.S. regulations often require a tot tap permit. The manufacturer of the hot tap equipment and/or the contractor performing the hot tap is responsible for providing proof of such a permit.

1. Confirm that the installation site meets the minimum upstream and downstream pipe diameter requirements shown in Figure 2-1.

2. Calculate the flow meter insertion depth as shown in Figure 2-2 for a low pressure tap or Figure 2-3 for a high pressure tap.

3. Weld the process connection on the pipe.
   Make sure the process connection is within ± 5° perpendicular to the pipe centerline (see previous page).
   The pipe opening must be at least 0.88 inches (22 mm) in diameter.

4. Bolt an isolation valve on the process connection. The valve's full open bore must be at least 0.88 inches (22 mm) in diameter.

5. Hot tap the pipe.

Caution!
All flow meter connections, isolation valves and fittings for hot tapping must have the same or higher pressure rating as the main pipeline.

6. Close the isolation valve. Run a static pressure. If pressure loss or leaks are detected, repair the connection and re-test.

7. Insert the sensor probe through the isolation valve into the pipe with the flow direction indicator parallel to the pipe pointing downstream in the direction of flow. The correct insertion depth places the sensor at the pipe's centerline. Do not force into the pipe.

8. Tighten the fittings to lock the flow meter in position. If needed, adjust the optional display to the desired orientation.

〈Calculating Insertion Depth for a Low Pressure Tap〉

Variables

L = Nominal probe length

D = Duct O.D.

C = Duct I.D.

T = Height of "Thread let" or customer provided "Weld let"

Formula

$L \geq 12 + D/2 + T$

L must be equal or greater than 12 inches plus the height of the "Thread let" plus half the duct O.D.
(All dimensions in inches.)

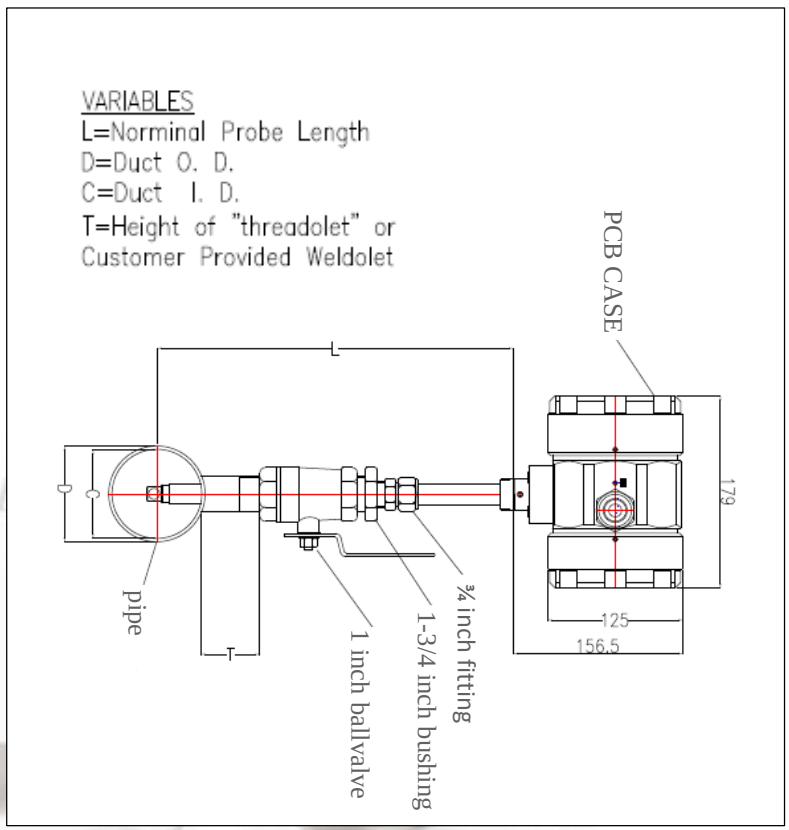


Figure 2-2. Low Pressure Tap Insertion Depth

〈Calculating Insertion Depth for a High Pressure Tap〉

Variables

S = Distance from face of mounting flange to outside of duct
D = Duct O.D.
P = Minimum probe length
T = Minimum probe travel
R = Allowable probe travel
IN = Inserted position (marker location)
RE = Retracted position (marker location)

Formulas

1) P = D/2 + S + 6.75 (minimum probe length–use next longer whole number length probe)
2) T = D/2 + 0.54
3) R = 28.2 – [actual probe length – S – (D/2)] (must be greater than or equal to T)
4) IN = (actual probe length + 2) – (5.5 + S + D/2)
5) RE = IN + T

(All dimensions in inches.

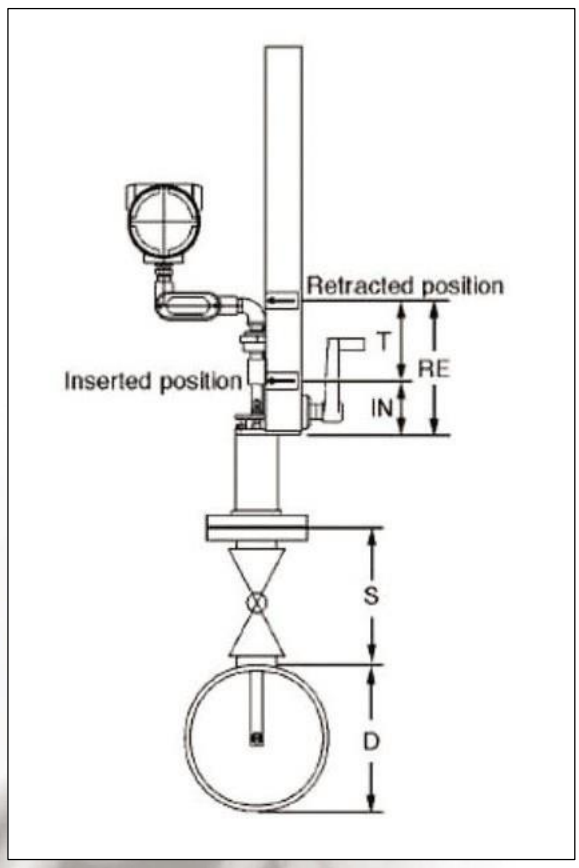


Figure 2-3. High Pressure Tap Insertion Depth

Wiring Connections

The KC-2600 enclosure type uses AC or DC terminals for power connections and uses 4-20mA OUT +,OUT- terminals for signal connection.To comply with all CE standard requirements use AC or DC connection method mentioned below

Standard type terminal block

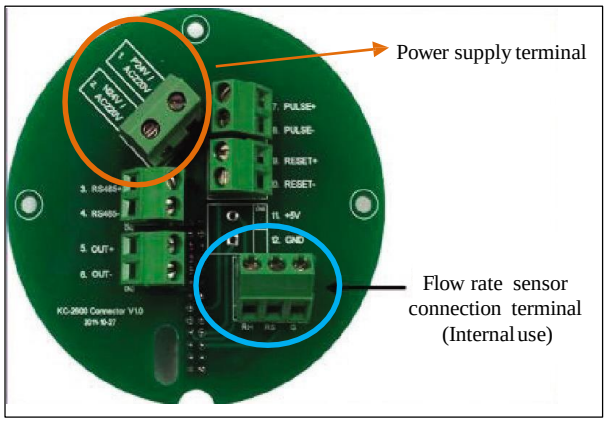
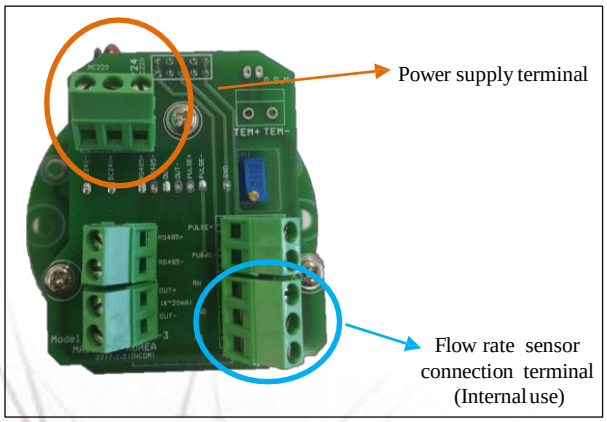


Figure 2-4. Wiring Access KC-2600 SeriesEnclosure

Explosion- proff terminal block



Warning!
To avoid ptenial electrical shock, connect the phantom to power source or when connecting to any peripherals follow NEC safety guidelines or local regulations.If you fail to do so injury or death could follow. All power connections must be in accordance with CE regulatoryguide lines.

Caution!
The AC wire nsulation temperature rating must meet or exceed 71°C (158°F)..

Warning!
All wiring rocedures must be performed with the power Off.

1. P24V / AC100 ~ 240V : Power input terminal (When DC inputting +)
2. N24V / AC100 ~ 240V : Power input terminal (When DC inputting −)
3. RS485 + : When MOD-BUS RS485 communicates, DATA + terminal
4. RS485 − : When MOD -BUS RS485 communicates, DATA − terminal
5. OUT + : ANALOG 4~20 mA CURRENT + terminal
6. OUT − : ANALOG 4~20 mA CURRENT + terminal
7. PULSE + : PULSE Output + terminal
8. PULSE − : PULSE Output − terminal

This chapter handles how to program the flowmeter, and how to check the progress of the flowmeter. All the explanations on programming are going ahead watching the LCD window.

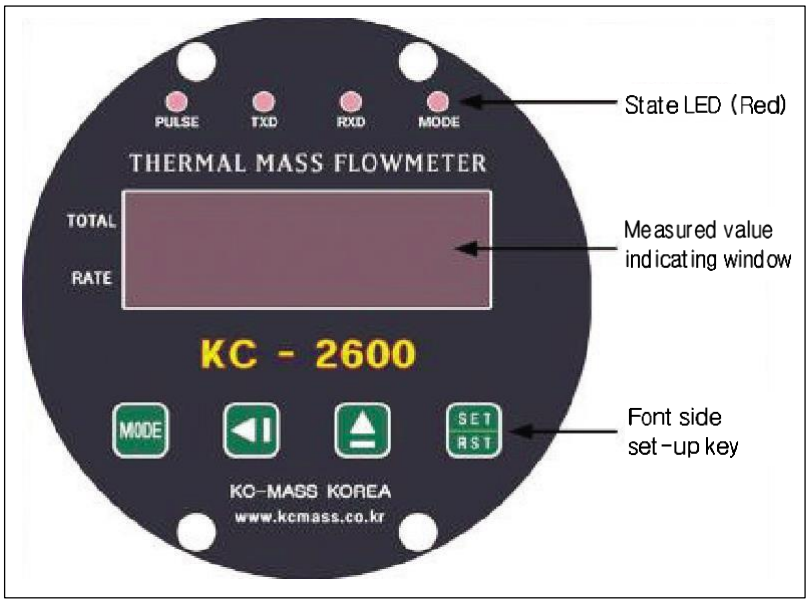


Figure 3-1. Smart Electronics DeviceLocations

How to use the basic specification

It explains how to do the basic input as follows.

1) State LED

PULSE : Lights on when Pulse output is on time

TXD : Data transmitting LED when RS485 communicates

RXD : Data receiving LED when RS485 communicates

MODE : Sensor-trouble sensing LED

(When there's trouble in sensor and inner sensor detection board, LED flickers)

Front side Set-up Key

MODE : Changes the set mode when setting parameter

: Changes the place when setting parameter

: Changes the value increase of set place when setting parameter

SET RST : Enters the mode or saves the set value when setting parameter

At normal state, use with total count reset key

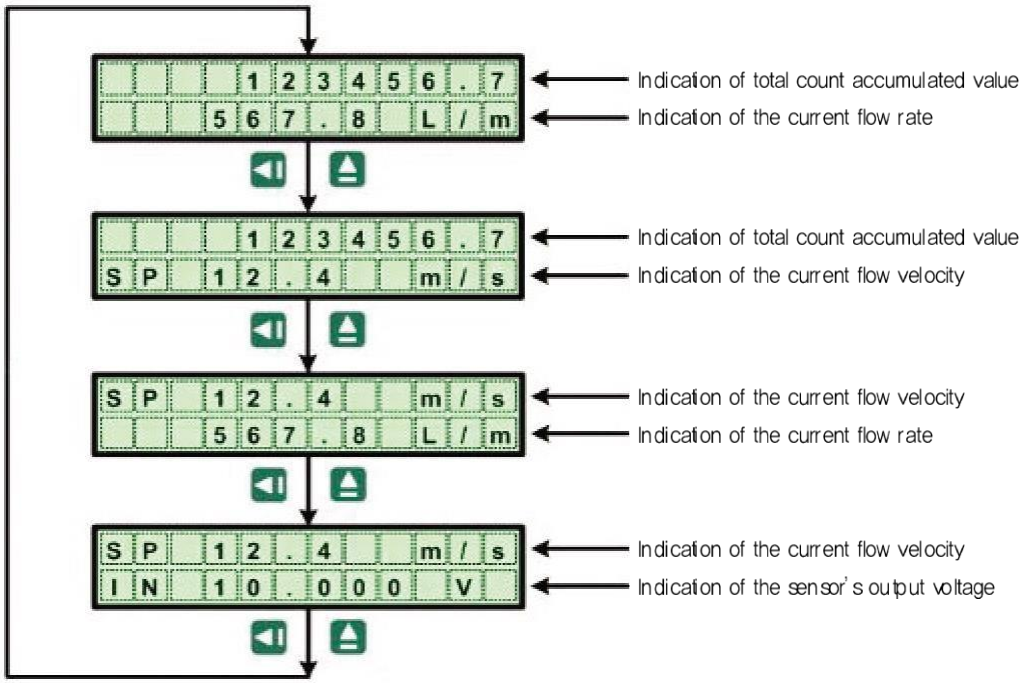
2) Indication window of measured value

① NOMAL state

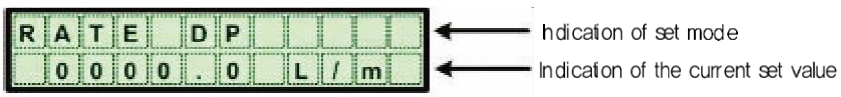
a. If pressing once ◀ or ▲ key respectively, one can see by selecting the following 4 kinds of indication mode.

b. Maximum value of data

- TOTAL COUNT accumulated value : 49999999999
- Flow rate : 99999 - Flow velocity : 99.9m/s



② Set state of parameter



3) How to reset total count accumulated value

1> Reset by the front reset key(SET RST)

① At normal state, if pressing SET RST key for 3 seconds, CNT RESET→ is displayed on LED window, at this time, if pressing SET RST key once more, total count accumulated value is reset.

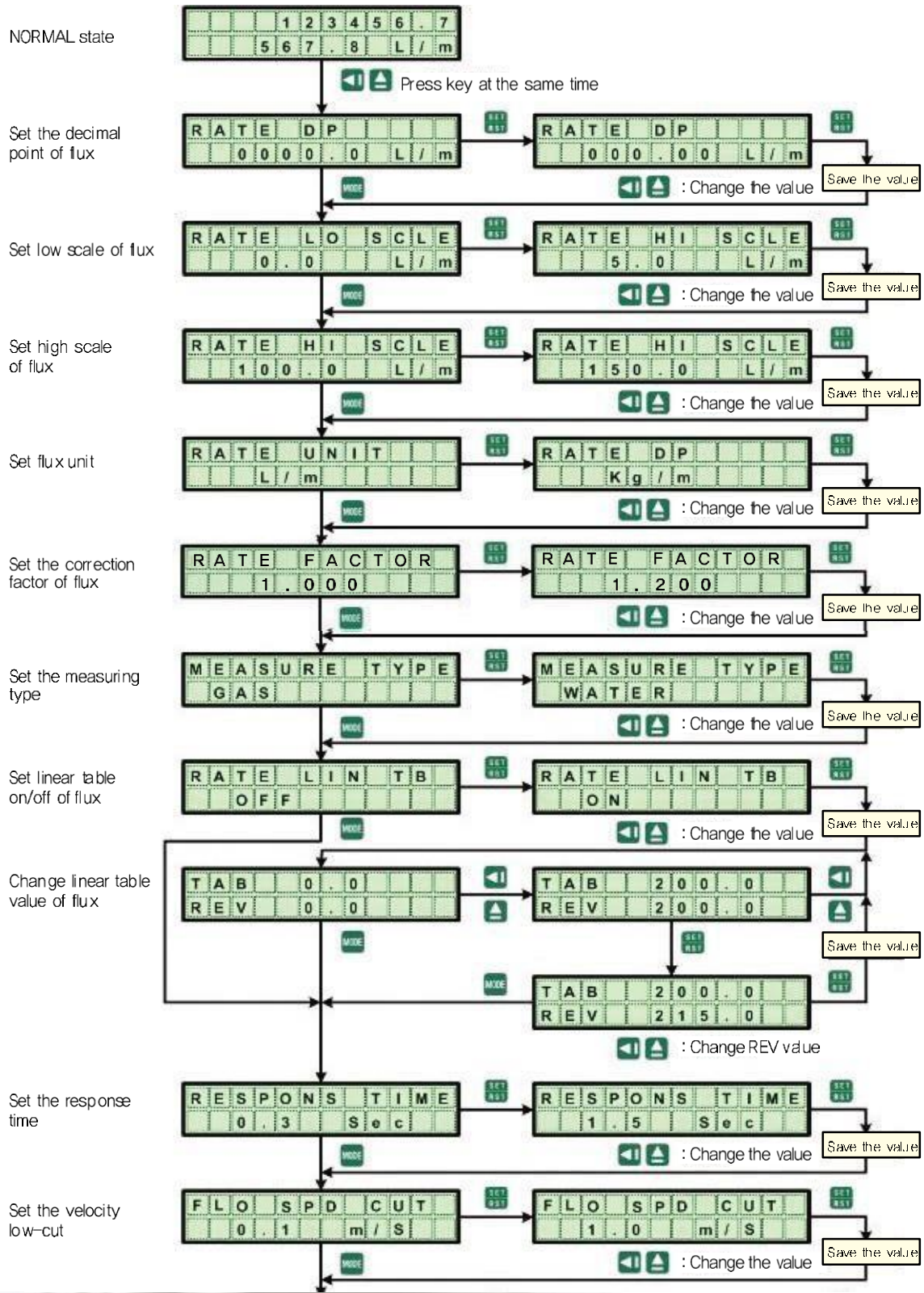
② CNT RESET→ message is displayed for 3 seconds, but, reset is available only when pressing SET RST key with this message displayed.

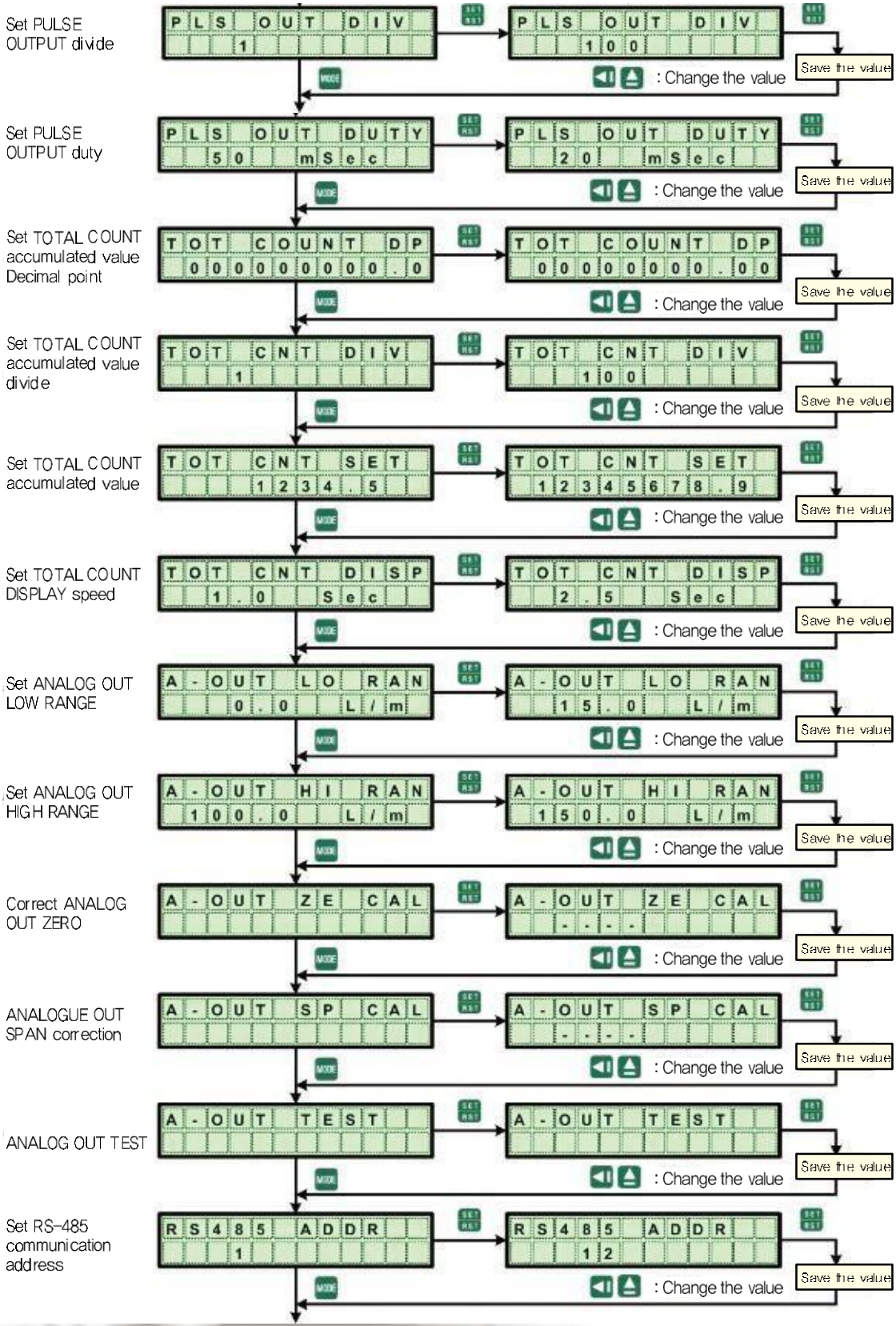
2> Reset by RS485 communication

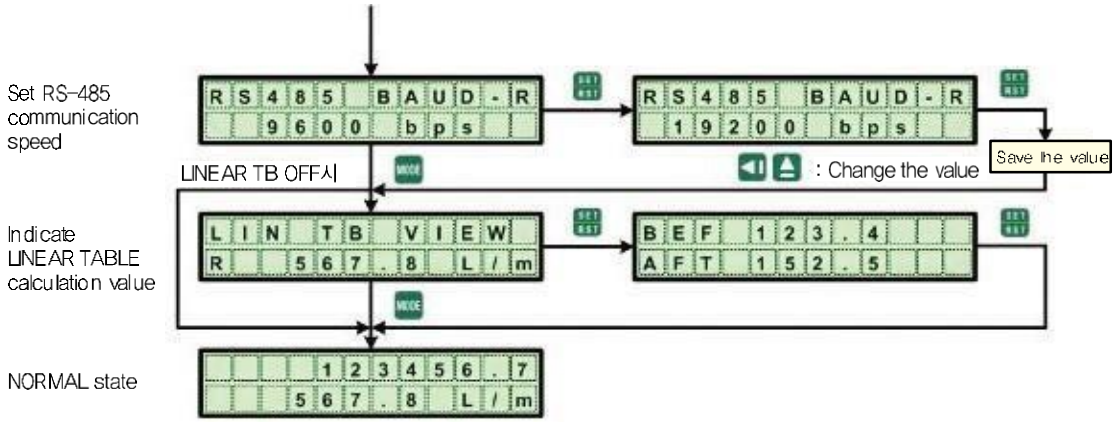
① If transmitting 1 to MOD-BUS ADDRESS 40016, total count accumulated value is reset.

How to set up Parameter

: At normal state, if pressing , keys at the same time, the current firmware version is displayed, and if opening the key, one can set up Parameter.




Set PULSE OUTPUT divide
PLS OUT DIV
1
100
: Change the value
Save the value
Set PULSE OUTPUT duty
PLS OUT DUTY
50 mSec
20 mSec
: Change the value
Save the value
Set TOTAL COUNT accumulated value Decimal point
TOT COUNT DP
0000000000.0
0000000000.00
: Change the value
Save the value
Set TOTAL COUNT accumulated value divide
TOT CNT DIV
1
100
: Change the value
Save the value
Set TOTAL COUNT accumulated value
TOT CNT SET
1234.5
12345678.9
: Change the value
Save the value
Set TOTAL COUNT DISPLAY speed
TOT CNT DISP
1.0 Sec
2.5 Sec
: Change the value
Save the value
Set ANALOG OUT LOW RANGE
A-OUT LO RAN
0.0 L/m
15.0 L/m
: Change the value
Save the value
Set ANALOG OUT HIGH RANGE
A-OUT HI RAN
100.0 L/m
150.0 L/m
: Change the value
Save the value
Correct ANALOG OUT ZERO
A-OUT ZE CAL
- - - -
: Change the value
Save the value
ANALOGUE OUT SPAN correction
A-OUT SP CAL
- - - -
: Change the value
Save the value
ANALOG OUT TEST
A-OUT TEST
: Change the value
Save the value
Set RS-485 communication address
RS485 ADDR
1
12
: Change the value
Save the value



EXPLANATION OF PARAMETER SET-UP MODE

1) DECIMAL POINT MODE OF FLUX

① MODE that explains the decimal point of the indicated flux

② The available decimal points are X.X and X.

2, 3) LOW And High SCALE SET-UP MODE OF FLUX

① MODE that sets up the low full scale of flux

② The set range is 0.0 ~ 99999.

③ If changing HIGH SCALE value, the ANALOG output HIGH RANGE one is automatically changed to this value.

4) FLUX UNIT SET-UP MODE

① MODE that sets up the unit of indicated flux

② The available units are as follows :

L/h, L/m,L/s, cc/h,cc/m,cc/s, m3/h, m3/m, m3/s, Kg/h, Kg/m, Kg/s, NL/h, NL/m NL/s, Ncc/h, Ncc/m, Ncc/s, Nm3/h, Nm3/m, Nm3/s, Nml/h, Nml/m, Nml/s, mL/h, mL/m, mL/s, Nm/h, Nm/m, Nm/s, Ton/h, Ton/m, Ton/s

5) FLUX CORRECTION FACTOR SET-UP BLANK MODE

① MODE that sets up the correction FACTOR, multiplied with multiplier value to the indicated flux

② The range is 0.001 ~ 999. 999, and the default value at factory is 1.000.

6) MEASURING TYPE SET-UP MODE

① MODE that selects the flux TYPE to measure.

② One can select one from GAS and WATER.

7) FLOW VELOCITY CORRECTION MODE BY FLOW VELOCITY LINEAR TABLE

① It's a mode, used to correct the indicated flow velocity only in a specific area.

② Linear table's factory value is off, and if changing to on, it's possible to correct by dividing up to 30m/s in 1m/sec.

③ If changing from off to on, TAB value and REV value are initialized to the same value, at this time, move to TAB area to correct, then, use by changing REV value.

8) RESPONSE-TIME SET UP MODE

① MODE that sets up the indicated response time

② The set range is 0.2 ~ 19.9 sec.
③ Default value at factory is 0.3 sec.

9) FLOW VELOCITY LOW CUT MODE

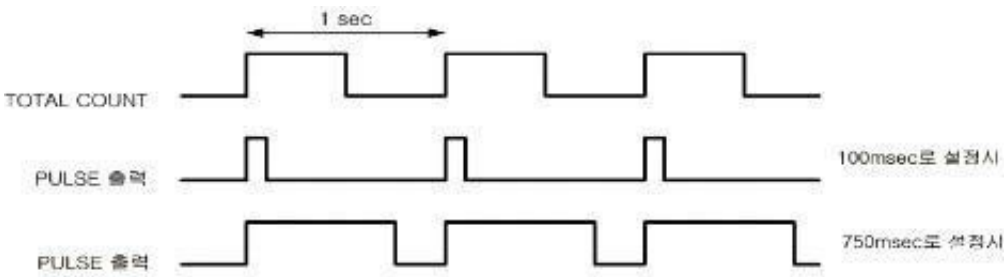
① If flow velocity is lower than the fixed value, make cutting and indicate with 0.0m/sec, then, don't accumulate total count.

10) PULSE OUTPUT DIVIDE SET-UP MODE

① MODE that sets up DIVIDE of PULSE output
② PULSE output COUNT value = TOTAL COUNT accumulated value /DIVIDE set value
③ Set range : 1, 10, 100, 1000
④ Factory default value is 1.

11) PULSE OUTPUT DUTY TIME SET-UP MODE

① As a mode that sets up on time of pulse output, output pulse ontime always turns on, and output during this set value.
② Set value : 10 ~ 9999msec. (10msec STEP)
③ Factory default value is 50 msec. appropriate value after checking the spec of the connected exterior meter.



12) TOTAL COUNT DECIMAL POINT SET-UP MODE

① MODE that sets up the decimal point of TOTAL COUNT accumulated value
② The available decimal points are X.X and X.

13) TOTAL COUNT DIVIDE SET-UP MODE

① MODE that sets up the DIVIDE value of TOTAL COUNT accumulated value
② TOTAL COUNT value : TOTAL COUNT calculation value / DIVIDE set-up value
③ Set area : 0.01, 0.1, 1, 10, 100, 1000
④ Factory default value is 1.

14) TOTAL COUNT SET-UP MODE

① MODE that sets up the TOTAL COUNT accumulated value with optional value.

15) TOTAL COUNT DISP TIME SET-UP MODE

① MODE that sets up the speed indicating TOTAL COUNT accumulated value on LCD window.

② Set area is 0.1 ~ 99.9 sec.

③ Factory default value is 1.0 sec.

16) ANALOG OUT LOW RANGE SET-UP MODE

① MODE that sets up the flux value for 4mA of ANALOG output 4 ~ 20 mA output

② Set area is 0.0 ~ 99999.

③ If changing flux LOW SCALE value, this set value is automatically changed to flux low scale value.

④ If changing this value, it's possible to set separately from LOW SCALE value of flux.

17) ANALOG OUT HIGH RANGE SET-UP MODE

① MODE that sets up the flux value for 20mA of ANALOG output 4~20 mA output

② Set range is 0.0 ~ 99999.

③ If changing the flux HIGH SCALE value, this set value is automatically changed to flux HIGH SCALE value.

④ If changing this value, it's possible to set separately from the flux HIGH SCALE value.

18) ANALOG OUT ZERO CORRECTION MODE

① MODE that corrects 4 mA of ANALOG output 4~20 mA.

② As it's released after correcting to 4.000mA at the factory, the use doesn't need to correct separately, but, if needing to correct at the actual site, one must correct by means of accurate DIGITAL MULTI METER.

19) ANALOG OUT SPAN CORRECTION MODE

① MODE that corrects 20mA of ANALOG output 4~20 mA

② As it's released after correcting to 20.000mA at the factory, the user doesn't need to correct separately, but, if needing to correct at the actual site, one must correct by means of accurate DIGITAL MULTI METER.

Thermal mass flow meter (KC-2600 series) Field current (4-20mA) adjus tment method

I will show you how to adjust the current.

1.Press the MODE + UP + SET keys simultaneously.

2.Press the SHIFT key twice. If you press the UP key once, the password becomes 10. In this s tate, press the SET key

3. Press the MODE key to display the A-OUT ZE CAL menu and press SET.

4. Use the SHIFT and UP keys to set the 4mA precisely.

5. If the A-OUT SP CAL matches the 20mA output, if it is wrong Method.

6. When A-OUT TEST is displayed on the screen, press SET key and press UP key. 4mA at 0%, 8mA at 25% , At 50% 12mA , At 75% 16mA, check if At 100%20mA,as correct.

7.Press MODE key to exit MODE END when SET is pressed.

20) ANALOG OUT TEST MODE

① MODE that can TEST the meter, connected to the output by randomly outputting ANALOG output 4~20mA with 0%(4 mA), 25%(8 mA), 50%(12 mA), 75%(16mA), 100%(20mA).

21) RS485 COMMUNICATION ADDRESS SET-UP MODE

① MODE that sets up the STATION when MOD-BUS RS485 communicates

② Set range : 1 ~ 255

③ Factory default value is 1.

22) RS-485 COMMUNICATION SPEED SET-UP MODE

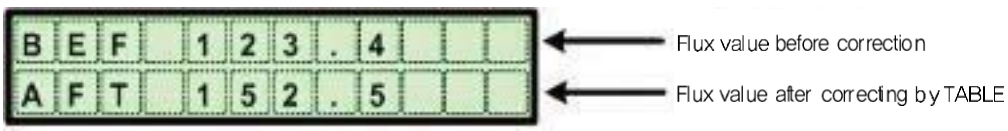
① MODE that sets up the communication speed (BAUD RATE) when MOD-BUS RS485 communicates

② Set range : 2400BPS ~ 57600 BPS

③ Factory default value is 9600BPS

23) LINEAR TABLE CALCULATION VALUE-INDICATING MODE

- This MODE is displayed only when turned ON the LINEAR TABLE correction mode of 7), and one can see the flux value before and after correcting linear table.



KC-2600 PROTOCOL MAP

- ◆ INTERFACE : 2WIRE RS-485
- ◆ COMMUNICATION SPEED : 2400BPS ~ 57600 BPS
- ◆ COMMUNICATION ADDRESS : 1 ~ 255
- ◆ DATA LENGTH : 8 BIT
- ◆ PARITY : NONE PARITY
- ◆ STOP BIT : 1 STOP BIT
- ◆ PROTOCOL : MOD-BUS RTU SLAVE PROTOCOL
- ◆ FORMAT

1) KC-2600 DATA REQUEST FORMAT

KC-2600 ADDR	FUNCTION CODE	START ADDR HIGH	START ADDR LOW	CHANNEL H	CHANNEL L	CRC H	CRC L
1~255	04H or 03H	START ADDRESS		CHANNEL SIZE(n)		CRC16	

a. REQUEST OF CURRENT FLUX, FLUX SPEED, TOTAL COUNT ACCUMULATED VALUE DATA

· FUNCTION CODE : 04H (MOD-BUS MEMORY FUNCTION의 INPUT REGISTER 04H)

· START ADDRESS : 0000H ~ 0008H (MOD-BUS ADDRESS 30000 ~ 30007

· CHANNEL SIZE : 0001H ~ 0008H

· DATA CONTENT : Refer to article a of response format (DATA 0 ~ DATA 7)

b. REQUEST FOR KC-2600 SET VALUE

· FUNCTION CODE : 03H (MOD-BUS MEMORY FUNCTION의 HOLDING REGISTER 03H)

· START ADDRESS : 0000H ~ 001AH (MOD-BUS ADDRESS 40001 ~ 40020)

· CHANNEL SIZE : 0001H ~ 001AH

· DATA CONTENT : Refer to article b of response format (DATA 0 ~ DATA 19)

2) KC-2600 RESPONSE FORMAT

ADDR	FUNCTION CODE	BYTE SIZE	DATA H	DATA L	DATA H	DATA L
1~255	04H or 03H	STARTADDR X2	DATA0		DATA1	

DATA H	DATA L	DATA H	DATA L	CRC H	CRC L
DATAn-1		DATAn		CRC16	

a. CURRENT FLOW RATE, FLOW RATE, ACCUMULATED VALUE OF TOTAL COUNT RESPONSE TO DATA REQUEST (MOD-BUS ADDR 30000 ~ 30007)

· FUNCTION CODE : 04H (INPUT register 04H of MOD-BUS MEMORY FUNCTION)

· BYTE SIZE : DATA request CHANNEL SIZE X 2

· DATA0, DATA1 (MOD-BUS ADDRESS (30000, 30001):THE CURREN FLOW BALUE

- Use 2 words, and the calculation formula is the value of (Value of 30001X 65536) + 30000
- It's 1 digit value with same to decimal point

· DATA2 (MOD-BUS ADDRESS 30002: Unit of flow rate

- Range is 0 ~ 32.

(Nm3/h : 0, Nm3/m : 1, Nm3/s : 2, Kg/h : 3, Kg/m : 4, Kg/s : 5, NL/h : 6, NL/m : 7, NL/s : 8, Ncc/h : 9, Ncc/m : 10, Ncc/s : 11, m3/h : 12, m3/m : 13, m3/s : 14, L/h : 15, L/m : 16, L/s : 17, cc/h : 18, cc/m : 19, cc/s : 20 NmL/h : 21, NmL/m : 22, NmL/s : 23, mL/h : 24, mL/m : 25, mL/S : 26, Nm/h : 27 Nm/min : 28, Nm/s : 29, TON/h : 30, TON/m : 31, TON/s : 32)

· DATA 3 (MOD-BUS ADDRESS 30003: Current flow cate

- The same decimal point is 1 digit and the unit is m/s

· DATA4, DATA5 (MOD-BUS ADDRESS 30004,30005 : Total count accumulated value
- Using 2 word and the formula is (Value of 30005 × 65536) + 30004

-The value is combined with the decimal point of DATA6(MOD-BUS ADDRESS30006
Ex) The value of DATA4. DATA5 is 123456 if value of DATA6 is 1 true accumulate valu e is TOTAL COUNT is 12345.6

· DATA6(MOD-BUS ADDRESS 300006): TOTAL COUNT DECIMAL POINT OF CUMULATIVE VALUE
- Range : 0 or 1 (0: no decimal point, 1: one decimal place)

· DATA7 (MOD-BUS ADDRESS 30007) : When there's trouble in sensor and inner sensor detection board, transmit 1. (When sensor works normally, transmit 0)

b. RESPONSE OF KC-2600 SET VALUE (MOD-BUS ADDRESS 40001 ~ 40020)
· FUNCTION CODE : 03H (Holding register 03H of MOD-BUS Memory function)
· BYTE SIZE : Data request channel size X 2
· For data content, refer to the format saving the set value change

3) FORMAT SAVING KC-2600 SET VALUE CHANGE (MOD-BUS ADDR 40001 ~ 40026)
◆ SAVE 1 WORD DATA

KC-2600 ADDR	FUNCTION CODE	ADDR H	ADDR L	DATA H	DATA L	CRC H	CRC L
1~255	06H	0000H ~ 0000DH		DATA0 ~ DATA15		CRC16	

· ALL PARAMETERS except flux LOW SCALE, HIGH SCALE, analog OUT PUT LOW RANGE, HIGH RANGE, TOTAL COUNT accumulated value set-up parameter correspond to it.
· FUNCTION CODE : 06H (Holding register 0311 of MOD-BUS MEMORY FUNCTION)
· ADDR H,ADDR L : ADDRESS of set PARAMETER
- ADDRESS 0000H becomes 400001(Data 0 value)
· DATA0 (MOD-BUS ADDRESS 40001) : Set decimal point of the current flux value
- Range is 0 or 1 (0: no decimal point, 1 : one decimal place)
· DATA 1(MOD-BUS ADDRESS 40002) : Set the flux unit
- Range is 0 ~ 32.
(Nm3/h : 0, Nm3/m : 1, Nm3/s : 2, Kg/h : 3, Kg/m : 4, Kg/s : 5, NL/h : 6, NL/m : 7, NL/s : 8, Ncc/h : 9, Ncc/m : 10, Ncc/s : 11, m3/h : 12, m3/m : 13, m3/s : 14, L/h : 15, L/m : 16, L/s : 17, cc/h : 18, cc/m : 19, cc/s : 20 NmL/h : 21, NmL/m : 22, NmL/s : 23, mL/h : 24, mL/m : 25, mL/S : 26, Nm/h : 27 Nm/min : 28, Nm/s : 29, TON/h : 30, TON/m : 31, TON/s : 32)

· DATA2 (MOD-BUS ADDRESS 40003) : Set up measuring type
- It's possible to select between gas and water, and the range is 0, 1. (0: Gas, 1: Water)

· DATA3 (MOD-BUS ADDRESS 40004) : Set flow velocity low cut
- The range is 0.0m/s ~ 99.9m/sec, and one should multiply 10 when transmitting the value.

· DATA4 (MOD-BUS ADDRESS 40005) : Set response time
- Range is 0.1 ~ 99.9 sec., and when transmitting the value, one should send by multiplying 10.

· DATA 5 (MOD-BUS ADDRESS 40006) : Set the pulse output divide value
- Range is 0 ~ 3. (0:1, 1:10, 2:100, 3:1000)

· DATA 6 (MOD-BUS ADDRESS 40007) Set Pulse output duty
- Range is 10 ~ 9999msec., and possible to set by 10msec step.

· DATA 7 (MOD-BUS ADDRESS 40008) : Decimal point of total count accumulated value
- Range is 0 or 1. (0 : no decimal point, 1: one decimal place)

· DATA 8 (MOD-BUS ADDRESS 40009) : Set Divide of total count accumulated value
- Range is 0 ~ 5. (0:0.01, 1:0.1, 2:1, 3:10, 4:100, 5:1000)

· DATA9 (MOD-BUS ADDRESS 40010) : not used

· DATA10 (MOD-BUS ADDRESS 40011) : not used

· DATA11 (MOD-BUS ADDRESS 40012) : Set display speed of total count accumulated value
- Range is 0.1~19.9 sec., and one should send by multiplying 10 when transmitting the value.

· DATA 12 (MOD-BUS ADDRESS 40013) : Set RS485 Communication address
- Range is 1 ~ 255.

· DATA 13 (MOD-BUS ADDRESS 40014) : Set RS485 COMMUNICATION SPEED
- Range is 0 ~ 5.
(0 : 2400bps, 1 : 4800bps, 2 : 9600bps, 3 : 19200bps, 4 : 38400bps, 5 : 57600bps)

※ Be careful as it can't be communicated when transmitting incorrectly the communication address and communication speed.

· DATA14 (MOD-BUS ADDRESS 40015) : Not used

· DATA15 (MOD-BUS ADDRESS 40016) : Reset total count accumulated value
- If transmitting 1 to Address 40016, one can reset total count accumulated value.

◆ SAVE OF 2 WORD DATA

KC-2600 ADDR	FUNCTION CODE	ADDR H	ADDR L	CHANNEL H	CHANNEL L	BYTE SIZE
1~255	10H	0010H or 0012H or 0014H or 0016H or 0018H		02H		04H

DATA LH	DATA LL	DATA HH	DATA HL	CRC H	CRC L
0010H or 0012H or 0014H or 0016H or 0018H				CRC 16	

· FLUX LOW SCALE, HIGH SCALE, ANALOG OUTPUT LOW RANGE, HIGH RANGE, TOTAL COUNT accumulated value parameter correspond to it.

· FUNCTION CODE : 10H (Holding register 03H of MOD-BUS memory function)

· ADDR H, ADDR L : START ADDRESS of set PARAMETER
  - 0010H = START ADDRESS of flux LOW SCALE (MOD-BUS Address 40017, 40018)
  - 0012H = START ADDRESS of flux HIGH SCALE (MOD-BUS Address 40019, 40020)
  - 0014H = START ADDRESS of ANALOG output LOW RANGE (MOD-BUS ADDRESS 40021, 40022)
  - 0016H = START ADDRESS of ANALOG output HIGH RANGE (MOD-BUS ADDRESS 40023, 40024)
  - 0018H = START ADDRESS of TOTAL COUNT accumulated value (MOD-BUS Address 40025, 40026)

· CHANNEL H, CHANNEL L : Fix to 02H as it's 2 WORD

· BYTE SIZE : Fix to 04H as it's BYTE SIZE : 4 BYTE DATA

· DATA 16, 17 (MOD-BUS ADDRESS 40017, 40018) : Set the FLUX LOW SCALE value
  - Range is 0 ~ 99999, and it should be transmitted with value not having decimal point.

· DATA18, 19 (MOD-BUS ADDRESS 40019, 40020) : Set up flux HIGH SCALE value.
  - Range is 0 ~ 99999, and it should be transmitted with value not having decimal point.

· DATA20, 21 (MOD-BUS ADDRESS 40021, 40022) : Set up ANALOG output LOW RANGE.
  - Range is 0 ~ 99999, and it should be transmitted with value not having decimal point.

· DATA22, 23 (MOD-BUS ADDRESS 40023, 40024) : Set up ANALOG output HIGH RANGE.
  - Range is 0 ~ 99999, and it should be transmitted with value not having decimal point.

· DATA24, 25 : Set up TOTAL COUNT accumulated value.
  - Range is 0 ~ 1999999999, and it should be transmitted with value not having decimal point.

※ Even number DATA is the LOW WORD of value, and odd number DATA is HIGH WORD of value.

Troubleshooting the Flow Meter

Begin hardware troubleshooting by verifying the following facilities issues are correct. These areas impact system operation and must be corrected prior to performing any flow meter inspections.

1. Verify the incoming power to the flow meter is present and of the correct voltage and polarity.
2. Check the flow meter wiring for correct connections as described in Chapter 2.
3. Verify the flow meter is installed with the correct number of upstream and downstream pipe diameters as shown on page 9
4. Verify the flow direction indicator is correctly aligned pointing downstream of flow.
5. Make sure there are no leaks in the line being measured.

※ After verifying the factors above, follow the troubleshooting procedures outlined on the next page. If you need to return the flow meter to the factory, see page 28 for return shipping instructions.

Caution!

Before attempting any flow meter repair, verify that the line is not pressurized.

Caution!

Always remove main power before disassembling any part of the mass flow meter.

Symptom	possible causes	measure
Flow rate measurement value is wrong or fluctuates too much	Abnormal flow	Refer to chapter.2Installation conditions
	The front and rear pipe diameters of the sensor are smaller thanrequired specification	Refet to chapter.2 installation conditions
	Insertion sensor is not securely fastened	Secure the sensor firmly in place without vibration.
	The constituent parts of the sensor are damaged	Exchange od repair
	Failure if electronic caution	Exchange od repair
	Bad ground	Refer to chapter.2 wiring
	Moisture in gas	Install moisture eliminator of filler at the front end of the sensor
Measured value is too high or low	Sensor is not installed correctly in the direction of fluid flow	Sensor is installed with the momitor facing front
	Sensor not inserted at the correct depth	Set the measuring point to be in the center of the pipe
No response from the sensor	The power is off	Switch on power
	The low-speed removal value was set too high (FLO SPD cut 0.1m/s)	Correctly reset lpw-speed removal function
	Exceeds low flow measurement limit below instrument minimum measurement range	Factory inquiry Set the user setting range equal to the manufacturing setting range Expand the piping to below the maximum the measuring range of the meter nameplate or inquire at factory
No pulse output	Relay coil insufficient current capacity	Relay coil current should be within 25mA maximum relay
	Torsion of instrument appearance	Relocate installation to another installation location
	several vortex flow	Setup separate blower or idle mixer or valve near instrument
Self diagnosis function sensor and sensor board When detects PCB failure	Sensor failure BAD substrate (MODE lamp flashing red)	Replace ield after confirming fault Check for sensor failure (RH and GND = 48Ω) (RH and GND =1280Ω) Check factory repair board fault (Display not directed)

GAS FACTOR TABLE 1

Gasname	Formula	Gasfactor	Orifice factor	Density (kg/m3)
Acetylene (Ethyne)	C2H2	0,615	0,970	1,173
Air	Mixture	0,998	1,018	1,293
Allene	C3H4	0,478	1,199	1,787
Ammonia	NH3	0,786	0,781	0,771
Argon	Ar	1,395	1,195	1,784
Arsine	AsH3	0,754	1,661	3,478
Boron Trichloride	BCL3	0,443	2,044	5,227
Boron Trifluoride	BF3	0,579	1,569	3,025
Bromine Pentafluoride	BrF5	0,287	2,502	7,806
Bromine Trifluoride	BrF3	0,439	2,214	6,108
Bromotrifluoroethylene	C2BrF3	0,326	2,397	7,165
Bromotrifluoromethane (f-13B1)	CBrF3	0,412	2,303	6,615
1,3-Butadiene	C4H6	0,354	1,413	2,491
Butane	C4H10	0,257	1,467	2,593
1-Butene	C4H8	0,294	1,435	2,503
CIS-2-Butene	C4H8	0,320	1,435	2,503
Trans-2-Butene	C4H8	0,291	1,435	2,503
Carbon Dioxide	CO2	0,773	1,255	1,977
Carbon Disulfide	CS2	0,638	1,650	3,393
Carbon Monoxide	CO	0,995	1,000	1,250
Carbon Tetrachloride	CCL4	0,344	2,345	6,860
Carbon Tetrafluoride (f-14)	CF4	0,440	1,770	3,926
Carbonyl Fluoride	COF2	0,567	1,555	2,045
Carbonyl Sulfide	COS	0,680	1,463	2,680
Chlorine	CL2	0,876	1,598	3,214
Chlorine Dioxide	CLO2	0,693	1,554	3,011
Chlorine Trifluoride	CLF3	0,433	1,812	4,125
Chlorodifluoromethane (f-22)	CHCLF2	0,505	1,770	3,906
Chloroform (Trichloromethane)	CHCL3	0,442	2,066	5,340
Chloropentafluoroethane (f-115)	C2CLF5	0,243	2,397	7,165
Chlorotrifluoroethylene	C2CLF3	0,337	2,044	5,208
Chlorotrifluoromethane (f-13)	CCLF3	0,430	1,985	4,912
2-Chlorobutane	C4H9CL	0,234	1,818	4,134
Cyanogen	(CN)2	0,498	1,366	2,322
Cyanogen Chloride	CLCN	0,618	1,480	2,730
Cyclobutane	C4H8	0,387	1,413	2,491

GAS FACTOR TABLE 2

Gasname	Formula	Gasfactor	Orifice factor	Density (kg/m3)
Cyclopropane	C3H6	0,505	1,224	1,877
Deuterium	D2	0,995	0,379	0,177
Diborane	B2H6	0,448	1,000	1,235
Diboromodifluoromethane (f-12B2)	CBr2F2	0,363	2,652	8,768
1,2-Dibromotetrafluoroethane (f-114B2)	C2Br2F4	0,215	2,905	10,530
Dichlorodifluoromethane (f-12)	CCL2F2	0,390	2,099	5,492
Dichlorofluoromethane (f-21)	CHCL2F	0,456	1,985	4,912
Dichlorosilane	SiH2CL2	0,442	1,897	4,506
Diedthylsilane	C4H12Si	0,183	1,775	3,940
2,2 Dichloro- 1,1,1- Trifloroethane	C2HCL2F3	0,259	2,336	6,829
1,2-Dichloroethane (Ethylene dichloride)	C2H4CL2	0,382	1,879	4,419
1,2-Dichlorotetrafluoroethane (f-114)	C2CL2F4	0,231	2,449	7,479
1,1-Difluoro-1-Chloroethane	C2H3CLF2	0,341	1,957	4,776
1,1-Difluoroethane	CH3CHF2	0,415	1,536	2,940
1,1-Difluoroethylene	CH2:CF2	0,458	1,512	2,860
Difluoromethane (f-32)	CF2H2	0,627	1,360	2,411
Dimethylamine	(CH3)2NH	0,370	1,269	2,013
Dimethylether	(CH3)2O	0,392	1,281	2,055
2,2-Dimethylpropane	C(CH3)4	0,247	1,613	3,244
Disilane	Si2H6	0,332	1,493	2,779
Ethane	C2H6	0,490	1,038	1,357
Ethanol	C2H6O	0,394	1,282	2,057
Ethylacetylene	C4H6	0,365	1,384	2,388
Ethyl Chloride	C2H5CL	0,408	1,516	2,879
Ethylene	C2H4	0,619	1,000	1,261
Ethylene Oxide	C2H4O	0,589	1,254	1,965
Fluorine	F2	0,924	1,163	1,695
Fluoroform (f-23)	CHF3	0,529	1,584	3,127
Germane	GeH4	0,649	1,653	3,418
Germanium Tetrachloride	GeCL4	0,268	2,766	9,574
Halothane	C2HBrCLF3	0,257	2,654	8,814
Helium	He	1,386	0,378	0,178
Hexafluoroacetone	C3F6O	0,219	2,434	7,414
Hexafluorobenzine	C6F6	0,632	2,577	8,309
Hexafluoroethane (f-116)	C2F6	0,255	2,219	6,139
Hexafluoropropylene (HFP)	C3F6	0,249	2,312	6,663

GAS FACTOR TABLE 3

Gasname	Formula	Gasfactor	Orifice factor	Density (kg/m3)
Hydrogen	H2	1.008	0.269	0.090
Hydrogen Bromide	HBr	0.987	1.695	3.645
Hydrogen Chloride	HCL	0.983	1.141	1.639
Hydrogen Cyanide	HCN	0.744	0.973	1.179
Hydrogen Fluoride	HF	0.998	0.845	0.893
Hydrogen Iodide	HI	0.953	2.144	5.789
Hydrogen Selenide	H2Se	0.837	1.695	3.613
Hydrogen Sulfide	H2S	0.850	1.108	1.539
Iodine Pentafluoride	IF5	0.283	2.819	9.907
Isobutane	C4H10	0.260	1.440	2.596
Isobutene	C4H8	0.289	1.435	2.503
Isopentane	C5H12	0.211	1.605	3.222
Krypton	Kr	1.382	1.729	3.708
Methane	CH4	0.763	0.763	0.717
Methylacetylene	C3H4	0.473	1.196	1.782
Methyl Bromide	CH3Br	0.646	1.834	4.236
3-Methyl-1-butene	C5H10	0.252	1.584	3.127
Methyl Chloride	CH3CL	0.687	1.347	2.308
Methyl Fluoride	CH3F	0.761	1.102	1.518
Methyl Mercaptan	CH4S	0.588	1.313	2.146
Methyl Silane	CH6Si	0.393	1.283	2.061
Methyl Trichlorosilane	CH3CL3Si	0.267	2.310	6.675
Methyl Vinyl Ether	C3H6O	0.377	1.435	2.567
Monoethyanolamine	C2H7NO	0.305	1.477	2.728
Monoethylamine (CH3CH2NH2)	C2H7	0.359	1.269	2.013
Monomethylamine	CH3NH2	0.565	1.047	1.420
Neon	Ne	1.398	0.847	0.902
Nickel Carbonyl	Ni(CO)4	0.212	2.371	7.008
Nitric Oxide	NO	0.995	1.030	1.339
Nitrogen	N2	1.000	1.000	1.251
Nitrogen Dioxide	NO2	0.758	1.713	2.052
Nitrogen Trifluoride	NF3	0.501	1.598	3.168
Nitrogen Trioxide	N2O3	0.443	1.649	3.389
Nitrosyl Chloride	NOCL	0.644	1.529	2.913
Nitrous Oxide	N2O	0.752	1.259	1.964
Octofluorocyclobutane	C4F8	0.169	2.678	8.933
Oxygen	O2	0.988	1.067	1.429

GAS FACTOR TABLE 4

Gasname	Formula	Gasfactor	Orifice factor	Density (kg/m3)
Oxygen Difluoride	OF2	0,672	1,388	2,402
Ozone	O3	0,738	1,310	2,138
Perchloryl Fluoride	CLO3F	0,448	1,905	4,571
Perfluorobutane	C4F10	0,738	2,918	10,610
Perfluoro-2-Butene	C4F8	0,268	2,672	8,933
Perfluoromethyl-vinylether (PMVE)	PMVE	0,296	2,029	5,131
Perfluoropropane	C3F8	0,179	2,591	8,396
Pentane (n-Pentane)	C5H12	0,212	1,605	3,222
Pentafluoroethane	C2HF5	0,287	2,070	5,360
Phosgene	COCL2	0,504	1,881	4,418
Phosphine	PH3	0,783	1,100	1,517
Phosphorous Pentafluoride	PF5	0,346	2,109	5,620
Phosphorous Trifluoridide	PF3	0,495	1,770	3,906
Propane (same as CH3CH2CH3)	C3H8	0,343	1,274	2,008
Propylene (Propene)*	C3H6	0,401	1,234	1,875
Rhenium Hexafluoride	ReF6	0,230	3,279	13,410
Silane	SiH4	0,625	1,070	1,440
Silicon Tetrachloride	SiCL4	0,310	2,462	7,579
Silicon Tetrafluoride	SiF4	0,395	1,931	4,648
Sulfur Dioxide	SO2	0,728	1,529	2,858
Sulfur Hexafluoride	SF6	0,270	2,348	6,516
Sulfur Tetrafluoride	SF4	0,353	1,957	4,776
Sulfur Trioxide	SO3	0,535	1,691	3,575
Sulfuryl Fluoride	SO2F2	0,423	1,931	4,648
Tetrachloromethane	CCL4	0,344	2,345	6,858
Tetrafluoroethylene (TFE)	C2F4	0,361	1,905	4,526
Tetrafluorohydrazine	N2F4	0,367	1,926	4,624
Trichlorofluoromethane (f-11)	CCL3F	0,374	2,244	6,281
Trichlorosilane	SiHCL3	0,329	2,201	6,038
Trimethyloxyborane (TMB)	B(OCH3)3	0,300	1,929	4,638
1,1,2-Trichloro-1,1,2-Triflouroet (f-113)	C2CL3F3	0,231	2,520	7,920
Trimethylamine	(CH3)3N	0,316	1,467	2,639
Tungsten Hexafluoride	WF6	0,227	3,264	13,280
Uranium Hexafluoride	UF6	0,220	3,548	15,700
Vinyl Bromide	C2H3Br	0,524	1,985	4,772
Vinyl Chloride	C2H3CL	0,542	1,492	2,788
Vinyl Fluoride	C2H3F	0,576	1,281	2,046
Water Vapor	H2O	0,861	0,802	0,804
Xenon	Xe	1.383	2.180	5.851

Gas & Liquid type THERMAL MASS FLOW METER
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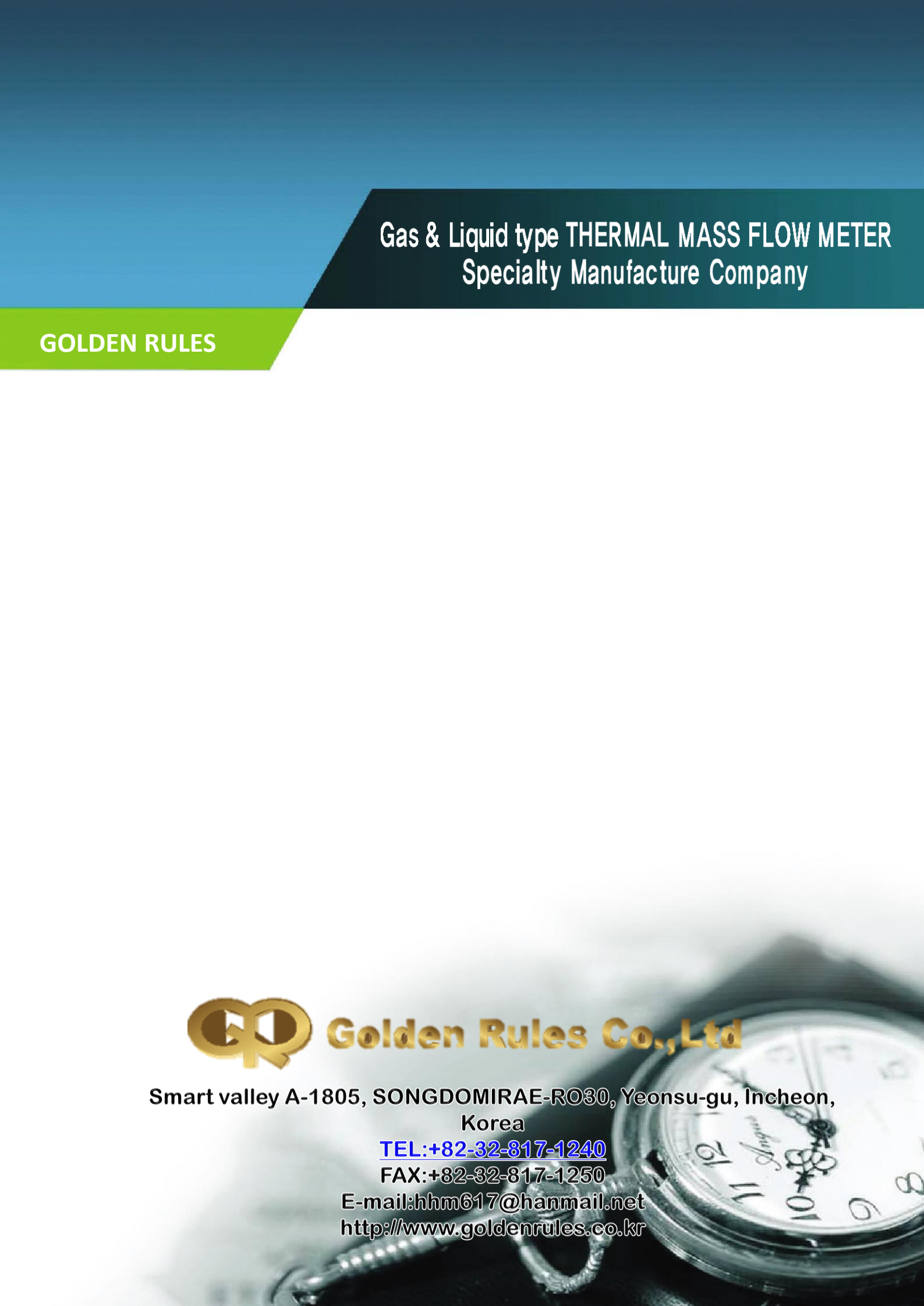
GOLDEN RULES



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