Operating Instructions

for

Thermal Mass Flow Meter

Model: MAK

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2. Note

Please read these operating instructions before unpacking and putting the unit into operation. Follow the instructions precisely as described herein.
The instruction manuals on our website www.kobold.com are always for currently manufactured version of our products. Due to technical changes, the instruction manuals available online may not always correspond to the product version you have purchased. If you need an instruction manual that corresponds to the purchased product version, you can request it from us free of charge by email (info.de@kobold.com) in PDF format, specifying the relevant invoice number and serial number. If you wish, the operating instructions can also be sent to you by post in paper form against an applicable postage fee.

Operating instructions, data sheet, approvals and further information via the QR code on the device or via www.kobold.com

The devices are only to be used, maintained and serviced by persons familiar with these operating instructions and in accordance with local regulations applying to Health & Safety and prevention of accidents.

When used in machines, the measuring unit should be used only when the machines fulfil the EC machinery directive.

3. Instrument Inspection

Instruments are inspected before shipping and sent out in perfect condition.
Should damage to a device be visible, we recommend a thorough inspection of the delivery packaging. In case of damage, please inform your parcel service / forwarding agent immediately, since they are responsible for damages during transit.

Scope of delivery:
The standard delivery includes:

- Thermal Mass Flow Meter model: MAK

4. Regulation Use

Any use of the device, which exceeds the manufacturer's specification, may invalidate its warranty. Therefore, any resulting damage is not the responsibility of the manufacturer. The user assumes all risk for such usage.

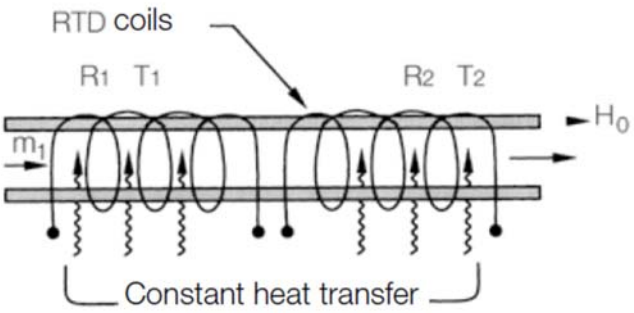
5. Operating Principle

The new MAK series KOBOLD digital mass flowmeters have been specially developed for use in gas measurement, where excellent accuracy, high reliability, robust casing, stainless materials and maximum flexibility are important.
MAK is equipped with an indicator that employs a proven flow sensor. It has a function to indicate the integrated flow rate, in addition to the existing instantaneous flow rate indication.
A model with a flow sensor and precision needle valve in one unit is also available.

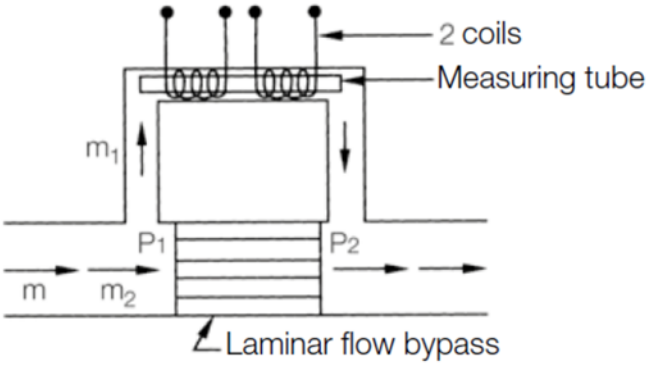
Theory of Operation

The medium flows through the bypass measuring system. The resulting differential pressure between P1 and P2 causes a small amount of gas to flow through the overhead measuring tube. The separation ratio is constant.
Two resistance temperature detectors (RTD elements) transferring a constant amount of heat to the gas stream are mounted on the measuring tube.
Under flow conditions, the gas molecules absorb and transport the heat away. This gives rise to a temperature difference between the two detector coils, which causes a change in resistance in the detector coils, whereby R1 <> R2. The electronics converts the signal for indication. The temperature difference increases as the flow increases.

Measuring tube design



Flow diagram



6. Mechanical Connection

(1) Use the equipment within the pressure range shown in the specification.
(2) Use the equipment at the ambient temperature and humidity shown in the specification.
(3) This is precision equipment. Keep it protected against strong shock.

Caution! Do not apply a pressure exceeding the allowable level. Otherwise, the product may be damaged.

This product is precision equipment. Exercise caution to protect it from shocks by, for example, falling and hitting. Otherwise, the product may be damaged.

6.1 Installation and piping

- Installation place
  - This equipment is designed for indoor use.
    Never install the equipment in a place where it is likely to be wetted by water or rain.
    The equipment may fail. Install the equipment in a place where sufficient ventilation is provided and changes in humidity are minimal.
  - Install the equipment in a place free of vibration and impact.
  - Do not use the equipment under direct sunlight or at high temperature/humidity.
  - Install the equipment in a place free of dust.
  - Install the product in a place free of corrosive gases.
  - Install the product in a place free of a strong electric/magnetic field.
    The frame to fix the block shall be connected to an electrically stable point (e.g. being grounded).
  - Install the product in a place where ambient temperature is 15 to 35℃.
- Lay piping so that the flow direction matches the arrow (►) shown on the body.
- Install the product horizontally.
- Install the product in such a way that the LED/switches do not face downward.
- Be sure to install a line filter (100 μm or finer) on the inlet side of gas.
- Where complete shutoff is required, provide a shutoff valve.
- To use a highly reactive gas, be sure to conduct complete purge with inert gas before and after use.

Installation method
Install the product with two M4 screws from the back using threaded holes on the bottom. For the location of threaded holes, see Dimensions.

Warning!

- **Never let gas exceeding the explosion limit flow to the product. Otherwise, it may cause explosion accidents**
- **Never use the product the gas contact part of which has not been degreased (oil-free treatment) for oxygen. Otherwise, a fire may break out. Even when the product has been degreased, if it has been used for a gas other than oxygen, never use it for oxygen.**

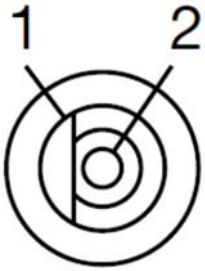
Caution!

- **Ensure that no foreign matter will flow into the product. If piping rust, water droplets, oil mist, dust, etc. flow into the product, they may cause measurement/control errors and damage to the product.**
- **If there is a possibility that foreign matter will flow into the product, install a suitable device such as a filter, strainer and mist trap having a capacity to remove foreign matter larger than 100̀m in the upstream and inspect or replace it periodically.**
- **The needle valve of this product has not been designed for complete shutoff. If complete closing id required, please install a shutoff valve externally separately.**
- **Rapid heating to high temperatures can cause serious malfunctions.**
- **Install the product on a horizontal pipe. Ensure that the display will not face downward**
- **Install the product firmly so that it will not vibrate. Otherwise, it may malfunction or fail.**
- **After piping, inspect it to ensure that no gas will leak**
- **Be sure to use the product within the flow rate range defined in the product specifications. Also, in order to prevent an excessive flow rate, control the proper supply pressure and provide instrumentation in consideration of installation of a throttle valve, etc.**
- **If damages are envisaged due to a problem of the product, use a redundant design.**

7. Electrical Connection

- Make sure that the supply wires are de-energized.
- Plug in the system according to the connecting diagrams.

DC Jack

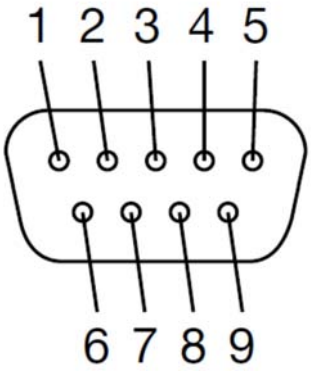


Pin No.	Signal name	Description
1	Power supply COM	Power supply COM
2	Power supply +24 V	Power supply +24 V

Connectors

Product side connector: D-subminiature 9-pin male (M2.6 short screw)
Applicable connectors: D-subminiature 9-pin female (M2.6 short screw)

Pin assignment



Pin No.	Signal name	Description
1	Power supply +24 V	Power supply +24 V
2	Power supply COM	Power supply COM
3	OUT 1	Event output 1
4	OUT 2	Event output 2
5	OUT COM	Event output COM
6	Analog output	Analog output
7	TR+	RS485 communications
8	TR-	RS485 communications
9	Analog output COM TR COM	Analog output COM RS485 communications COM

Caution! Prior to turning on the power, make sure that the product has been wired correctly.

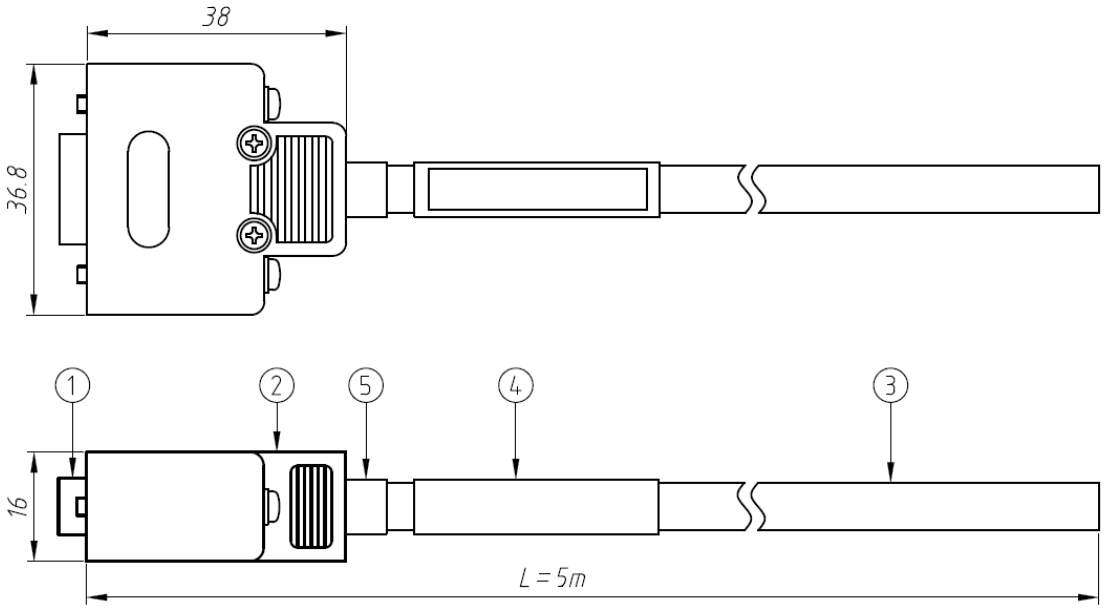
Incorrect wiring will cause damage and malfunction.

7.1 PIN Assignment D-Sub cable

The optional 9-pin D-Sub female connector with 5 meters cable model **ZUB-MAK-D095** is provided with following dimensions and colour coding:

Dsub Connector 9P (Female)

Pin No.	Signal	Lead colour
1	+24 V	White (Red dot)
2	Power COM	White (Black dot)
3	OUT 1	Yellow (Red dot)
4	OUT 2	Yellow (Black dot)
5	OUT COM	Pink (Red dot)
6	SIGNAL	Pink (Black dot)
7	RS485 TR+	Orange (Red dot)
8	RS485 TR-	Orange (Black dot)
9	RS485/SIGNAL COM	Gray (Red dot)
SHELL	CASE GND	SHIELD



No.	Name	Specification
1	Dsub connector 9P (female)	DE-9SF-N
2	Junction Shell	DE-C8-J9-F1-1
3	Cable	UL2464 AWG28 10LEADS WITH SHIELD (GRAY)
4	Label Tape	
5	Heat Shrink Tube	8 (Black)

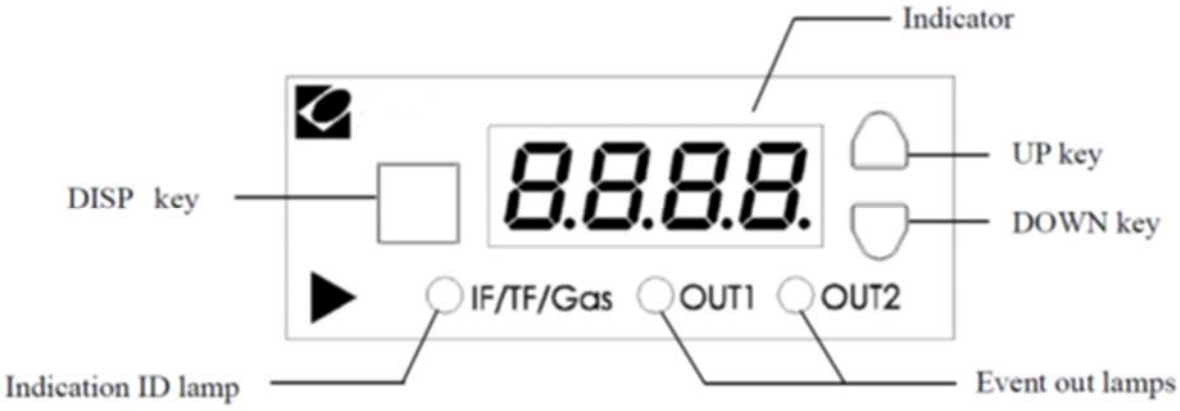
8. Operation / Configuration / Adjustments

8.1 Warming up

Warm up the equipment at least 15 minutes after it was powered on.

8.2 Operating procedure

Indicator panel



Indicator
Indicates an instantaneous flow rate or integrated flow rate. When lower 4 digits of the integrated flow rate are indicated, the decimal point is shown.
The decimal point is not shown for upper 4 digits.
During setting, the parameter No. or set value is shown here.

Event out lamps
When the Event output 1 is on, "OUT1" lights and when the Event output 2 is on, "OUT2" lights

Indication ID lamp
Lights when an instantaneous flow rate is being indicated and flashes when an integrated flow rate is being indicated.

DISP key [□]

[Measurement]

- Press: Switches over the indication. The indication switches over in the order of instantaneous flow rate → integrated flow rate (lower 4 digits) → integrated flow rate (upper 4 digits) → gas type → instantaneous flow rate. The integrated flow rate (upper 4 digits) is not indicated if the integrated flow rate value has not reached the upper 4 digits.
- Press & hold: Goes to a setting mode.
  - Pressing and holding this key when an instantaneous flow rate is being indicated shows "Parameter setting mode". Continuing to press and hold this key after "Parameter setting mode" has appeared shows "Zero adjustment mode".
  - Pressing and holding this key when an integrated flow rate is being indicated shows "Integrated flow rate resetting mode".

[Setting]

- Press: Selects items and accepts values entered in each setting mode.
- Press & hold: [Parameter setting mode] Returns to the instantaneous flow rate indication.
  [Zero adjustment mode] When <Yes> is shown, the integrated flow rate is reset.

UP key [△]/Down key [▽]

[Parameter setting mode]

- Press: Increase/decreases the value of the flashing digit
- Press and hold: Shifts the digit.

[Zero adjustment mode]: switching <Yes>/<No>

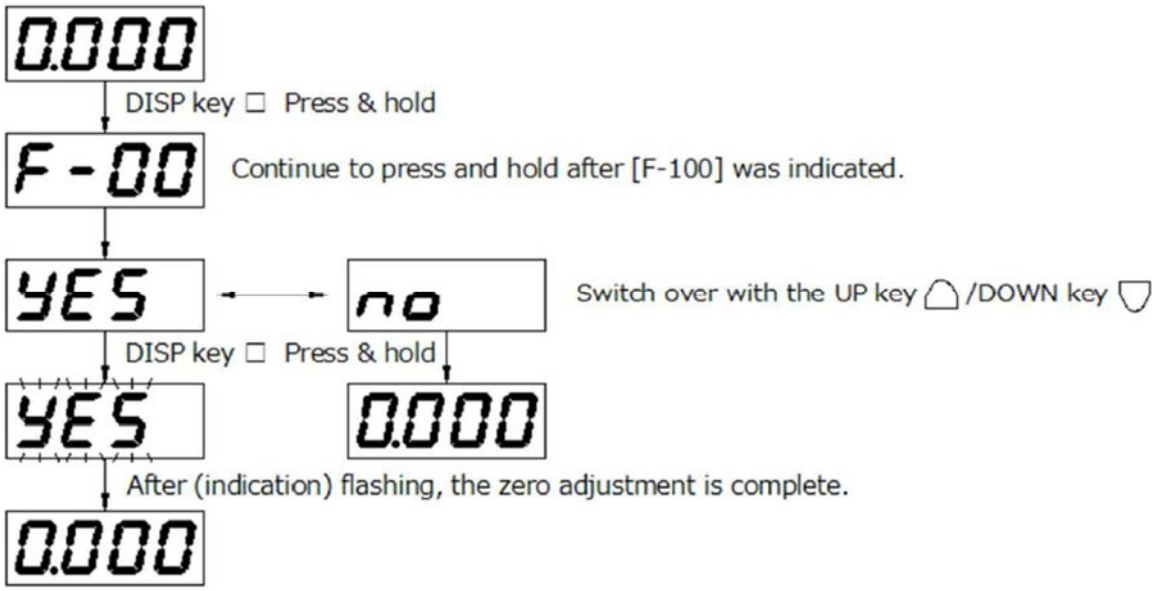
[Integrated flow rate resetting mode]: switching <Yes>/<No>

Caution! This meter has been adjusted in the flow rate in the factory and adjustment data has been stored in an F-RAM. Please keep in mind that if several keys on the indicator panel are pressed and held simultaneously when turning on the power, the indicator shows the mode where the stored data will be rewritten. When the meter has entered this mode, turn off the power. If rewrite has not been enabled yet, the data may be recovered. If the data has been rewritten, it is necessary to correct the data.

8.3 Zero adjustment mode

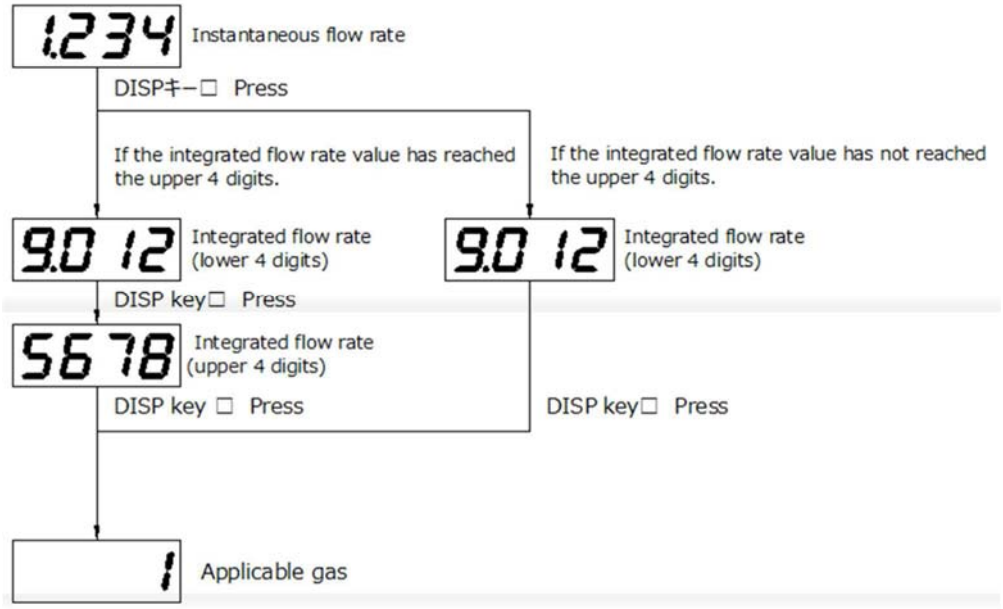
Stop the flow of gas completely with an instantaneous flow rate being indicated. In this state, pressing and holding the DISP key [□] shows “Parameter setting mode” and <F-00> will be shown. Continuing to press and hold the key shows “Zero adjustment mode” and <Yes> will be shown. Switch over <Yes>/<No> with the UP key [△]/DOWN key [▽] and when <Yes> is being shown, pressing and holding the DISP key [□] completes zero adjustment.
When <No> is being shown, pressing the DISP key [□] returns to the instantaneous flow rate indication. (If flickering of a figure near 0 is annoying, select the low cut function. The indication of a figure below 0.5% F.S. is cut.)

Caution! If the indicated value is largely different (2% or more) from the zero point set in the factory, the zero adjustment is not possible. In this case, please contact our sales office or the dealer.



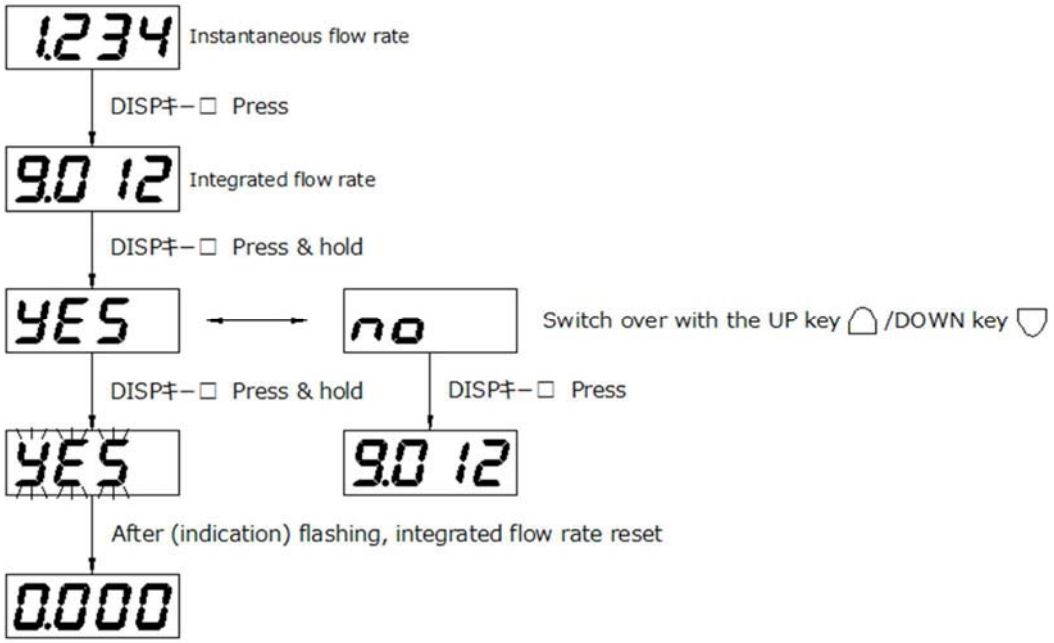
8.4 Flow rate indication

1. Switching over flow rates to indicate
   Each time the DISP key [□] on the flow rate indicator panel is pressed, indication is switched over in the order of instantaneous flow rate → integrated flow rate (lower 4 digits) → integrated flow rate (upper 4 digits) → applicable gas. The integrated flow rate (upper 4 digits) will not be indicated, however, when the integrated flow rate value has not reached the upper 4 digits.



2. [Integrated flow rate resetting]

In the state of integrated flow rate indication setting, press and hold the DISP key [□]. Then the indicator will show <yes>. <yes> and <no> can be switched over with the UP key[△] or DOWN key[▽].
When <yes> is being shown, pressing and holding the DISP key [□] causes <yes> to flash. When the DISP key [□] is pressed and held, the integrated flow rate value will be reset.



8.5 [Parameter setting mode]

When an instantaneous flow rate is being indicated, pressing and holding DISP key [□] sets the parameter setting mode. Each time DISP key [□] is pressed, the indication changes in the order of mode No. → set value → mode No. → set value.
To change the set value, use the UP key [△] or DOWN key [▽]. When the UP key [△] or DOWN key [▽] is pressed and held, the digit can be shifted.
After setting a parameter, pressing and holding DISP key [□] registers the set value and returns the mode to the flow rate indication mode.

Default values

Mode No.	Default Value				Set Item
	A	B	C	D	
F-00	※	※	※	※	Indication of max. value (unchangeable)
P-00				※	Reference condition on flow rate
P-01				1	Low cut function selection
P-02				3	PV filter
P-03				3	Instantaneous flow rate indication update cycle
P-04				0	Integrated flow rate hold selection
P-05				※	Analog output selection
P-10			0	0	OUT1 output selection
P-11	9	9	9	9	OUT1 instantaneous flow rate upper limit preset setting
P-12	9	9	9	9	OUT1 instantaneous flow rate lower limit preset setting
P-13			3	0	Dead time value
P-14	9	9	9	9	OUT1 integrated flow rate reach preset setting upper 4 digits
P-15	9	9	9	9	OUT1 integrated flow rate reach preset setting lower 4 dig-its
P-16		0	1	0	Integrating pulse output rate
P-20			0	0	OUT2 output selection
P-21	9	9	9	9	OUT2 instantaneous flow rate upper limit preset setting
P-22	9	9	9	9	OUT2 instantaneous flow rate lower limit preset setting
P-23			3	0	Dead time value
P-24	9	9	9	9	OUT2 integrated flow rate reach preset setting upper 4 digits
P-25	9	9	9	9	OUT2 integrated flow rate reach preset setting lower 4 dig-its
P-26		0	1	0	Integrating pulse output rate
P-30				1	Applicable gas selection
P-31	1.	0	0	0	CF value
P-40				1	Communication ID
P-41				2	Transmission speed selection
P-42				0	Parity

※According to the ordered specifications

Setting mode No. and description of set values

Mode No.	Set Item	Description of set values	Default Value
F-00	Indication of max. value (Full scale)	A B C D 2 0 0 0 The value of the full scale is indicated. Unchangeable. Max value :2000	※
P-00	Reference condition on flow rate	A B C D 0 Reference condition on flow rate 0: 20℃,1atm 1: 0℃,1atm 2: 25℃,1atm Set the flow rate reference condition. ※The default values are as per the specifications.	※
P-01	Low cut function selection	A B C D 1 Low cut function selection (±0.5%F.S.) 0: Disable 1: Enable 0:Disable: Instantaneous flow rates below 0.5% F.S. are indicated. Negative values are also indicated. 1:Enable: Instantaneous flow rates below 0.5% F.S. are indicated as 0. Negative values are also indicated as 0.	1
P-02	PV filter	A B C D 0 PV filter 0: No. 1: Moving average of sampling 2 times 2: Moving average of sampling 4 times 3: Moving average of sampling 8 times 4: Moving average of sampling 16 times 5: Moving average of sampling 32 times Input signals are measured during the period set here and an average value is calculated. Therefore, the indication is averaged and updated at the set cycle.	3
P-03	Instantaneous flow rate indication update cycle	A B C D 0 Instantaneous flow rate indication update cycle 0: 25ms 1: 50ms 2: 100ms 3: 200ms 4: 500ms 5: 1000ms	3
P-04	Integrated flow rate hold selection	A B C D 0 (The integrated flow rate value hold cycle :1min.) Integrated flow rate hold 0: disable 1: enable 0:Disable: The integrated flow rate value is reset when the power is turned off. 1:Enable: The integrated flow rate value is held after the power is turned off. The integrated flow rate value hold cycle is 1 minute.	1
P-05	Analog output selection	A B C D 0 Analog output 0: 4-20mA 1: 0-5V 2: 1-5V ※The default values are as per the specifications.	※

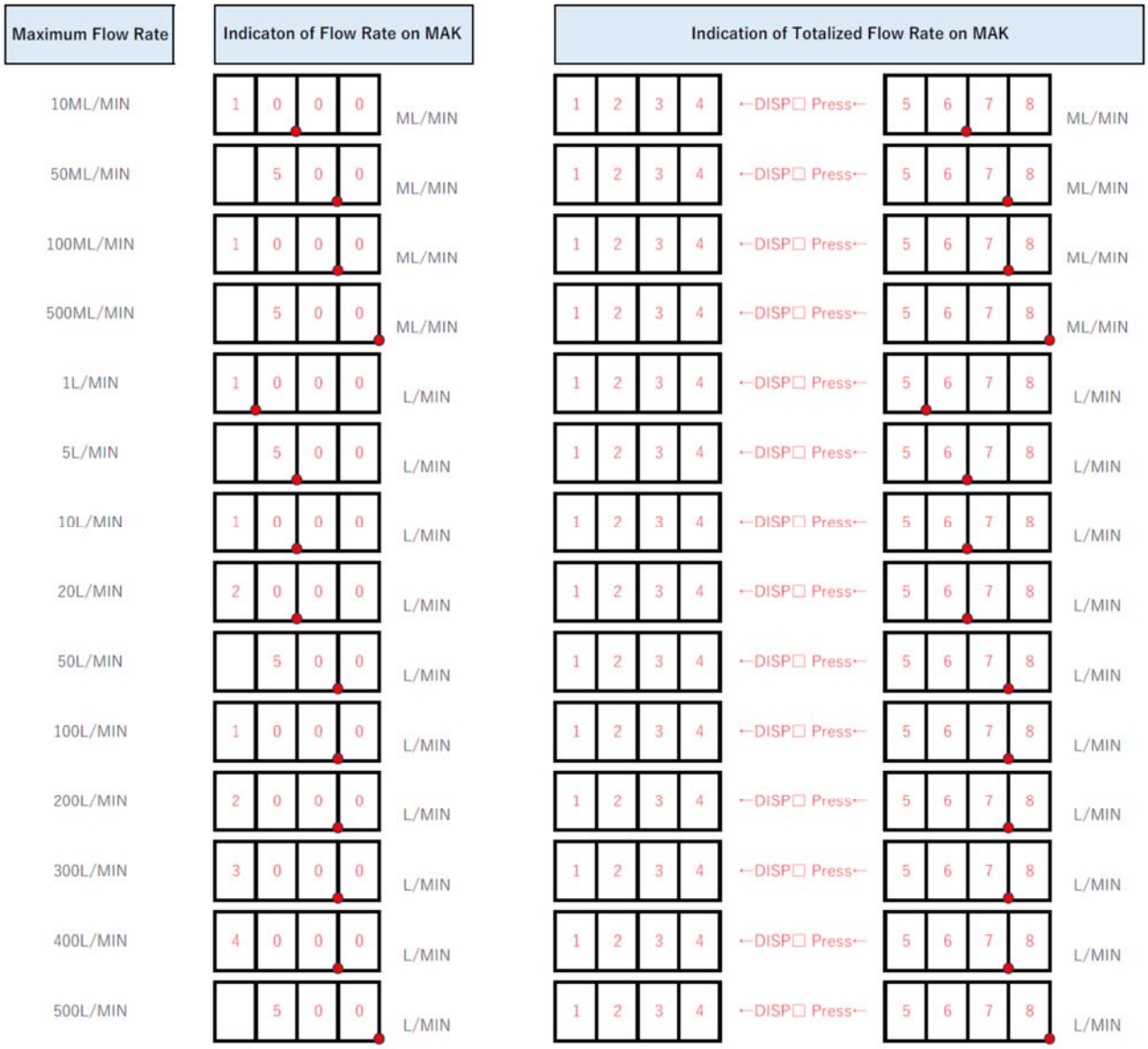
Parameter setting No.	Set Item	Description of set values	Default Value
P-10	OUT1 output selection	A B C D 0 0 00:No 10: Instantaneous flow rate upper limit : ON 11: Instantaneous flow rate upper limit : OFF 20:Instantaneous flow rate lower limit : ON 21:Instantaneous flow rate lower limit : OFF 30:Instantaneous flow rate upper/lower limit : ON 31:Instantaneous flow rate upper/lower limit : OFF 40:Integrated flow rate reach : ON 41:Integrated flow rate reach : OFF 50:Integrating pulse : ON 51:Integrating pulse :OFF ※:ON:Normal output, OFF:Inverted output The function works according to results of comparison between the indicated value and the preset value. [OUT1 setting] 00:The event output mode is not used. 10:Instantaneous flow rate upper limit output Output when "instantaneous flow rate value ≧ P-11 upper limit preset value". 20:Instantaneous flow rate lower limit output Output when "instantaneous flow rate value ≦ P-12 lower limit preset value". 30:Instantaneous flow rate upper/lower limit output Output when "instantaneous flow rate value ≧ P-11 upper limit preset value" or "instantaneous flow rate value ≦ P-12 lower limit preset value". ※The alarm is constantly output when "P-11 upper limit preset value ≦ P-12 lower limit preset value" is set. 40: Integrated flow rate reach Output when "integrated flow rate value ≧ P-13 upper limit preset value". 50:Pulses of approx. 50 ms are output every preset value of P-16 of the integrated flow rate value.	00
P-11	OUT1 instantaneous flow rate upper limit preset setting	A B C D 9 9 9 9 Setting of output 1 preset value: 0000 – 9999 Indicated only when [10]/[11] or [30]/[31] are selected in P-10.	9999
P-12	OUT1 instantaneous flow rate lower limit preset setting	A B C D 0 0 0 0 Setting of output 1 preset value: 0000 – 9999 Indicated only when [20]/[21] or [30]/[31] are selected in P-10.	0000
P-13	Dead time value	A B C D 0 0 Setting of output 1 preset value: 00~30 (unit:sec.) Indicated only when [10]/[11] or [20]/[21] or [30]/[31] are selected in P-10.The upper limit, lower limit and upper/lower limit are output when each condition is met during this period continuously.	00
P-14	OUT1 integrated flow rate reach preset setting upper 4 digits	A B C D 9 9 9 9 (Upper 4 digits) Setting of output 1 preset value: 0000 – 9999 Indicated only when [40]/[41] are selected in P-10.	9999
P-15	OUT1 integrated flow rate reach preset setting lower 4 digits	A B C D 9 9 9 9. (Lower 4 digits) Setting of output 1 preset value: 0000 – 9999 Indicated only when [40]/[41] are selected in P-10. ＊The decimal point is shown in lower 4 digits. The position of the decimal point varies depending on specification flow rates.	9999
P-16	Integrating pulse output rate	A B C D 0 1 0 Setting of output 1 preset value: 001~100(unit:%FS) Indicated only when [50]/[51] are selected in P-10.	10

Parameter setting No.	Set Item	Description of set values	Default Value
P-20	OUT2 output selection	A B C D 0 0 00:No 10: Instantaneous flow rate upper limit : ON 11: Instantaneous flow rate upper limit : OFF 20:Instantaneous flow rate lower limit : ON 21:Instantaneous flow rate lower limit : OFF 30:Instantaneous flow rate upper/lower limit : ON 31:Instantaneous flow rate upper/lower limit : OFF 40:Integrated flow rate reach : ON 41:Integrated flow rate reach : OFF 50:Integrating pulse : ON 51:Integrating pulse :OFF ※ON:Normal output, OFF:Inverted output The function works according to results of comparison between the indicated value and the preset value. [OUT2 setting] 00:The event output mode is not used. 10:Instantaneous flow rate upper limit output Output when "instantaneous flow rate value ≧ P-21 upper limit preset value". 20:Instantaneous flow rate lower limit output Output when "instantaneous flow rate value ≦ P-22 lower limit preset value". 30:Instantaneous flow rate upper/lower limit output Output when "instantaneous flow rate value ≧ P-21 upper limit preset value" or "instantaneous flow rate value ≦ P-22 lower limit preset value". ※The alarm is constantly output when "P-11 upper limit preset value ≦ P-22 lower limit preset value" is set. 40: Integrated flow rate reach Output when "integrated flow rate value ≧ P-23 upper limit preset value". 50:Pulses of approx. 50 ms are output every preset value of P-26 of the integrated flow rate value.	00
P-21	OUT2 instantaneous flow rate upper limit preset setting	A B C D 9 9 9 9 Setting of output 2 preset value: 0000 – 9999 Indicated only when [10]/[11] or [30]/[31] are selected in P-20.	9999
P-22	OUT2 instantaneous flow rate lower limit preset setting	A B C D 0 0 0 0 Setting of output 2 preset value: 0000 – 9999 Indicated only when [20]/[21] or [30]/[31] are selected in P-20.	0000
P-23	Dead time value	A B C D 0 0 Setting of output 2 preset value: 00～30 (unit:sec.) Indicated only when [10]/[11] or [20]/[21] or [30]/[31] are selected in P-20.The upper limit, lower limit and upper/lower limit are output when each condition is met during this period continuously.	00
P-24	OUT2 integrated flow rate reach preset setting upper 4 digits	A B C D 9 9 9 9 (Upper 4 digits) Setting of output 2 preset value: 0000 – 9999 Indicated only when [40]/[41] are selected in P-20.	9999
P-25	OUT2 integrated flow rate reach preset setting lower 4 digits	A B C D 9 9 9 9. (Lower 4 digits) Setting of output 2 preset value: 0000 – 9999 Indicated only when [40]/[41] are selected in P-20. ＊The decimal point is shown in lower 4 digits. The position of the decimal point varies depending on specification flow rates.	9999
P-26	Integrating pulse output rate	A B C D 0 1 0 Setting of output 2 preset value: 001～100(unit:%FS) Indicated only when [50]/[51] are selected in P-20.	10

Parameter setting No.	Set Item	Description of set values	Default Value
P-30	Applicable gas selection	A B C D 0 — Applicable gas and CF value setting 0: CF value setting 1: N_2 2: Air 3: H_2 4: He 5: Ar 6: O_2 7: CO_2 8: CH_4 ※Default:N2. FS.50～200SLM: [0]or[1]or[2]or[5]. FS.300～500SLM:[0]or[1]	1
P-31	CF value	A B C D 1. 0 0 0 0.500～1.500 Indicated only when [0] is selected in P-10.	1.000
P-40	Communication ID	A B C D 0 0 1 Communication ID: 1～247, - [-]:Communication is disabled. [001] to [247]:Modbus conforming	1
P-41	Transmission speed selection	A B C D 0 — Transmission speed 0: 9600bps 1: 19200bps 2: 38400bps Not indicated when [-] is selected in P-40. Fixed value: Start bit:1bit, Data length:8bit, Stop bit:1bit	2
P-42	Parity	A B C D 0 — Parity 0: No parity 1: Odd parity 2: Even parity Not indicated when [-] is selected in P-40. Fixed value: Start bit:1bit, Data length:8bit, Stop bit:1bit	0

8.6 Decimal Point Positioning/Totaliser Indication

The position for fixed decimal point depends on maximum flow rate of individual ranges and is shown below.
The indication of totalised flow rate on MAK is in 8-digits, whereas 4 x digits are displayed at a time as shown below.



9. Troubleshooting

Problem	Probable Cause	Check Item and Corrective Action
1. The indicator shows nothing.	a. The power is not on.	1. Check to see if the power has been turned on.
	b. The connector has not been connected to the meter properly.	1. Connect the connector properly. Check to see if the pin numbers of wires and destinations match.
2. The indication of a flow rate remains 0.	a. Gas is not flowing.	1. Check the source pressure of the gas cylinder and check the valve to see if it is open. 2. Check to see if the solenoid valve, three-way valve, etc. in the line are operating properly. 3. Check to see if the line filter is not clogged.
	b. The outlet side piping of the mass flow meter is blocked somewhere.	1. Check the solenoid valve, three-way valve, air valve, etc.
	c. The power supply is faulty.	1. Disconnect the cable and check the voltage 24 VDC (within ±5%) with a tester. If the correct voltage is not present, replace the power supply.
	d. The sensor tube is clogged.	1. If it is clogged, gas keeps flowing. The sensor must be replaced. Please send it to our sales office or the dealer.
3. The output will not become zero (more than 45 minutes after power on).	a. The control valve is leaking internally or externally.	1. Disconnect the pipe before of the mass flow controller and remove gas to see if the output will become zero.
	b. The zero point of the sensor has moved.	1. Conduct zero adjustment.
	c. The sensor is faulty or the electronic circuit is faulty.	1. The meter may be used after zero point adjustment, but the flow accuracy will be impaired. Please send them to our sales office or the dealer for replacement.
4. The indication of a flow rate flickers when gas is flowing.	a. The supply pressure on the inlet side is constantly instable.	1. Install a pressure regulator on the inlet side to keep the pressure constant.
	b. The connector connection is poor.	1. Check to see if the connector has been connected correctly.
	c. The power supply is faulty.	1. Disconnect the cable and check the voltage 24 VDC (within ±5%) with a tester. If the voltage is not stable, replace the power supply.

＊If the problem cannot be solved by the above corrective actions, please contact our sales office or the dealer.

10. Maintenance/storage

10.1 Cleaning the inlet and outlet joints

When removing the joints for cleaning, conduct the work in clean environment so that no dust and dirt will enter the product. However, never disassemble or overhaul the product nor remove the protective seals.
If the product has been disassembled or overhauled or the protective seals have been removed, it is considered that the user has waived his/her right to warranty even within the warranty period.

10.2 Storage

If the product is not put in use for a long time after it was received, unexpected troubles may occur.
When it is expected that the product will be kept in storage for a long time, take the following precautions:

(1) Store the product in the package in which it was received from Kobold, wherever possible.
(2) Store the product in a place described below:
  ① A place free of rain and water.
  ② A place free of vibration and impact.
  ③ A place of normal temperature and normal humidity (around 25℃, 65%).
  ④ A place free of dust.
  ⑤ A place free of corrosive gases.
  ⑥ A place free of a strong electric/magnetic field.
(3) To store the product that has been used, purge it with clean air or N2 so that measuring gas will not remain in the flow meter. Cover the inlet and outlet sides (joints) of measuring gas with caps to prevent intrusion of dust and dirt.

11. CF Value for Various Gases

The last column in the table on the next page gives the CF value for various gases (also known as correction factor or K-factor). This value is needed to be entered in parameter setting No. P-31 of MAK, when parameter setting No. P-30 for the applicable gas selection is selected as "0". "0" indicates that a gas other than default gases saved in MAK is selected.

Table for CF Value (Correction Factor Value/ K-Factor)

No	Symbol	Dry Gas	Vapor Pressure or Boiling Point	ρ (0℃) g/l	Cp (25℃) cal/gK	MAK CF/ Correction Factor/ K-Factor
1	Air	Air	—	1.292	0.2403	1.000
2	Ar	Argon	-185.9℃	1.782	0.1244	1.410
3	B2H6	Diborane	-92.8℃	1.234	0.508	0.420
4	BF3	Boron trifluoride	-100.3℃	3.025	0.1778	0.525
5	BH3	Boron trihydride	—	0.617	0.1957	0.769
6	C2H2	Acetylene	-75.0℃	1.162	0.4036	0.598
7	C2H4	Ethylene	-169.2℃	1.251	0.3695	0.584
8	C2H6	Ethane	-161.5℃	1.342	0.4097	0.470
9	C3H6	Propylene	-47℃	1.877	0.3541	0.389
10	C3H8	Propane	0.47MPa @0℃	1.968	0.3885	0.349
11	1-C4H8	1-Butene	464kPa @21℃	2.503	0.3805	0.288
12	C4H10	Normal butane	0.10MPa @0℃	2.593	0.3908	0.254
13	(CH3)2O	Dimethyl Ether	-24.8℃	2.055	0.3405	0.387
14	CH3CHO	Acetaldehyde	44kPa @0℃	1.965	0.2965	0.468
15	CH4	Methane	-161.5℃	0.716	0.5328	0.772
16	CHCl F 2	Freon 22	-41℃	3.858	0.1577	0.453
17	Cl2	Chlorine	0.59MPa	3.164	0.1144	0.835
18	CO	Carbon monoxide	-191.5℃	1.250	0.2488	1.000
19	CO2	Carbon dioxide	5.7MPa	1.964	0.2016	0.745
20	D2	Deuterium	- 249.5℃	0.1799	1.722	0.999
21	F2	Fluorine	-188.1℃	1.695	0.1970	0.895
22	H2	Hydrogen	-252.8℃	0.0899	3.419	0.997
23	H2S	Hydrogen sulfide	1.57MPa @15℃	1.520	0.2397	0.832
24	HCl	Hydrogen chloride	4.2MPa	1.627	0.1912	1.001
25	HCHO	Formaldehyde	−19℃	1.340	0.2813	0.770
26	He	Helium	-268.9℃	0.1786	1.241	1.403
27	i-C4H10	Isobutane	-11.7℃	2.593	0.3872	0.259
28	i-C4H8	Isobutylene	- 6.9℃	2.503	0.3796	0.291
29	Kr	Krypton	-153.4℃	3.739	0.0593	1.404
30	N2	Nitrogen	-195.8℃	1.250	0.2485	1.000
31	N2O	Nitrous oxide	5.1MPa	1.964	0.2088	0.702
32	Ne	Neon	-246.1℃	0.900	0.246	1.404
33	NH3	Ammonia	0.78MPa	0.760	0.492	0.773
34	NO	Nitric oxide	-151.8℃	1.339	0.2328	0.979
35	NO2	Nitrogen dioxide	21.2℃	2.053	0.1933	0.745
36	O2	Oxygen	-183℃	1.428	0.2193	0.985
37	O3	Ozone	-111.8℃	2.142	0.1952	0.686
38	PH3	Phosphine	4.1MPa	1.517	0.2374	0.725
39	SF6	Sulfur Hexafluoride	2.2MPa	6.516	0.1592	0.262
40	SiF4	Silicon Tetrafluoride	-94.8℃	4.644	0.1691	0.360
41	SO2	Sulfur dioxide	0.34MPa @21℃	2.858	0.1488	0.688
42	Xe	Xenon	-108.1℃	5.857	0.0378	1.404
	Liquefied Gas					
43	Si(CH3)4	Tetramethylsilane	26.7kPa @-6.5℃	3.936	0.3392	0.183
44	BCl3	Boron trichloride	0.15MPa @20℃	5.229	0.1279	0.437
45	C2H5OH	Ethanol	5.3kPa	2.055	0.3395	0.387
46	C4H6	Butadiene	-4.413℃	2.413	0.3514	0.282
47	C6H5CH3	Toluene	0.90kPa @0℃	4.111	0.2693	0.224
48	C6H6	Benzene	9.9kPa	3.485	0.2496	0.279
49	C6H14	Hexane	17kPa @20℃	3.845	0.4068	0.171
50	HBr	Hydrogen bromide	2.2MPa	3.610	0.0861	1.000
51	HF	Hydrogen fluoride	48kPa @0℃	0.893	0.3479	1.001
52	HCN	Hydrogen cyanide	82.6kPa @20℃	1.206	0.3184	0.761
53	SiCl4	Silicon tetrachloride	10.3kPa @0℃	7.580	0.1270	0.305
54	SiH2Cl2	Dichlorosilane	0.25MPa @20℃	4.506	0.1500	0.422
55	SiHCl3	Silane trichloride	65.3kPa @20℃	6.043	0.1380	0.358
56	WF6	Tungsten Hexafluoride	91kPa @15℃	13.288	0.095	0.150
57	C5H8	Isoprene	65.7kPa @20℃	3.040	0.360	0.225

12. Technical Information

Operating instructions, data sheet, approvals and further information via the QR code on the device or via www.kobold.com

13. Order Codes

Operating instructions, data sheet, approvals and further information via the QR code on the device or via www.kobold.com

14. Dimensions

Operating instructions, data sheet, approvals and further information via the QR code on the device or via www.kobold.com

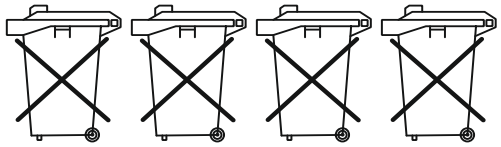
15. Disposal

Note!

- Avoid environmental damage caused by media-contaminated parts
- Dispose of the device and packaging in an environmentally friendly manner
- Comply with applicable national and international disposal regulations and environmental regulations.

Batteries

Batteries containing pollutants are marked with a sign consisting of a crossed-out garbage can and the chemical symbol (Cd, Hg, Li or Pb) of the heavy metal that is decisive for the classification as containing pollutants:



1. „Cd" stands for cadmium
2. „Hg" stands for mercury
3. „Pb" stands for lead
4. „Li" stands for lithium

Electrical and electronic equipment

16. EU Declaration of Conformance

We, KOBOLD Messring GmbH, Nordring 22-24, 65719 Hofheim, Germany, declare under our sole responsibility that the product:

Thermal Mass Flowmeter **Model: MAK**

to which this declaration relates is in conformity with the following EU directives stated below:

2014/30/EU	**EMC Directive**
2011/65/EU	**RoHS** (category 9)
2015/863/EU	Delegated Directive (RoHS III)

Also, the following standards are fulfilled:

EN 61326-1:2013 Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements

EN 61326-2-3:2013 Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 2-3: Particular requirements - Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning

EN IEC 63000:2018 Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Hofheim, 30 October 2023

H. Volz
General Manager

J. Burke
Compliance Manager

17. Appendix: RS485 Communication

17.1 Foreword

This document describes the specifications and handling of the Modbus (RTU) function. With reference to the Modbus (RTU) standard, please prepare for it by yourself.
The wiring, installation and operating procedures, other than communications, are presented in a separate instruction manual. Prior to use, please read it also.

17.2 RS-485 Communications

Synchronization	Start-stop
Transmission speed	38400/19200/9600bps (Parameter: P-41)
Start bit	1bit
Data length	8bit
Stop bit	1bit
Parity	No parity/Odd parity/Even parity (Parameter: P-42)
Transmission system	3-wire half-duplex
Insulation	Communication – control circuit: Uninsulated Communication – power supply: Uninsulated
Communication ID setting range	1-247 (Paremeter: P-40)

17.3 Modbus Function Codes supported

Read Coil Status	0x01
Read Input Status	0x02
Read Holding Register	0x03
Read Input Register	0x04
Force Single Coil	0x05
Preset Single Register	0x06
ZERO Adjustment	0x41

Details of Vendor-defined function (ZERO Adjustment)

Queries

Communication ID	8bit
Function code	0x41
Error check	CRC (16 bit)

Response

Communication ID	8 bit
Function code	0x41
Error check	CRC (16bit)

Sensor zero adjustment is executed.

17.4 Data·Adress List

Category	Address	Name	Description of set values
Coil	00001	(P-01) Low cut	0: Instantaneous flow rates below 0.5% F.S. are indicated. Negative values are also indicated. 1: Instantaneous flow rates below 0.5% F.S. are indicated as 0. Negative values are also indicated as 0.
	00002	(P-04)Integrated flow rate hold	0: The integrated flow rate value is reset when the power is turned off. 1: The integrated flow rate value is held after the power is turned off. The integrated flow rate value hold cycle is 1 minute.
Input Status	10001	Flow rate unit	0: cc, 1: L
Input Register	30001	Full scale flow rate [significand]	Mantissa portion of the full scale flow rate currently set for operation 0001 ~ 2000
	30002	Flow rate decimal point position [number of decimal places]	0: none, 1: digit, 2: digit, 3: digit
	30003	Instantaneous flow rate [significand]	-9999 ~ 9999 (As per the specifications)
Holding Register	40001	(P-30)Applicable gas	0: CF value, 1: N2(nitrogen), 2: Air, 3: H2(hydrogen), 4: He(helium), 5: Ar(argon), 6: O2(oxygen), 7: CO2(carbon dioxide), 8: CH4(methane)
	40002	(P-31)CF value	0500 ~ 1500 (0.500 ~ 1.500)
	40003	(P-00)Reference condition on flow rate	0: 20℃(1atm), 1: 0℃(1atm), 2: 25℃(1atm)
	40004	(P-02)PV filter	0: No 1: Moving average of sampling 2 times 2: Moving average of sampling 4 times 3: Moving average of sampling 8 times 4:Moving average of sampling 16 times 5: Moving average of sampling 32 times
	40005	(P-03) Instantaneous flow rate indication update cycle	0: 25(ms), 1: 50(ms), 2: 100(ms), 3: 200(ms), 4: 500(ms), 5: 1(sec)
	40006	Integrated flow rate reach preset setting upper 4 digits	0000 ~ 9999
	40007	Integrated flow rate reach preset setting lower 4 digits	0000 ~ 9999 (Mantissa portion not including the decimal point)
	40008	(P-10)Event output 1	00: None 10: Instantaneous flow rate upper limit : ON 11: Instantaneous flow rate upper limit : OFF 20: Instantaneous flow rate lower limit : ON 21: Instantaneous flow rate lower limit : OFF 30: Instantaneous flow rate upper/lower limit : ON 31: Instantaneous flow rate upper/lower limit : OFF 40: Integrated flow rate reach : ON 41: Integrated flow rate reach : OFF 50: Integrating pulse : ON 51: Integrating pulse : OFF ※ON: Normal output, OFF: Inverted output
	40009	(P-11)Instantaneous flow rate upper limit preset setting	0000 ~ 9999
	40010	(P-12)Instantaneous flow rate lower limit preset setting	0000 ~ 9999
	40011	(P-13)Dead time	00 ~ 30(sec)
	40012	(P-14)Integrated flow rate reach preset setting upper 4 digits	0000 ~ 9999
	40013	(P-15)Integrated flow rate reach preset setting lower 4 digits	0000 ~ 9999

Holding Registe	40014	(P-20)Event output 2	00: None 10: Instantaneous flow rate upper limit : ON 11: Instantaneous flow rate upper limit : OFF 20: Instantaneous flow rate lower limit : ON 21: Instantaneous flow rate lower limit : OFF 30: Instantaneous flow rate upper/lower limit : ON 31: Instantaneous flow rate upper/lower limit : OFF 40: Integrated flow rate reach : ON 41: Integrated flow rate reach : OFF 50: Integrating pulse : ON 51: Integrating pulse : OFF ※ON: Normal output, OFF: Inverted output
	40015	(P-21)Instantaneous flow rate upper limit preset setting	0000 ~ 9999
	40016	(P-22)Instantaneous flow rate lower limit preset setting	0000 ~ 9999
	40017	(P-23)Dead time	00 ~ 30(sec)
	40018	(P-24)Integrated flow rate reach preset setting upper 4 digits	0000 ~ 9999
	40019	(P-25)Integrated flow rate reach preset setting lower 4 digits	0000 ~ 9999

17.5 Flow Rate Expression

The maximum full scale flow rate, full scale flow rate, instantaneous flow rate, set flow rate (digital) and set flow rate are expressed by a combination of the significand and flow rate decimal point position [number of decimal places] and flow rate unit.
Note that flow rate decimal point position [number of decimal places] and flow rate unit are used commonly for each flow rate and cannot be changed.

Examples are presented below:

Full scale flow rate [significand]	1000
Flow rate decimal point position [number of decimal places]	1: 1digit
Flow rate unit	0: cc
Full scale flow rate	100.0 (cc)

Full scale flow rate [significand]	1234
Flow rate decimal point position [number of decimal places]	3: 3digit
Flow rate unit	1: L
Instantaneous flow rate	1.234 (L)