CKD

D2-180166-A

INSTRUCTION MANUAL

SMALL SIZE FLOW SENSOR

RAPIFLOW®

FSM2-D series

(Separation indicator)

- Read this instruction manual carefully before using this product, particularly the section describing safety.
- Retain this instruction manual with the product for further consultation whenever necessary.

3rd EDITION
CKD Corporation

Warning / cautions to secure safety

●Safety cautions are ranked by the safety cautions as [danger] [warning] [caution] in this section.

⚠Danger	When a dangerous situation may occur, or when there is high urgency to a warning leading to fatal or serious injuries, if handling is mistaken.
⚠Warning	When a dangerous situation may occur if handling is mistaken, leading to fatal or serious injuries.
⚠Caution	When a dangerous situation may occur if handling is mistaken, leading to minor injuries or physical damages.

●Working fluid, Working environment

⚠Danger
- ●A flammable fluid must not be used.
- ●Do not use the product in flammable gas environment. Since explosion-protection is not taken, explosion or fire may be caused.

⚠Warning
- ●Please confirm the specification of the sensor used.
- ●The product can not be used as a business mater. Not conformed to the Measurement Law, do not use the product for the commercial purpose. Use the product as an industrial sensor.
- ●Do not use the product in an environment containing corrosive gas such as salphur dioxide, etc.
- ●Use the product within the ambient and fluid temperature ranges 0 to 50 °C. Even in the specified temperature range, do not use the product where ambient and fluid temperatures will change suddenly, and form dew condensations.
- ●The protective structure of this product is equivalent to IP40. Do not install the product where moisture, salt, dust or swarf is contained, or where pressurized, or depressurized, neither.

⚠Caution
- ●The flow rate of this product is measured by mass flow not depended with temperature and pressure. Unit is L/min where mass flow is converted to volumetric flow at 20 °C and 1 atmospheric pressure (101kPa).

●Installation

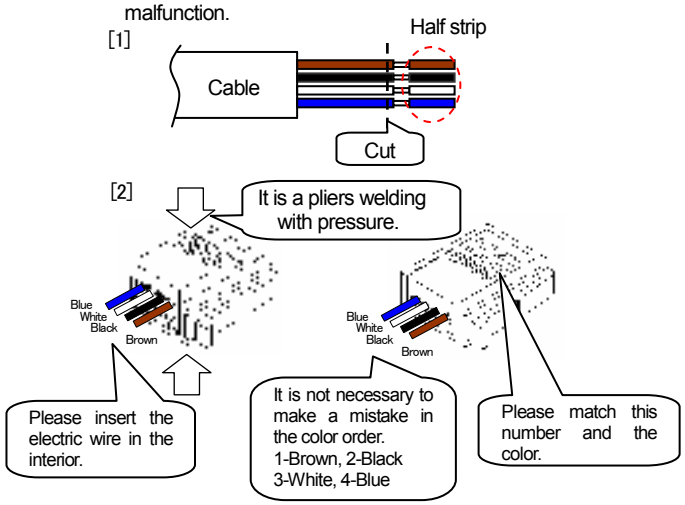
⚠Caution
- ●The display part uses the LCD. The display becomes difficult to see for the view angle.
- ●This product can be installed with any attitude; vertical, horizontal, right or left.
- ●When you install the panel mounting please fix by the tightening torque of 0.06N·m when you fix the panel bessel suppression.

●Wiring

⚠Danger
- ●Power supply voltage and outputs must be used with the specified voltage. Applying the voltage more than specified voltage may cause malfunction, damage of sensor, electric shock or fire.
  Do not apply load more than the rated output. Damage or fire of the output may be caused.

⚠Caution
- ●The input signal of the separation indicator is only for (1 to 5V). When the sensor of other output specifications is connected, there is a possibility of damaging it.
- ●For wiring, stop control unit/machinery and equipment, and turn off the power supply.
- ●This product and wiring must be installed as far away as possible from noise source such as strong electric line, etc. Take other countermeasures for a surge on the power supply line.
- ●Do not short-circuit a load, or causing damage or burn.
- ●Line color must be checked when wiring. Check the wiring color with handling precaution, since improper wire connection may result in damage, failure or malfunction of the sensor.

⚠Caution
- ●After the connectors are inserted, lay the connector covers over the connectors.
- ●Make sure that stress by forcible bend of pulling is not applies directly to the sensor cable joint.
- ●Please connect it by E-CON connector appended to this product.
- ●Please use connecting the e-CON connector after cutting the half strip part. Please insert the electric wire in the interior of the connector when you connect the e-CON connector, and please clamp surely with a tool such as pliers. The removal of the cover of the electric wire is unnecessary. Please confirm the color and the number when you connect it, and please do not make a mistake. The faulty wiring destroys the sensor and the separation indicator, and causes the breakdown and the malfunction.



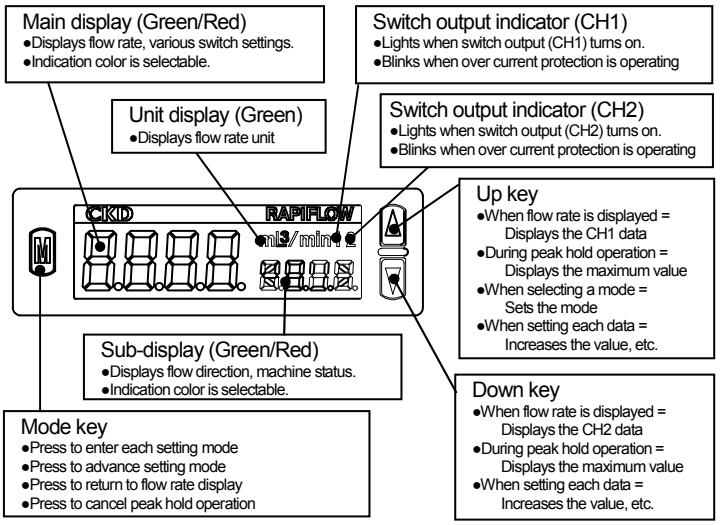
- ●This product can be connected with the FSM series and the WFK3000 series of the frow sensor of our company. However, in this case, the automatic model setting function cannot be used. Please set the model with the manual. [Please refer to page 8.]

●Usage & maintenance

⚠Warning
- ●Output accuracy is affected by self exoergics caused by energizing other than temperature characteristics. When using, stand-by time (5 minutes and over after energizing) must be provided.
- ●For self-diagnosis, this product does not conduct flow rate detecting switch operation for proximate 2 seconds immediately after energized. Make a control circuit and programs to ignore signals for approximate 2 seconds after energized.

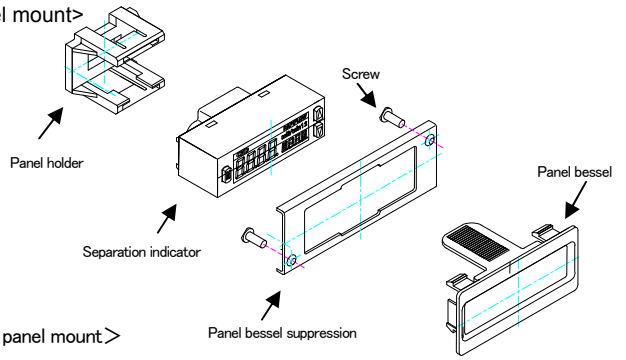
⚠Caution
- ●When the FSM2 separation display type is connected, and the power supply is turned on, the model is automatically recognized. However, please set the model by the manual operation when mis-recognizing it by the noise etc. When other sensors are connected, the automatic recognition cannot be done. In this case, please set it by the manual operation.
- ●When changing set-points of the output, stop the equip-ment, then change the set-points, or an accident may occur.
- ●Disassembly and modification must not be done or causing a failure.
- ●When an error occurs during operation, turn off power supply immediately, and terminate the operation, and contact to the sales office.
- ●The material of case is resin. Solvent/alcohol/cleaner, etc., must not be used to remove contamination, etc., or causing a resin to be corroded. Wipe weakened neutral detergent with tightly squeezed waste cloth, etc.
- ●When out of flow rate range, analog output will be provided. [Hi] or [Lo] will be displayed. However, accuracy is not guaranteed.
- ●The display part use the liquid crystal. Do not push the display part., or causing damage.

[1]Names and Functions of Each Parts

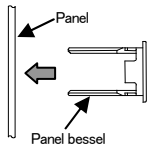
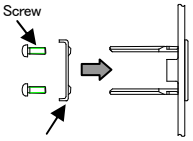
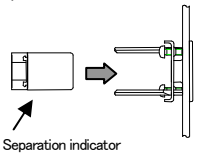
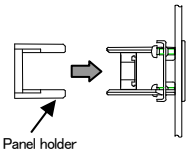
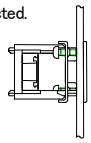


[2] Installation

<Panel mount>



<How to panel mount>

①	②	③
The panel bessel is inserted from the front side of the panel. 	The panel Bessel is inserted from the back side of the panel, and holding with the screw. 	The separation indicator is inserted from the back side of the panel. 
④	⑤	Note:
The panel holder is inserted from the back side of the panel. 	The bessel suppression is pushed until the sensor is firmly fixed, and connector is connected. 	・Please fix by the tightening torque of 0.06N・m when you fix the panel bessel suppression.

[3] Wiring

1] How to wiring for sensor

Note1: The input signal of the separation indicator is only for (1 to 5V). When the sensor of other output specifications is connected, there is a possibility of damaging it.

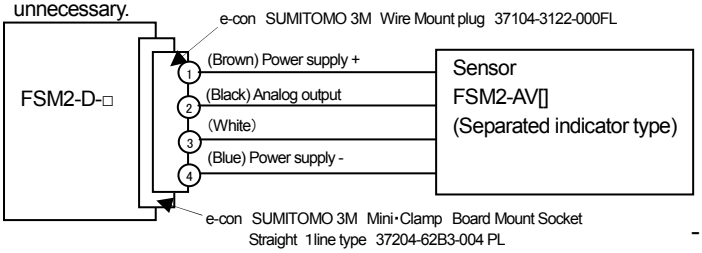
Note2: Please connect it by E-CON connector appended to this product.

Note3:In the case of wiring other than FSM2 display separate model (FSM2-A□), please set the model with the manual before the measurement of flow, because the automatic model setting function cannot be used.

<How to wiring for FSM2 Separated indicator type.>

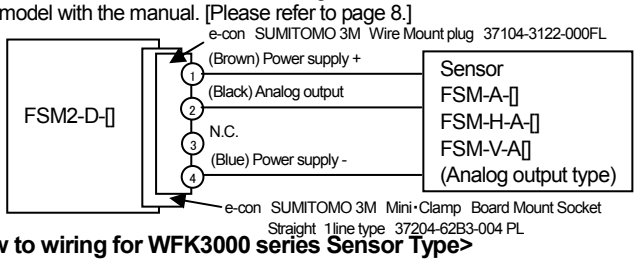
Please select the voltage output type of the FSM2 separation display type (1 to 5V output).

Because the model is recognized automatically, the model setting is unnecessary.



<How to wiring for FMS/FSM-H/FSM-V series analog output type.>

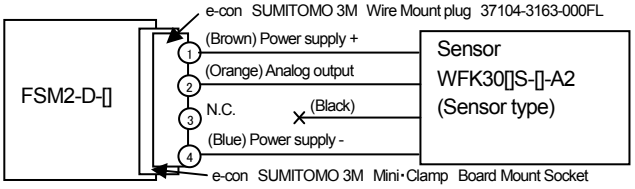
In this case, the automatic model setting function cannot be used. Please set the model with the manual. [Please refer to page 8.]



<How to wiring for WFK3000 series Sensor Type>

Please select the voltage output type of the WFK3000 sensor type (A2:1 to 5V output). Please do not connect a black line.

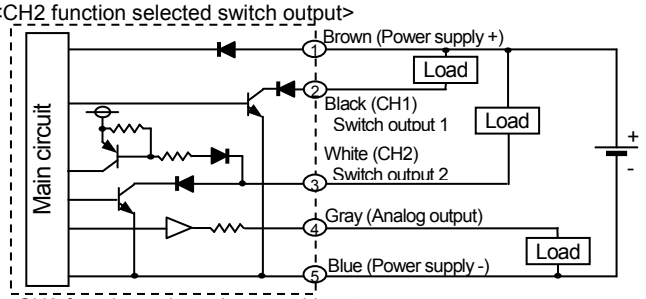
In this case, the automatic model setting function cannot be used. Please set the model with the manual. [Please refer to page 8.]



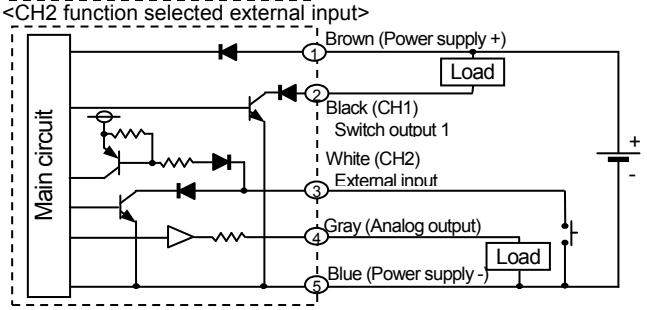
2] Example of internal circuit and load connection

2]-1NPN output Model No.: FSM2-D-N[ ]-[ ]

<CH2 function selected switch output>

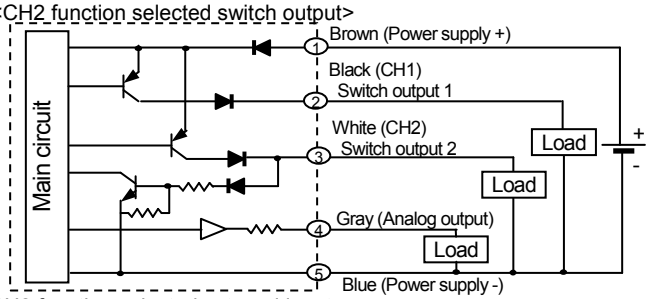


<CH2 function selected external input>

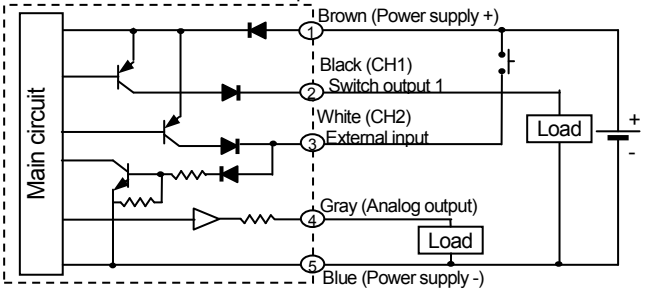


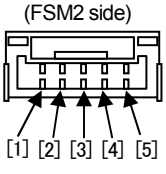
2]-2 PNP output Model No.: FSM2-P[ ]-[ ]

<CH2 function selected switch output>



<CH2 function selected external input>





Pin No.	Line color	Content
[1]	Brown	Power supply (DC 12 to 24V, DC 24V)
[2]	Black	CH1(Switch output 1: max50mA)
[3]	White	CH2(Switch output 2: max50mA or External input)
[4]	Gray	Analog voltage output : DC 1 to 5V Connected load impedance 50kΩ and over) Analog current output : DC 4 to 20mA Connected load impedance 300Ω or less)
[5]	Blue	0V (GND)

[4] Function

<Normal mode>

Item	Description
Flow rate display	Instantaneous flow rate is displayed.
Integrating function	Integrated flow rate is displayed.
Peak hold function	Maximum and minimum flow rate values during the specified period can be read.
Set-point verification	Switch data (set-point value and operation mode) are displayed to check.
Key lock	Setting changes are disabled to prevent incorrect operations.
Error display function	The error state is displayed.

<Standard setting mode>

Item	Description
Switch output	Having 2 pieces of switch output, 7 operation patterns and stop of operation can be set.
Forcible output function	Switch output is turned on forcibly to check wiring connection and initial operation of input unit.
0 point adjustment	Deviation of the display from o is corrected.

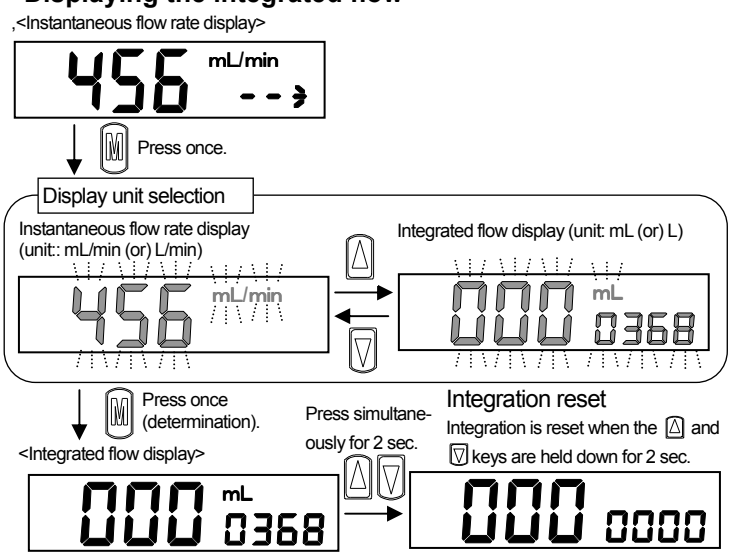
<Detailed setting mode>

Item	Description
CH2 function selection	Sets the CH2 function. Selects “Switch output”, ”External input of auto reference”, or ”External input of integrated reset”.
Auto reference function	When CH2 function selected external input of auto reference, setting value of switch output can be taken by external input or key operation.
Response time setting	Sets the response time. The response time can be selected from 20ms to 1280ms.
Display speed selection	Change the speed of the displayed.
Sub-display selection	Change the indication of the sub-display. Selects “Flow direction”, ”Flow rate unit”, or “Working fluid”.
Displayed color selection	Displayed color can be changed.
Hysteresis fixed value selection	Sets hysteresis of the window operation mode and the auto reference mode. (8 steps)
Flow rate unit selection	Flow rate unit can be changed. Standard condition (ANR): Converted to volumetric flow at 20°C and 1 atmospheric pressure (101kPa). Reference condition (NOR): Converted to volumetric flow at 0°C and 1 atmospheric pressure (101kPa).(calculation value)
Eco mode setting	Current consumption can be lowered. When the product is left for 1 min. without any operation, it’s shift to eco mode.
Reset setting	Return to default settings (factory settings)
Model change	Change flow rate, flow direction and gas type.

[5]How to operate

5-1.Normal mode

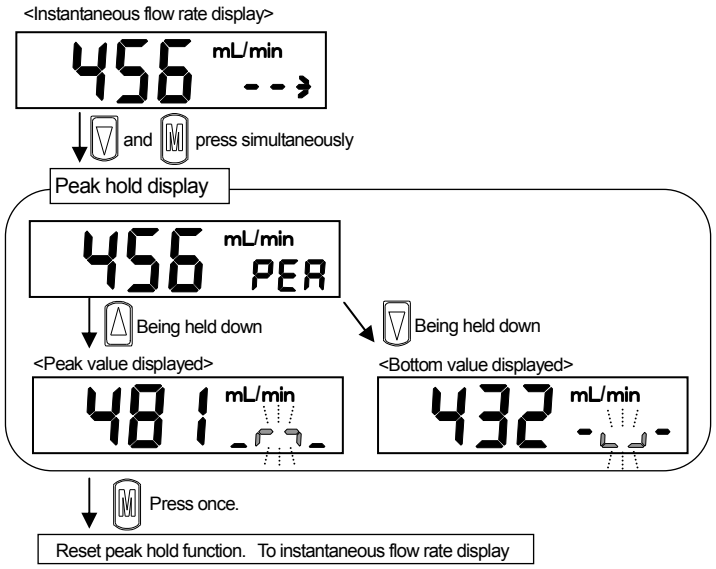
< Displaying the integrated flow >



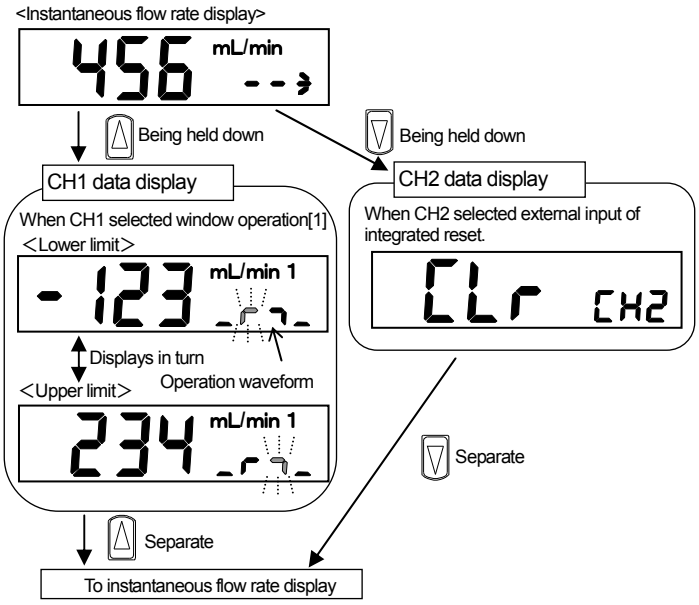
Note: Integration is reset with the external input. See auto reference function.

Note: Integration is also reset when power is turned OFF.

<Peak hold function>

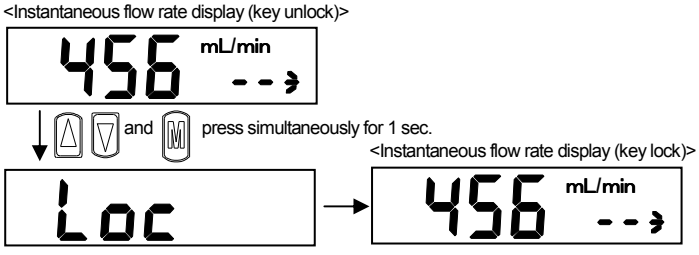


<Set-point check method>

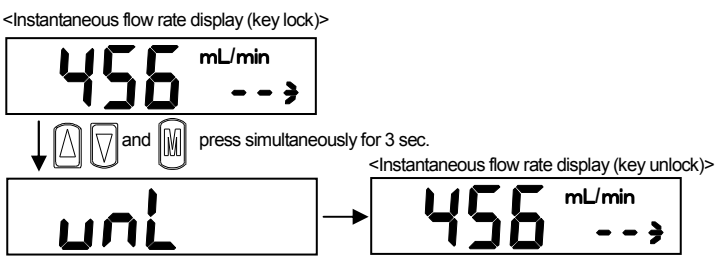


< Key lock function>

Key lock



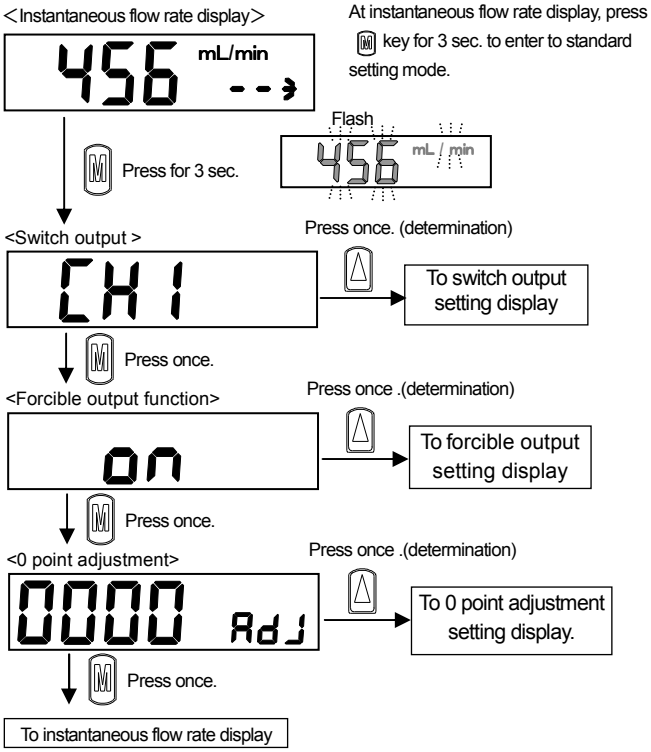
Key unlock



Note: Keys are unlocked when the controller is shipped. Lock keys if necessary.
The key lock/unlock state is held even if power is turned OFF.
When this product is operated with “Key lock” setting, the display shows”Loc”.

5-2.Standard setting mode

<How to enter to standard setting mode>



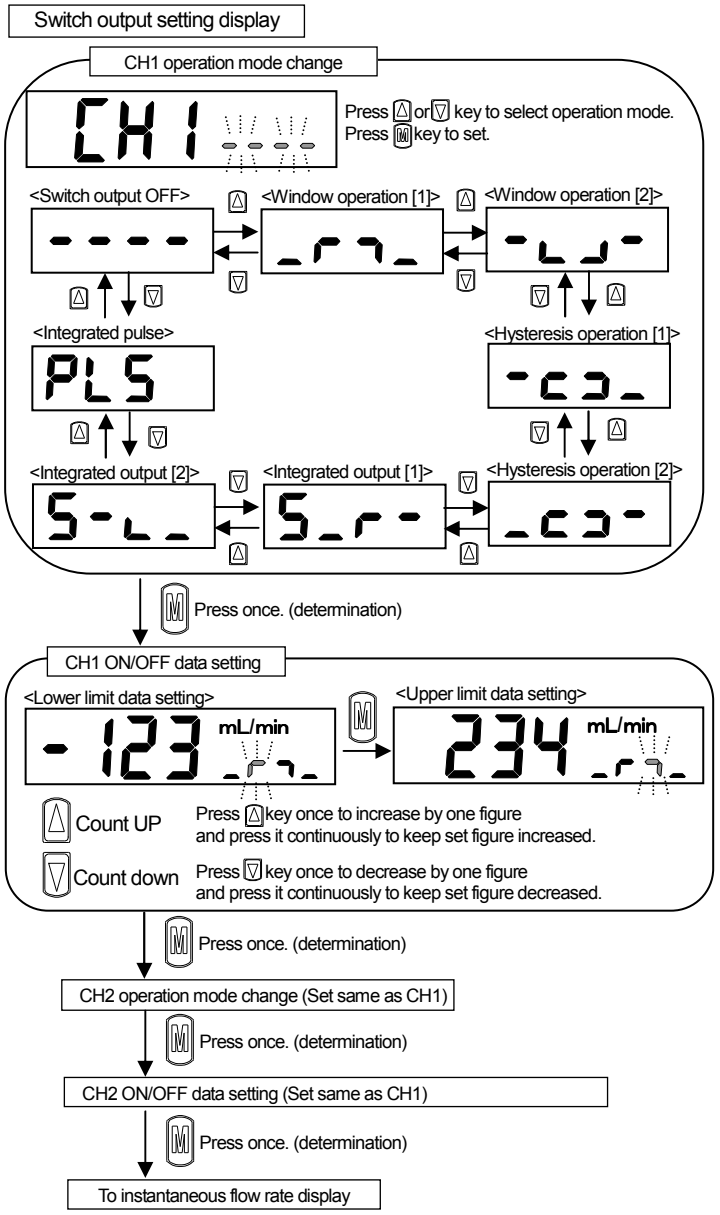
<Switch output>

Having 2 pieces of switch output, 7 operation patterns and stop of operation can be set.

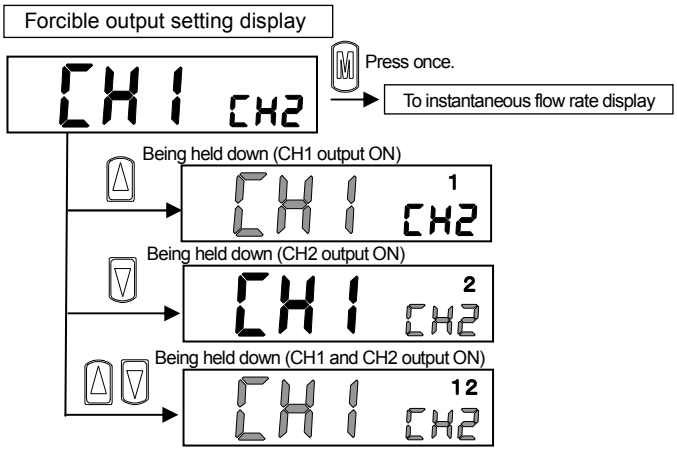
Operation pattern	Description	Operation waveform
Window operation[1] (Range inside ON)	The switch turns ON when the level is within the designated flow rate range.	ON / OFF, Lower limit, Upper limit, Flow rate
Window operation[2] (Range outside ON)	The switch turns ON when the level is not within the designated flow rate range.	ON / OFF, Lower limit, Upper limit, Flow rate
Hysteresis operation[1] (Flow rate small side ON)	ON when lower than set point. Hysteresis can be arbitrarily set.	ON / OFF, Lower limit, Upper limit, Flow rate
Hysteresis operation[2] (Flow rate large side ON)	ON when higher than set point. Hysteresis can be arbitrarily set.	ON / OFF, Lower limit, Upper limit, Flow rate
Integrated output[1] (ON when higher than set integration)	The switch turns ON at the set integrated flow.	ON / OFF, Set point, Integrated flow rate
Integrated output[2] (OFF when higher than set integration)	The switch turns OFF at the set integrated flow.	ON / OFF, Set point, Integrated flow rate
Integrated pulse	The integrated pulse is output during integration. See specifications for details on the pulse output rate.	ON / OFF, 40msec, Pulse rate, Integrated flow rate
Switch output OFF	Switch output OFF	

Note: Hysteresis is provided on upper and lower limit of window operation automatically. The hysteresis can be fixed in 8 steps. Refer to <Hysteresis fixed value selection> in <Detailed setting mode>.

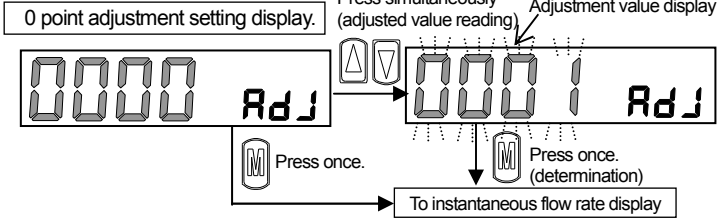
<Data setting of switch output function>



<Switch output forcible ON mode>



<0 point adjustment mode>

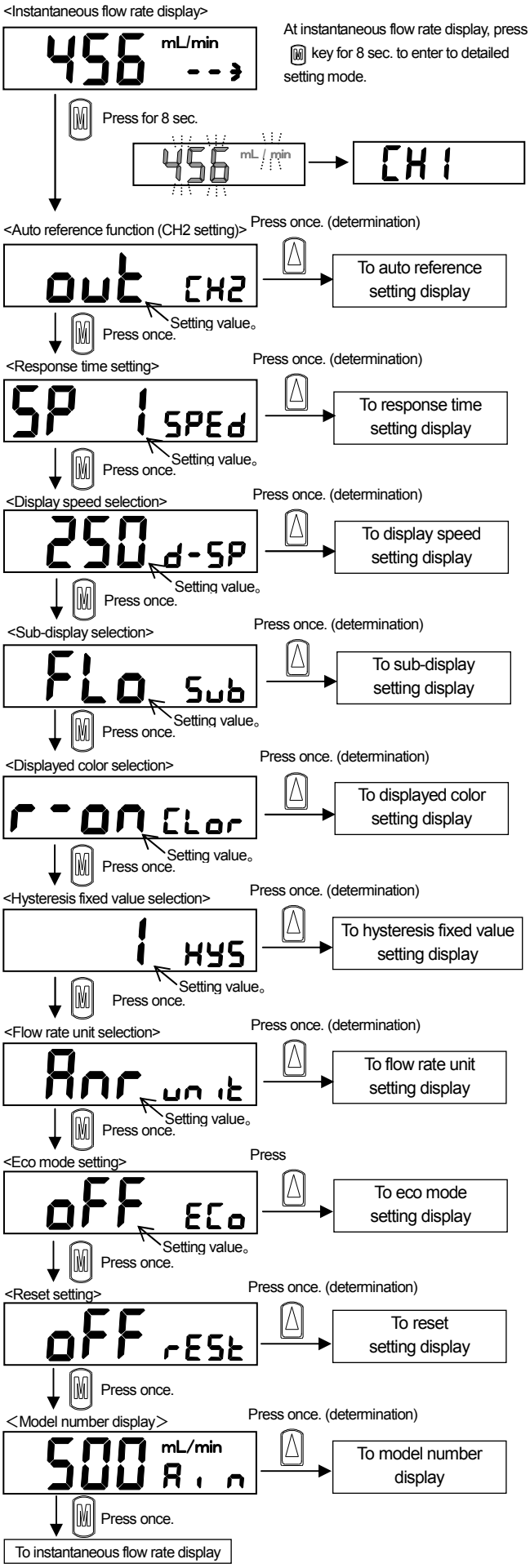


Caution Always adjust 0 point without flow.

Note: If fluid flows during zero adjustment setting, "E 02" is indicated.

5-3.Detailed setting mode

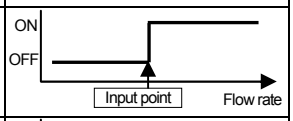
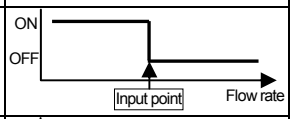
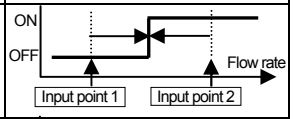
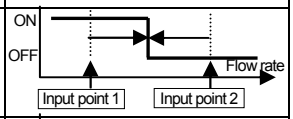
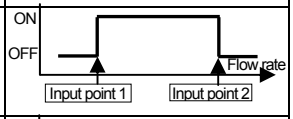
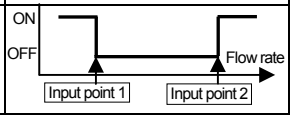
<How to enter to detailed setting mode>



<Auto reference function>

When CH2 function selected external input of auto reference, setting value of switch output can be taken by external input or key operation.

The set point takes the flow rate when external input is turned on (or key operation). When auto reference is executed, the switch setting of CH2 becomes invalid.

Input point	Operation mode	Description	Operation waveform
1 point	1-point input [1] (Flow rate large side ON)	ON when higher than input point. Set-point=input point	
	1-point input [2] (Flow rate small side ON)	OFF when higher than input point. Set-point=input point	
2 point	2-point input [1] (Flow rate large side ON)	ON when higher than centre value of two input points Set-point= (input point1+input point2)/2	
	2-point input [2] (Flow rate small side ON)	OFF when higher than centre value of two input points Set-point= (input point1+input point2)/2	
	2-point inside (Range inside ON)	ON when flow rate level is within two input points. Setpoint1=input point 1 Setpoint2=input point 2	
	2-point outside (Range outside ON)	OFF when flow rate level is within two input points. Setpoint1=input point 1 Setpoint2=input point 2	

How to take set point by key operation

- 1 point input : The set point takes the flow rate when press ▽ key for 2 sec.
- 2 point input : The upper limit takes the flow rate when press △ key for 2 sec.
  The lower limit takes the flow rate when press ▽ key for 2 sec.
- After taking, the set point is displayed.

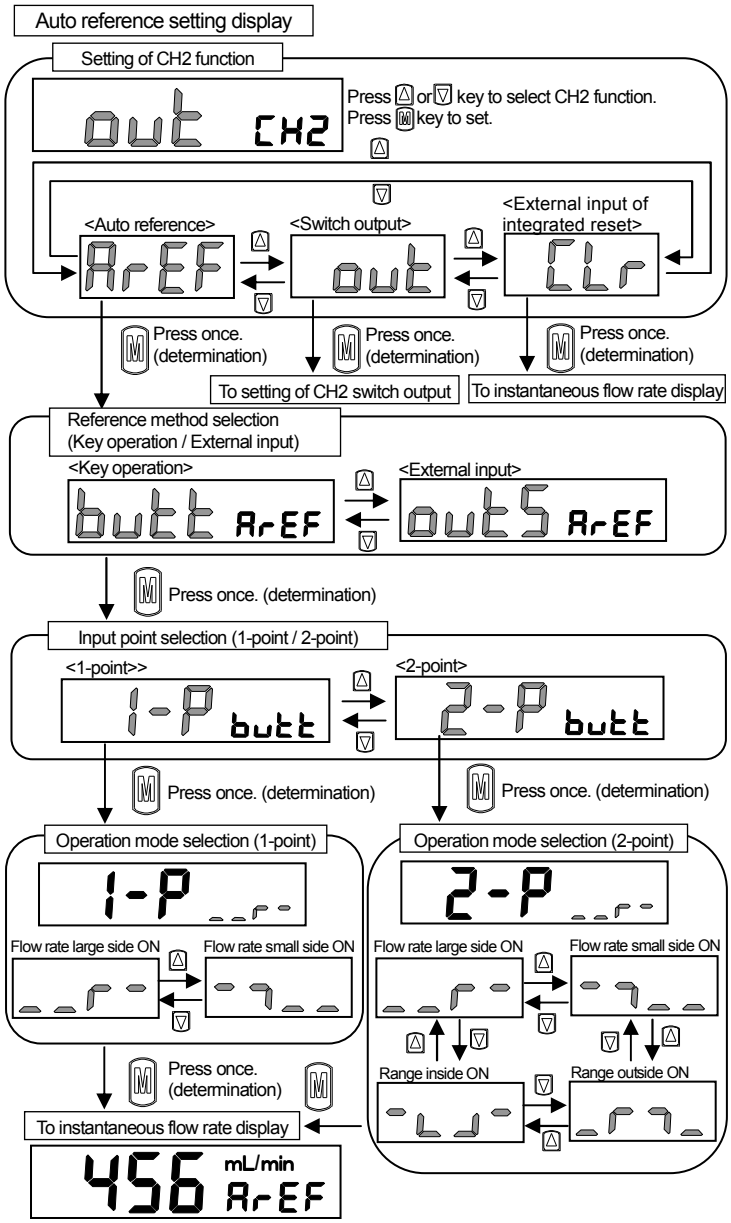
How to take set point by external input

- 1 point input : The set point takes the flow rate when external input is turned on (keep approx. 40msec.).
- 2 points input : The set point takes the flow rate when external input is turned on (keep approx. 40msec.). The big and small relations between latest two points are compared, upper limit and lower limit are distinguished automatically.

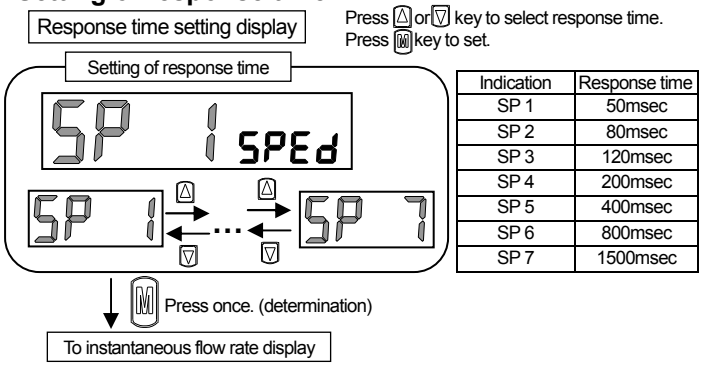
Input point(mL/min)		Upper limit(mL/min)	Lower limit(mL/min)
Initial value		0	0
1st	123	0	123
2nd	234	123	234
3rd	45	45	234
4th	345	45	345
5th	456	345	456

- After taking, the set point is displayed. Also the pulse is output from CH1 for the taking confirmation.
- The set point value is cleared if power is turned OFF.

Setting of auto reference

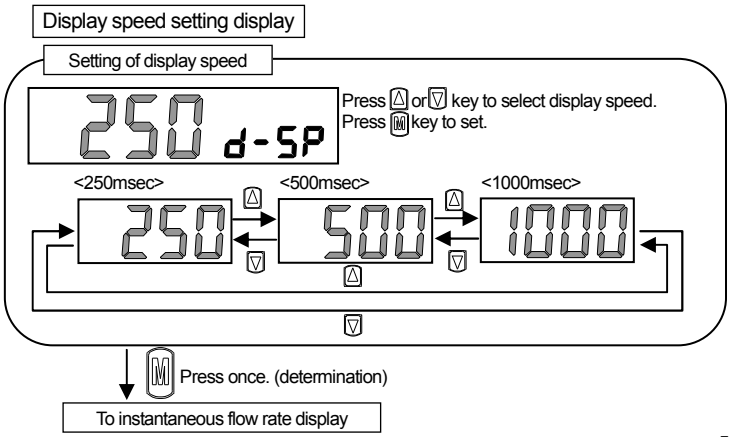


<Setting of response time>

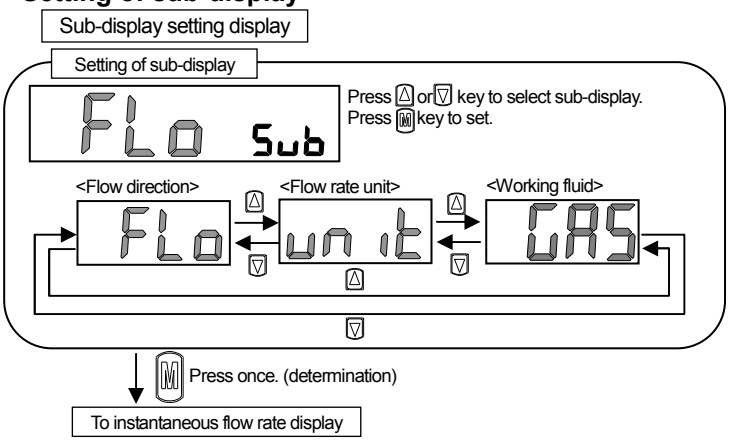


Indication	Response time
SP 1	50msec
SP 2	80msec
SP 3	120msec
SP 4	200msec
SP 5	400msec
SP 6	800msec
SP 7	1500msec

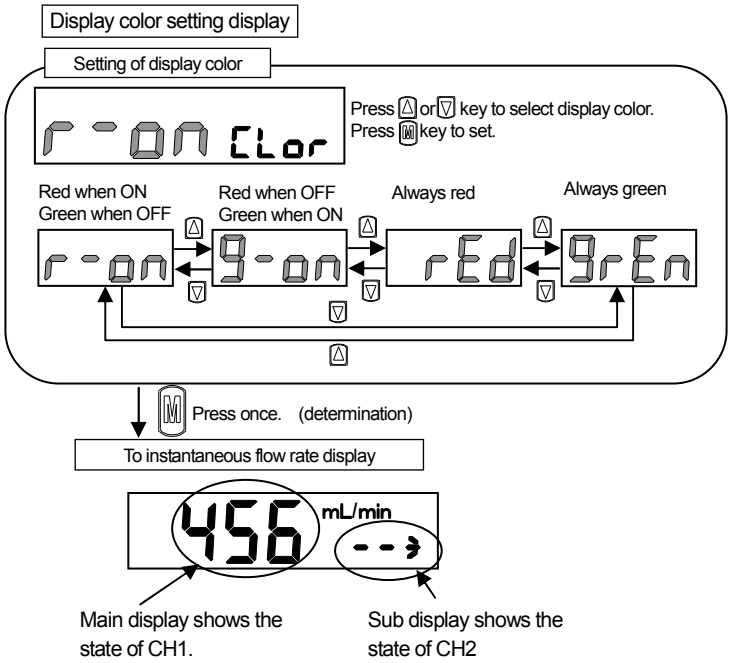
<Setting of display speed>



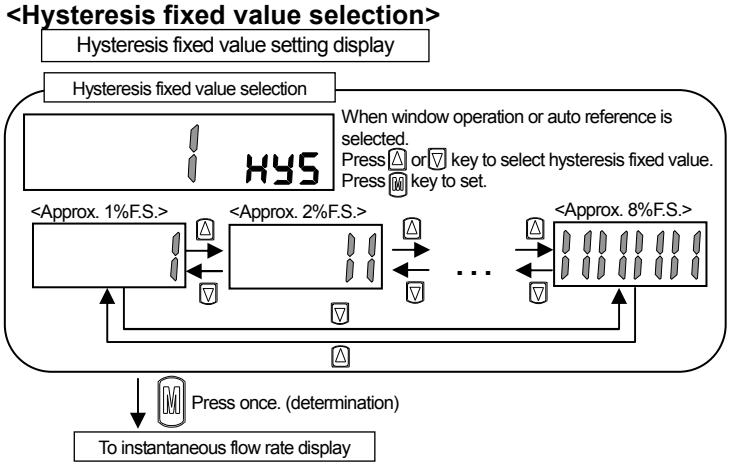
<Setting of sub-display>



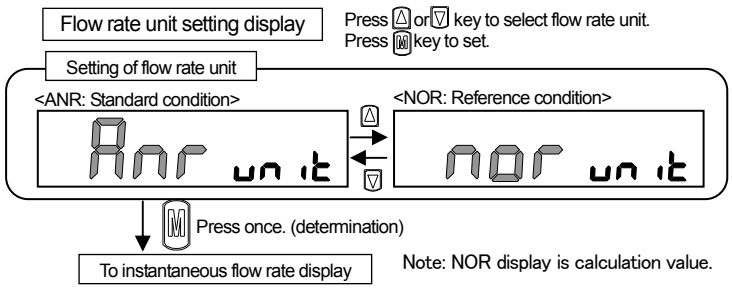
<Setting of display color>



<Hysteresis fixed value selection>

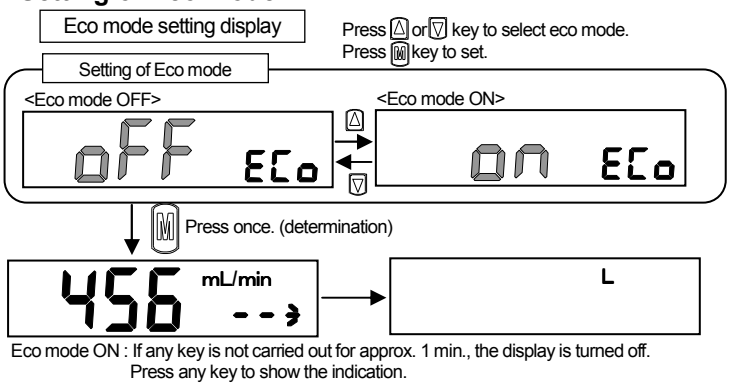


<Setting of flow rate unit.>



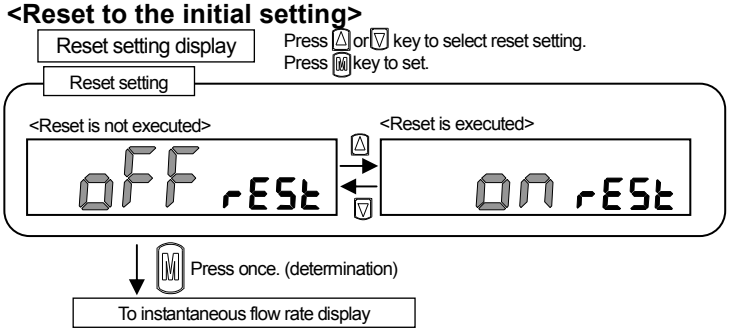
Note: NOR display is calculation value.

<Setting of Eco mode>



Eco mode ON : If any key is not carried out for approx. 1 min., the display is turned off.
Press any key to show the indication.

<Reset to the initial setting>

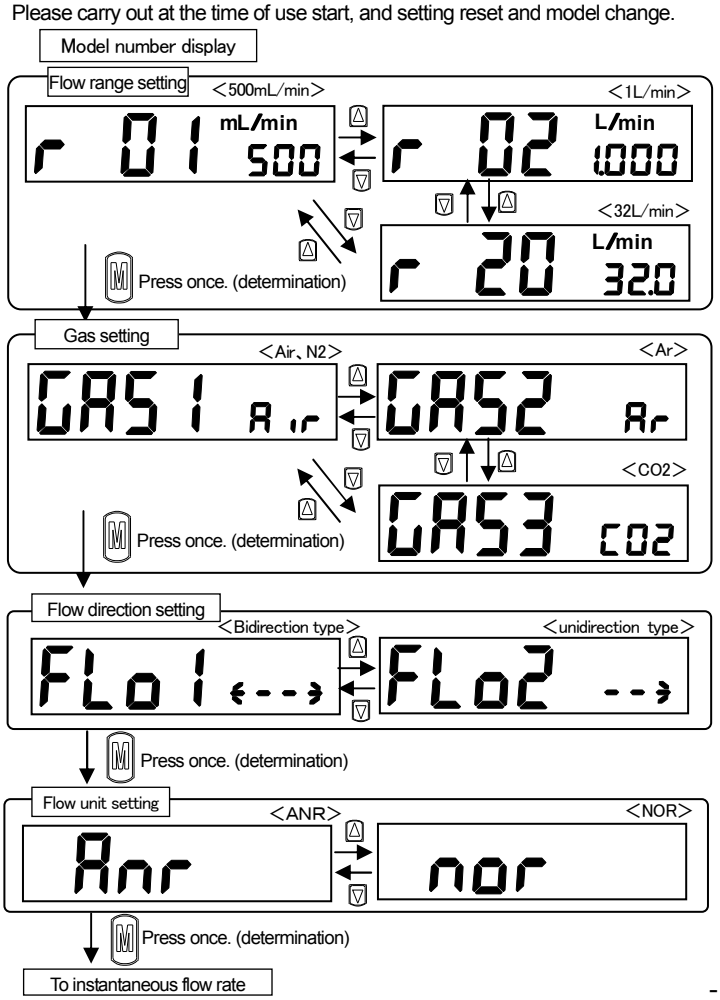


Setting at shipping out of factory

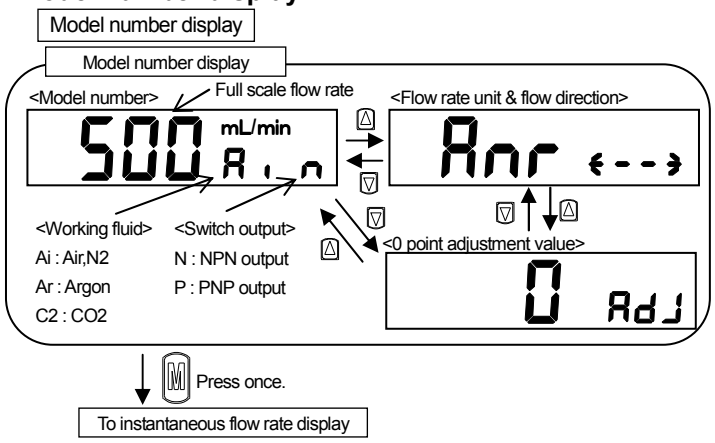
Item	Setting at shipping out of factory
Model setting	No-setting
Switch out put	OFF
Zero adjustment value	Zero
Integrating flow rate value	Zero
Auto reference (CH2 setting)	Switch output
Response time	20msec
Display speed	250msec
Sub-display	Flow direction display
Displayed color	Red when ON. Green when OFF.
Hysteresis	1%FS
Flow rate unit	ANR
Eco mode	OFF

<How to model number setting >

Please carry out at the time of use start, and setting reset and model change.



<Model number display>



[6]Troubleshooting

●Error displays and corrective action

Error indication	Cause	Corrective action
E 01	The supplied power voltage is not within the rating.	Check controller power specifications, set power voltage within the rating range, and turn power ON again.
E 02	If fluid flows during zero adjustment setting, "E 02" is indicated.	Please check that fluid doesn't flow at the time of zero adjustment setting.
E 03	An error occurred during EEPROM reading or writing.	Contact your nearest CKD Sales Office or dealer.
E 04	An error occurred during memory reading or writing.	Contact your nearest CKD Sales Office or dealer.
Hi	Reading exceeds the upper limit of detection range.	Reduce the flow.
	Sensor chip is broken.	Replace FSM2.
Lo	Reading exceeds the lower limit of detection range.	Reduce the flow.
	Sensor chip is broken.	Replace FSM2.
Switch output indicator is blinking	Switch output over current protection circuit is activated.	Check whether load current exceeds the rating, correctly connect the controller, and turn power ON again.

●Troubleshooting (Other than error displays)

Trouble	Cause	Corrective action
No flow display (No analog output)	Breakage of wire.	Replace FSM2. Recheck/repair external wiring.
	Wrong connection of power source.	Connect the rated power source correctly.
	Malfunction caused by noise.	Keep FSM2 main body and cable away from noise source.
	Output circuit is broken.	Replace FSM2.
	FSM2 is broken.	Replace FSM2.
Flow display remains 0. (Analog output remains 1V or 3V)	Flow path clogged by foreign matter.	Remove foreign matter and install filter at primary side of FSM2.
Flow display does not reach 0. (Analog output does not make 1V or 3V)	Leakage	Check and correct piping.
	Foreign matter sticking to sensor chip.	Replace FSM2.
	Malfunction caused by noise.	Keep FSM2 main body and cable away from the noise source.
Poor precision	Sensor chip is broken.	Replace FSM2.
	Foreign matter sticking to sensor chip.	Replace FSM2.
	Malfunction caused by noise.	Keep FSM2 main body and cable away from the noise source.
Flow display is not stable. (Analog output is not stable. Output is chattering.)	Pulsation of air. Fault in power source (not enough voltage/capacity) Pulsation of air.	Reduce pulsation by installing tank, etc.
		Change the response time.
		Change the display speed.
		Change the hysteresis.
	Fault in power source (not enough voltage/capacity)	Supply rated voltage. Provide power source with enough capacity.
	Malfunction caused by noise.	Keep FSM2 main body and cable away from noise source.

[7] Specifications

Separeted indicator type

Descriptions \ Model no.				Separate indicator type FSM2－D-[※1][※2]－□－[※3]
Flow rate note1				500mL/min、1L/min、2L/min、5L/min、10L/min、20 L/min、50 L/min 100 L/min、200 L/min、500 L/min、1000 L/min、1.50m^3/min 5mL/min、10mL/min、50mL/min、100mL/min、4L/min、12L/min、25L/min、32L/min
Ambient temperature / humidity				0 to 50°C and 90%RH or less
Type of display				Dual (2×4-digit 7-segment) Two-color LCD
In-put signal				Voltage input（1 to 5V）
Output	Switch output	※1	N	2 points (NPN open collector output, 50mA or less, voltage drop 2.4V or less)
			P	2 points (PNP open collector output, 50mA or less, voltage drop 2.4V or less)
	Analog output	※2	V	1 point (1 to 5V voltage output and connected load impedance 50kΩ and over)
			A	1 point (4 to 20mA current output and connected load impedance 300Ω or less)
Power supply voltage Note2		※2	V	DC12 to 24V (10.8 to 26.4V)
			A	DC24V (21.6 to 26.4V)
Current consumption Note3				40mA or less
Lead wire				φ3.7 AWG26×5
Functions				Flow rate display, flow rate display-peak hold, switch output and analog output
Protective structure				IEC standards IP40
Protective circuit Note4				Power supply and switch output reverse connection protections, and switch output load short-circuit protection
EMC directive				Conforming product
Accessory				Connector for sensor (e-con)1 pcs., applicable AWG24 to 26, isolator outer diameter ϕ1.0 to 1.2
Mass（body only）				Approx. 40g
Clean specification Note 5		※ 3	Blank	None
			P70	Particle generation prevention

Note1: Only when the FSM2 display separation type is connected, the flowing range, the flow direction, and the gas type are recognized automatically.
（Default setting）. It is also compatible with the flow range of FSM-H, FSM-V, WFK3000.
However, only FSM2 can be detected automatically so manually configure the flow range, flow direction and gas type before use.
Refer to the “Display for each flow range” below to find out the flow range that can be connected.
Also, the previous setting for flow range, etc. will remain even if you change the sensor. Use after resetting if you change the sensor.

Note2: Power voltage specifications differ for the voltage output and current output.

Note3: Current for 24VDC connection with no load connected. Consumed current varies with the load connection.

Note4: This product’s protective circuit is effective only for specific incorrect connections and load short-circuits. It does not necessarily provide protection for all incorrect connections.

Note5:<P70>Particle generation prevention (product surface degreased and cleaned before packaging). Heat seal into an antistatic bag in a clean bench over class 1000.

Note6: One connector (e-con connector) for the sensor connection is appended by the standard.
A cable with a different thickness is required to connect to FSM-V or WFK3000 so an e-con connector with the appropriate size will be required separately. Contact our sales office or distributor.
The included e-con connector is compatible with FSM and FSM-H.

Display range

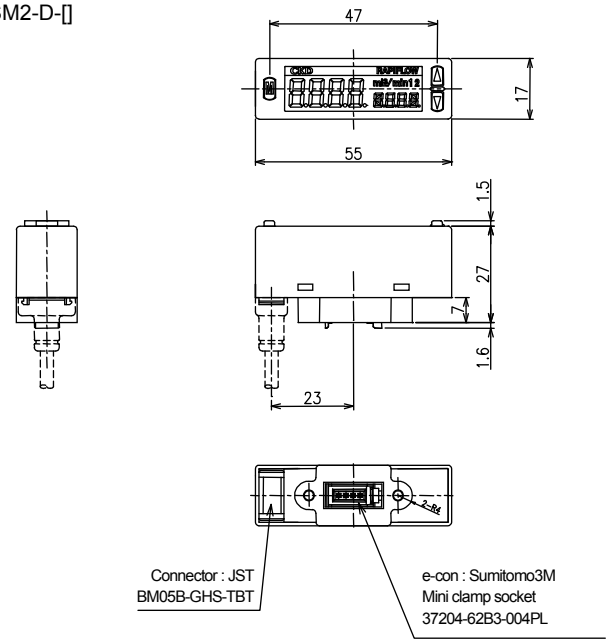
Type No.			1	2	3	17	4	5	18	6	19	20	7	8
Flow display	Display range	Unidirectional	0～500 mL/min	0～1000 mL/min	0～2.00 L/min	0～4.00 L/min	0～5.00 L/min	0～10.00 L/min	0～12.0 L/min	0～20.0 L/min	0～25.0 L/min	0～32.0 L/min	0～50.0 L/min	0～100.0 L/min
		Bidirectional	-500～500 mL/min	-1000～1000 mL/min	-2.00～2.00 L/min		-5.00～5.00 L/min	-10.00～10.00 L/min		-20.0～20.0 L/min			-50.0～50.0 L/min	-100.0～100.0 L/min
	Display resolution		1mL/min		0.01L/min				0.1mL/min					
Integration	Display range		9999999mL		99999.99L				999999.9L					
	Display resolution		1mL		0.01L				0.1mL					
	Pulse output rate		5mL	10mL	0.02L	0.04L	0.05L	0.1L	0.12L	0.2L	0.25L	0.32L	0.5L	1L

Type No.			9	10	11	12	13	14	15	16
Flow display	Display range	Unidirectional	0～200 L/min	0～500 L/min	0～1000 L/min	0～1.50 m^3/min	0～5.00 mL/min	0～10.00 mL/min	0～50.0 mL/min	0～100.0 mL/min
		Unidirectional	-200～200 L/min	-500～500 L/min	-1000～1000 L/min	-1.50～1.50 m^3/min	-5.00～5.00 mL/min	-10.00～10.00 mL/min	-50.0～50.0 mL/min	-100.0～100.0 mL/min
	Display resolution		1L/min			0.01m^3/min	0.01mL/min		0.1L	
Integration	Display range		9999999m^3			99999.99m^3	99999.99mL		999999.9mL	
	Display resolution		1L			0.01m^3	0.01mL		0.1mL	
	Pulse output rate		2L	5L	10L	15L	0.05mL	0.1mL	0.5mL	1mL

[8] Dimensions

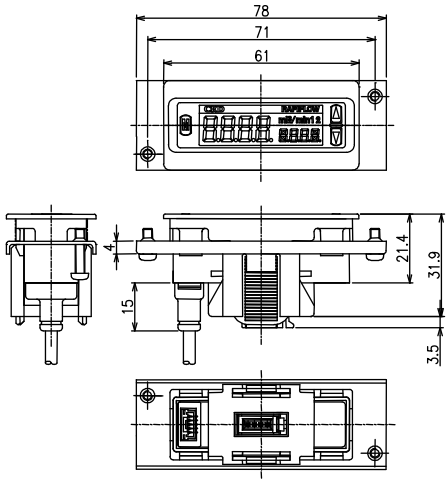
Separated indicator type

●FSM2-D-[]



How to panel mount

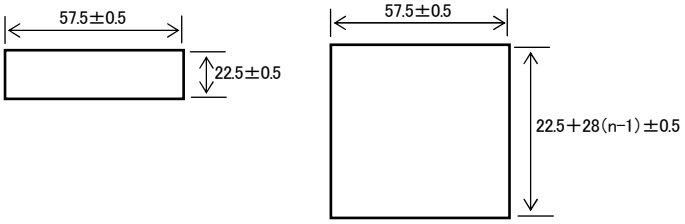
FSM2-KHS



Panel hold matching Fig （Plate thickness t0.8 to 6）

＜Single mount＞ ＜Sticking mount＞

n: Number of sticking installations



[9]How to order

FSM2 - D - [N] [V] - [1] [P] - [P70]

[1] [2] [3] [4] [5]

[1]Output type		[2]Analog output type		[3] Cable		[4] Bracket	
A	Separated indicator type Analog output: 1point	V	1 to 5V	Blank	None	Blank	None
		A	4 to 20mA	1	1m	P	Panel brackets
N	Integrated indicator type Switch output(NPN): 2points Analog output: 1point			3	3m		
P	Integrated indicator type Switch output(PNP): 2points Analog outpot: 1point						

[5]Clean	
Blank	Blank
P70	Particle occurrence prevention

Discrete option model

FSM2 – [KHS] — [P70]

[6] [7]

[6]Symbol		[7]Clean	
KHS	Panel mount brackets	Blank	None
C51	1m (for Integrated indicator type)	P70	Particle occurrence prevention
C53	3m (for Integrated indicator type)		

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