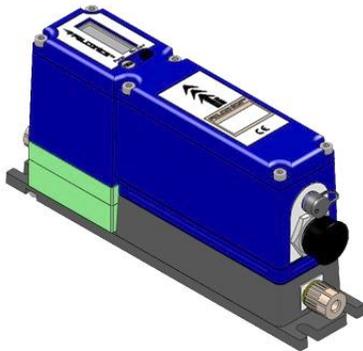




AVFCS2
Flow controller
Instruction Manual

User's Manual



<u>Table of Contents</u>	(Page)
1 Cautions on the product	1
2 Component names	3
3 Type selection	4
4 Specifications	5
5 Dimensions	7
6 Clamping method	7
7 Wiring method.....	8
8 Tubing method	11
9 Control method.....	11
10 Purge method	13
11 LCD display	14
12 Error.....	16
13 Functions	17
14 Optional features.....	18
15 Extended periods of outage.....	19
16 Inspection items	19
17 Storage.....	19
18 Troubleshooting and remedial actions	20
19 Disposal of Remaining and Waste Materials.....	20

(1) Cautions on the product

Be sure to comply with the product specifications, precautions, and so on when using the product.



Warning : Wrongful use of these products could death or severe injury.



Attention : Wrongful use of these products could cause material damage.



Warning

- ❑ ASAHI YUKIZAI CORPORATION. is trying to increase product qualities and reliabilities, but do not assure product perfectibilities. Particularly, when you are going to use the product in a facility that is seriously related to human lives, bodies, and/or properties, you must take appropriate safety designing and measures against possible troubles and accidents. If you use the product in such a facility without any written permission from ASAHI YUKIZAI CORPORATION. ASAHI YUKIZAI CORPORATION is not liable for damages and losses.
- ❑ Peruse and comprehend this manual and technical information before selecting, piping, installing and operating this product.

Cautions on product design and selection



Warning

1. Design the system and select the product in the specified ranges considering medium, temperature, pressure, and other operating conditions. (Using the product out of specification may result in breakage.)
2. For suitability of product materials and process media, see the Medium Suitability List in the latest **Dymatrix™** catalog (AV-V-029-EJ). For suitability of other media to the product materials, call ASAHI YUKIZAI CORPORATION. When using a compressible medium, its safety will not be warranted.
3. When using the product for foreign matter-contained fluid, install filter. (If omitted, the valve may go out of control.)
4. When using the product for crystalline substance-contained fluid, consult us. (If omitted, the valve may go out of control.)
5. Always use the product in the specified pressure range.
6. Always use the product in the specified medium temperature range.
7. Always use the product in the specified ambient temperature range. Check the suitability of the product materials to the ambient atmosphere. Always keep product surfaces clean away from the medium.
8. For the specification of fitting portion: operating pressure, temperature and ambient temperature, see the relevant fitting instruction manuals issued by each fitting manufacturer.
9. Provide an escape valve on the system. Do not make the system hermetically sealed.
10. Provide a maintenance clearance around the product.

Cautions on installation and piping **Warning**

1. Peruse and comprehend this manual before installing and piping the system.
2. Fully flush clean the inside of pipes and remove foreign matters before installing and piping them.
3. Always check the coupled pipe system for leaks and make sure there is no leak from the joints.
(For the checking, use hydrostatic pressure. If you use compressed air, its safety will not be warranted.)
4. Do not give any excessive pulling, compressing, and bending forces on valves.
5. Do not put any weighty stuff or objects on the valve.
6. Always flow medium in a specified direction when the flow direction is marked on the product.
7. For "air to open" actuator, open a port with no pilot pressure to the atmosphere.
8. Keep the product away from fire, flammables and high temperature objects. (If omitted, that may result in deformation, breakage and a fire.)
9. Do not use valves at places where are vulnerable to flooding.

 **Attention**

1. Do not give an impact to the product by throwing, dropping, or otherwise. (That may damage the product.)
2. Do not scratch, pierce, or otherwise damage the product with a knife or other sharp object, when unpacking. (That may damage the product.)

Precautions for use **Warning**

1. Use the product in the specified ranges considering medium, temperature, pressure, and other operating conditions. (Using the product out of specification may result in breakage.)

 **Cautions**

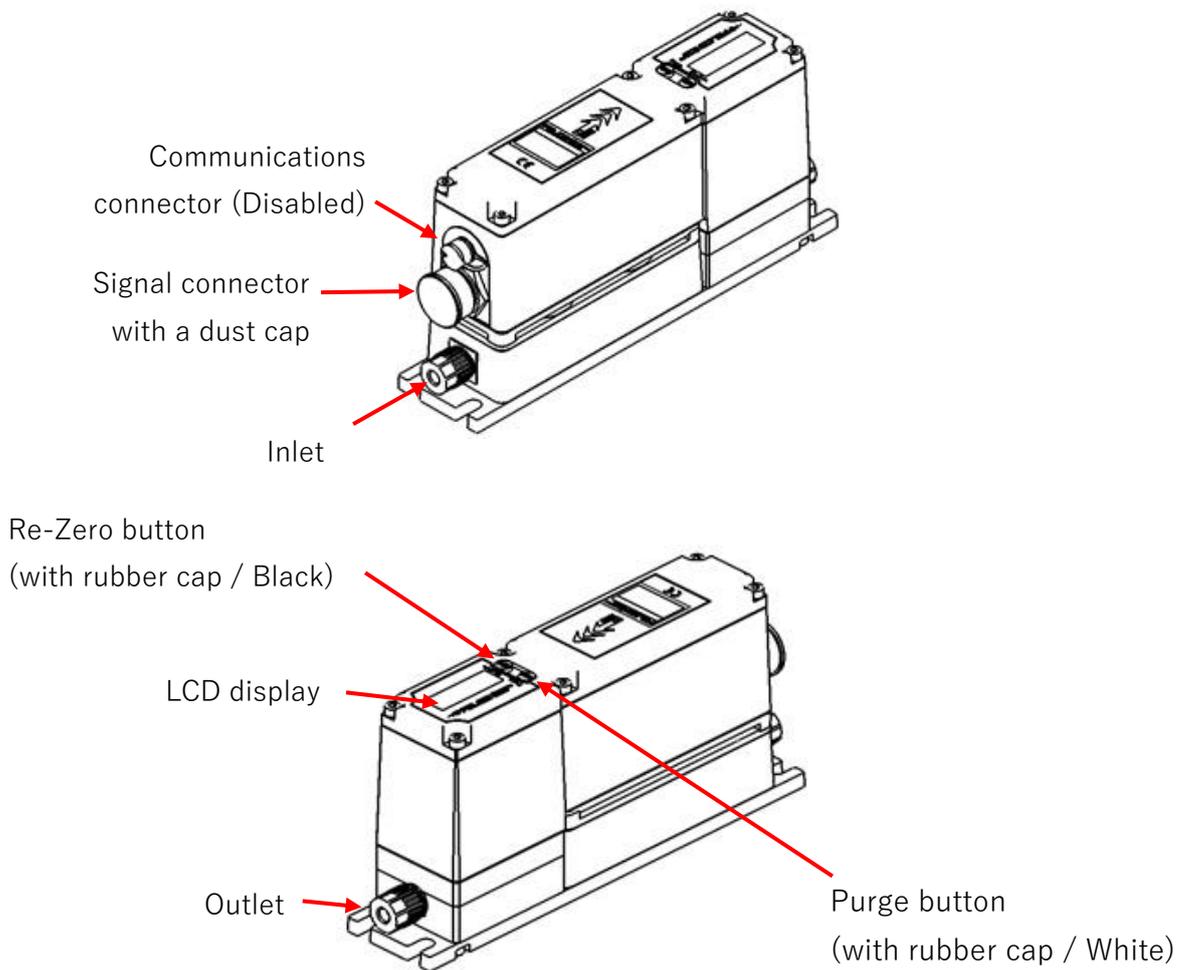
1. For suitability of product materials and process media, see the Medium Suitability List in the latest **Dymatrix™** catalog (AV-V-029-EJ). (Some chemicals may damage the product.) For suitability of other media to the product materials, call ASAHI YUKIZAI CORPORATION.
2. A water hammer may occur at a certain pressure. Adjust the on/off operating speed by speed controller.
3. A pump cavitation may occur in a certain operating condition. In such a case, check and review the medium pressure and piping conditions
4. Do not apply negative pressure to valves.
5. The product is precisely washed and packed in double-clean bag assuming the product will be installed in a clean room. Be careful not to contaminate the product when unpacking it.
6. For the flow rate adjusting type and bypass type, do not overtighten their handles.
7. Always use clean pilot air with no organic solvents and corrosive gas contained
8. Always flow medium in a specified direction. The flow direction of this product is specified.

Precautions for maintenance

⚠ Warning

1. Drain the medium from the system before starting maintenance.
2. Remove the medium from valves and pipes and fully clean their insides with DIW and air before starting maintenance.
3. Do not disassemble the product. When disassembled, the product may deteriorate its performance and specifications and will not be warranted.
4. To run the product in the best status, periodically check valves and coupling for leaks.

(2) Component names



⚠ Attention

Use a separately sold signal cable (AVFCS2-CBL1-00000-1) to connect to the signal connector.

(3) Type selection

AVFCS2	-	A		N			-		-	2
--------	---	---	--	---	--	--	---	--	---	---

Flowrate range	0 2 5 0	25 - 250 ml/min
	0 5 0 0	50 - 500 ml/min
Chemical resistance model	N	Standard *1
Coupling type	F	Flare type 1/4" fitting
	3	Super 300 Type Pillar Fitting™ 1/4" fitting
Standard	I	Inch
	M	mm
Option code *2		0 0 0 0 0

*1: The standard model is calibrated against the following materials.

Wet material: Silicon-based rubber, PFA, PTFE

Other shielding material: FKM

*2: The option code is used if "(14) Optional features" in this manual is specified, and will be specified by us.

(4) Specifications

○ General specifications

Item		Unit	Specification	
Working environment	Fluid temperature	°C	15 to 35	
	Structural pressure resistance ^{*1}	MPa	1.0	
	Working pressure difference range	MPa	0.1 to 0.3	
	Working pressure range ^{*1}	MPa	0.1 to 0.3	
	Ambient temperature	°C	20 to 30	
	Working humidity	%	30 to 80 (no-condensing)	
	Frequency of opening and closing	Times/min.	< 10	
	Mounting posture	-	Restricted ^{*2}	
Wetted: material		-	PFA/PTFE/silicon-based rubber	
Inlet/outlet	Connection	-	Flare Type	Super 300 Type Pillar Fitting™
	Aperture	mm	6.35 × 4.35	6.35 × 3.95 6 × 4
	Orifice	mm	1.6	
Weight		kg	0.9	

*1: For the relationship between the fluid temperature and the working pressure range, refer to the coupling manufacturer's specification.

*2: See "(6) Clamping method."

○ Performances

Item	Unit	Specification	
		AVFCS2-A0250	AVFC2-A0500
Maximum flowrate	ml/min	250	500
Minimum flowrate	ml/min	25	50
Flowrate accuracy ^{*1}	-	± 1%R.D. (> 50 ml/min)	
		± 0.75 ml/min (≤ 50 ml/min)	
Repeatability ^{*1}	-	0.5%R.D. (> 50mL/min)	
		0.5mL/min (≅ 50mL/min)	
Response time	Second	≅ 1 (Typical)	
Closure time	Second	≅ 1 (Typical)	
Valve seat leakage	-	0 cm ³ /min (at hydraulic pressure, 23°C)	
Cv value ^{*2}	-	0.05	

*1: Performance is a deionized water temperature of 25° C for the temperature correction-less type.

*2: Value at fully open time

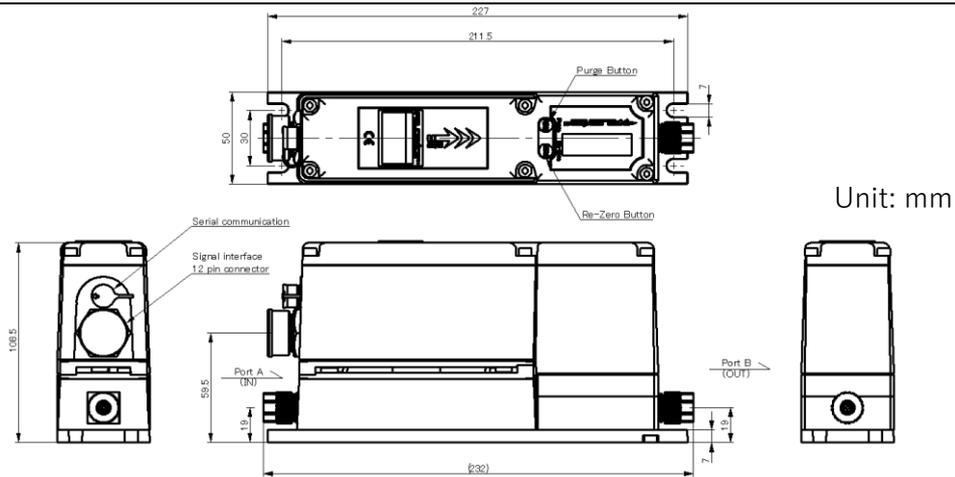
○ Electrical specifications

Item		Unit	Specification	
			AVFCS2-A0250	AVFCS2-A0500
Power supply		-	24 VDC ± 10%	
Current consumption		A	≤ 0.4	
Set flowrate input	Type *1	-	Current 4-20 mA	
	Analog signal span	ml/min	0-250	0-500
	Input impedance	Ω	200	
	Allowable input range	mA	0 to 24	
	Measurement accuracy	-	± 0.2%F.S.	
	Sampling period	msec	25	
	Resolution	-	2900	
Flowrate output	Type *1	-	Current 4-20 mA	
	Analog signal span	ml/min	0-500	0-250
	Load resistance	Ω	≤ 600 Ω	
	Output accuracy	-	± 0.2F.S.	
	Sampling period	msec	25 msec	
	Resolution	-	4000	
Re-Zero input	Type	-	Photo coupler	
	Limiting resistor	kΩ	2.2	
Alarm output	Type	-	Transistor	
	Maximum load current	mA	50	
	Logic *2	-	A-contact (normally open)	

*1: The product can be purchased, customized with 0-5V or 0-10V selected. See "(14) Optional features.

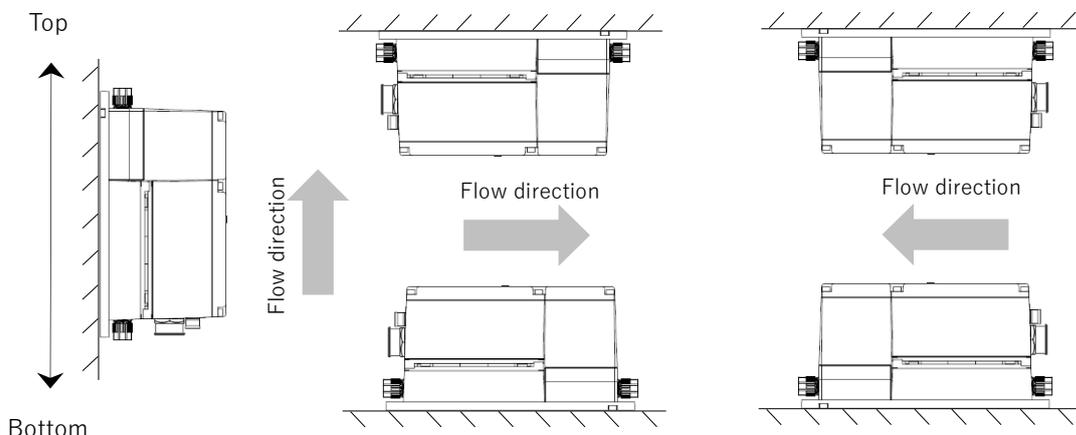
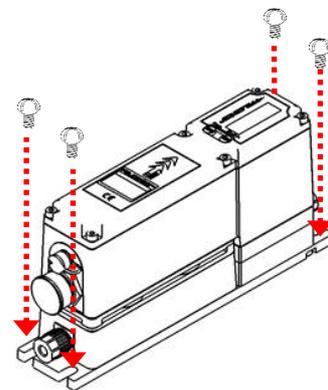
*2: The product can be purchased, customized with the B-contact (normally closed) selected, though it is enabled about 500 msec after the product is switched on because of a software mechanism that reverses logic.

(5) Dimensions



(6) Clamping method

- Install the product in places that are.
 - 1) In an ambient temperature range of 20 to 30° C and not exposed to direct sunlight.
 - 2) Free from concern over dielectric interference.
 - 3) Not subject to water drops or corrosive gases.
 - 4) Readily accessible for maintenance and inspection.
- Clamp the product with the mounting screw holes in the bottom of the unit as shown to the right. For the mounting position, see "(5) Dimensions."
- Mount the product in the directions shown below. Performance of the product would be unpredictable if it is mounted in any other direction.

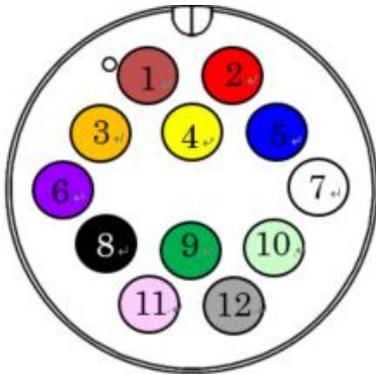


⚠ Attention

- Observe the thread length (to avoid possible damage).
- Tighten screws with a torque of 0.4 to 0.6N·m be careful not to overtighten to avoid possible damage).

(7) Wiring Method

Connect the power and signal lines to the product. Use a separately sold signal cable (AVFCS2-CBL1-00000-1) to make connections as shown below.



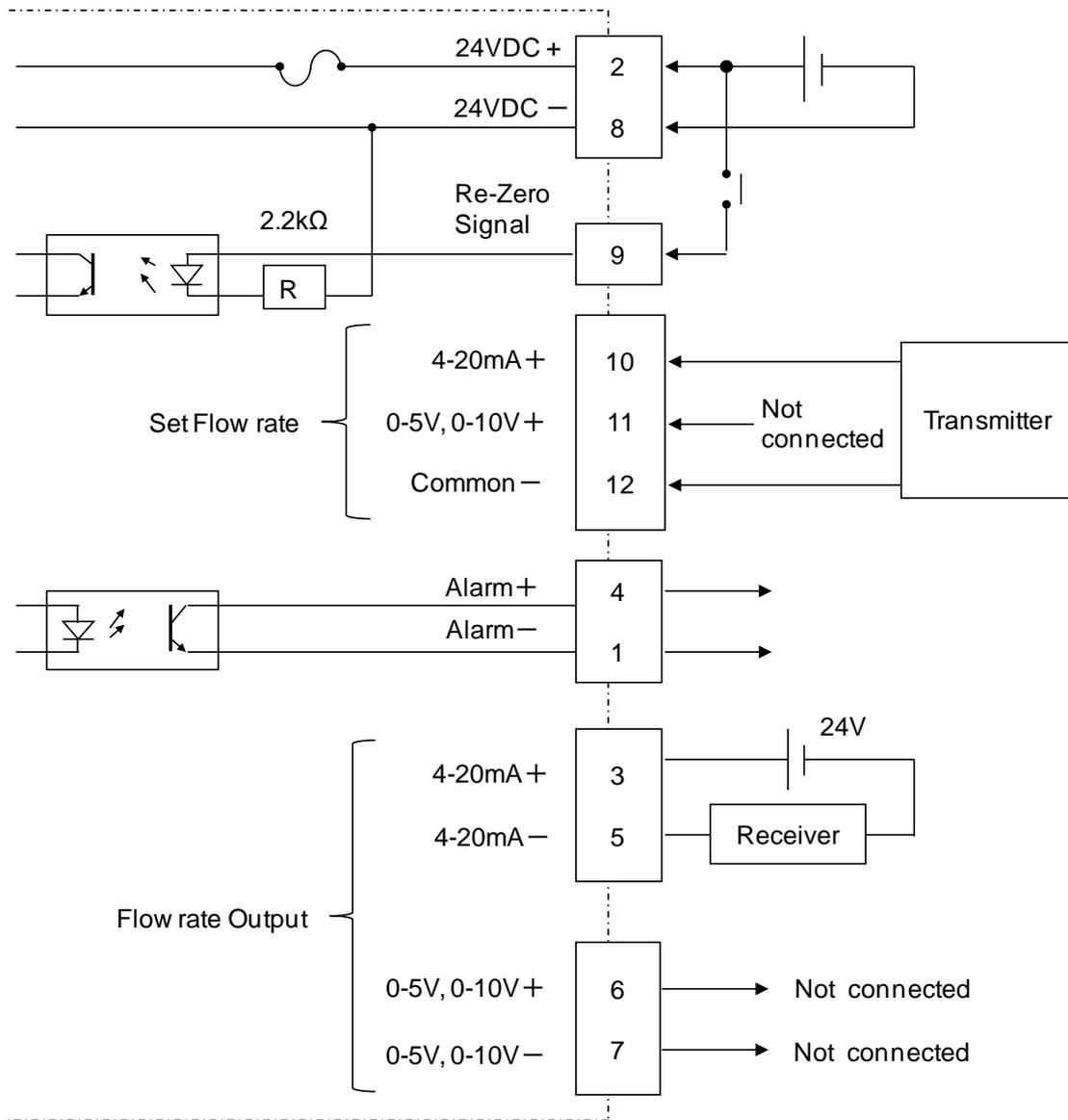
Pin No. allocation of signal connector

Pin	Cable color	Designation	Polarity
1	Brown	Alarm	-
2	Red	Power supply 24 VDC	+
3	Orange	Flowrate output 4-20 mA	+
4	Yellow	Alarm	+
5	Blue	Flowrate output 4-20 mA	-
6	Purple	Flowrate output 0-5 V/0-10 V	+
7	White	Flowrate output 0-5 V/0-10 V	-
8	Black	Power supply 24 VDC	-
9	Green	Re-Zero signal	+
10	Light Green	Set flowrate 4-20 mA	+
11	Pink	Set flowrate 0-5 V/0-10 V	+
12	Gray	Set flowrate common	-

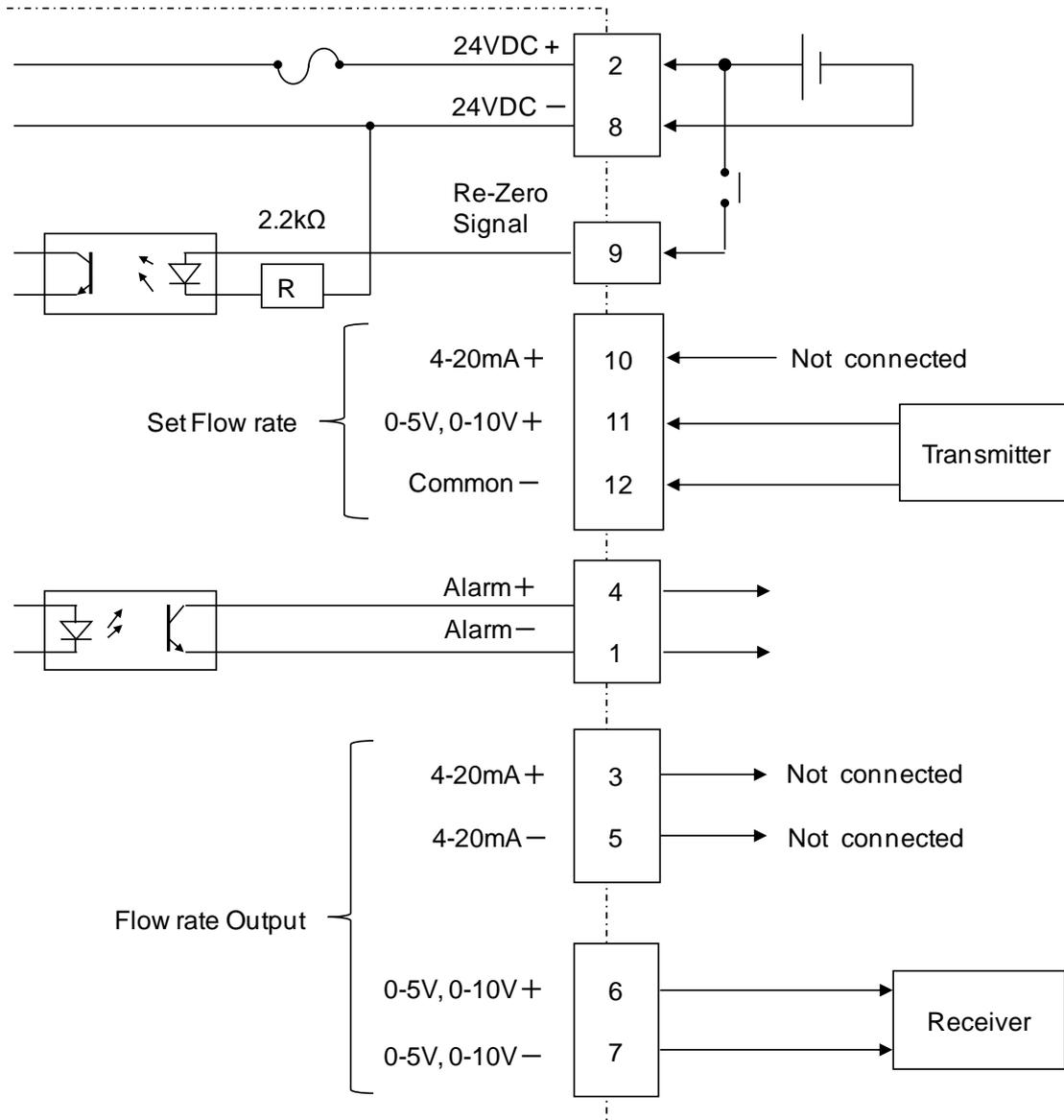
⚠ Caution

- Insert the connector in the correct direction (to avoid possible damage).
- Check the supply voltage is correct (to avoid possible damage).
- Leave unconnected pins open (to avoid possible malfunctioning).
- Connect the signal connector and make connections with the product switched off. Check also that the product is properly wired before switching it on.
- Confirm the maker's (Amphenol) instructions and notes in connecting the signal connector and cable.
 - Signal connector type : Amphenol ACD-12PMMS-LC7001
 - Signal cable connector type : Amphenol ACD-12BFFM-LL7000
- Keep the signal connector and the communications connector capped with a dust cap attached to them when they are out of use.
- While the power supply and analog I/O (4-20 mA set flow, 4-20mA flow output) are protected against instantaneous 30 VDC input, continuous input could cause them to fail.
- Digital I/O (Re-Zero signal, alarm signal) is protected against 30 VDC input.
- This product is not designed to withstand a 100 VAC source. AV voltage input could cause the product to fail.

○ Internal circuitry and sample connections (4-20mA model)



○ Internal circuitry and sample connections (0-5V / 0-10V model)



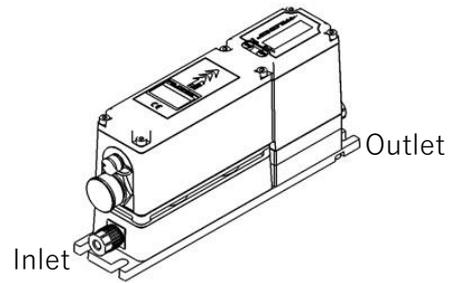
Attention

Keep lines open when they are out of service (to avoid possible malfunctioning).

(8) Tubing method

○ Inlet and outlet tubing

This product has the direction of fluid flow prescribed.
Construct tubing to suit the needs of your system.



Fitting connection method

【Flare Type】

- 1) Cut a tube at right angle. Pass the nut through the tube.
- 2) Using the dedicated tool, flare the tube.
- 3) Insert the tube into the fitting. Turn nut up to the required clearance by spanner, after tightening by hand firmly.
- 4) To check the tightness of union nut, use the dedicated gap gauges

【Super 300 Type Pillar Fitting™】

- 1) Cut a tube at right angle. Pass the union nut through the tube.
- 2) Using the dedicated tool, force the sleeve to fit into the inner surface of the tube.
- 3) Assemble the sleeve to the fitting and then tighten the fitting until the union nut makes contact with the projection on the gauge ring and a click can be heard.



Attention

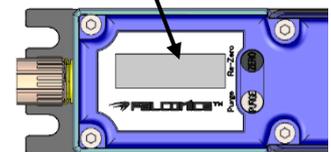
- Do not overtighten the fitting nuts (to avoid possible damage).
- Check that the direction of flow is correct.

(9) Control method

○ Application of supply voltage

- Check the following things before application of supply voltage.
 - Check correct connection.
 - Check the power supply voltage (±10% of 24V)
 - Check the safety of the tool and environment then turn the power.
- After having spent a power supply, please confirm that LCD displays it.

LCD display



○ Zero flowrate adjustment (Re-Zero)

This feature resets the currently measured flowrate to zero. Implement it while the channel in the product is filled up with a fluid and the fluid flow is still.

< Making Zero flowrate adjustment (1) External signal >

- 1) Check the that power supply and also that at least 120 minutes.
- 2) Fill up the channel in this product with a fluid.
- 3) Keep the fluid flow still (not flowing).
- 4) Check that the set flow rate to the product is zero.
- 5) Feed the Re-Zero signal for 100 msec or longer and then release it. Re-Zero will start on detection of the trailing edge of the signal.
- 6) Keep the fluid flow still for at least 12 seconds.

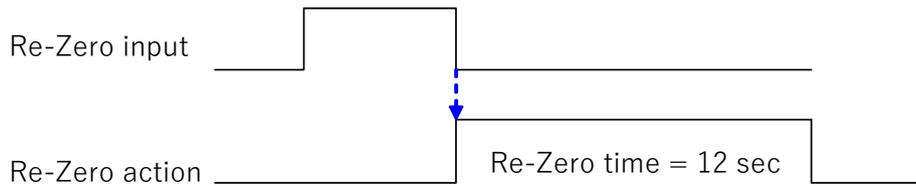
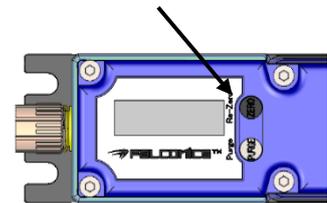


Figure 9-1. Re-Zero input time and operation

< Making Zero flowrate adjustment (2) Re-Zero button >

- 1) Check the that power supply and also that at least 120 minutes.
- 2) Fill up the channel in this product with a fluid.
- 3) Keep the fluid flow still (not flowing).
- 4) Check that the set flow rate to the product is zero.
- 5) After having excluded a re-zero rubber cap, with a thin stick less than ϕ 3mm, please push the re-zero button.

Re-zero button / Rubber cap(Black)



Re-Zero will start on detection of the trailing edge of the signal.

- 6) Keep the fluid flow still for at least 12 seconds.

< Making Zero flowrate adjustment (3) Dedicated application >

Please refer to user's manual (DTS208).

< Situations and symptoms that recommend the implementation of zero flowrate adjustment >

Implementation of zero flowrate adjustment is recommended in the following situations or following symptoms are observed:

1. Measured flowrate deviates from the actual flowrate
2. Initial installation or after extended periods of outage
3. Changing fluids to use

⚠ Attention

- Re-Zero input is enabled 500 msec after the product is switched on. Input prior to the expiry of the 500 msec period is ignored.
- Re-Zero launches at the trailing edge of the Re-Zero signal.
- Re-Zero data is invalidated if the product is switched off during the Re-Zero sequence, with the previous data being put to use.
- If a measurement disabled state, such as one caused by air bubbles, occurs during the Re-Zero sequence, it is terminated.
- If Re-Zero is carried out during a control sequence, its flowrate is set to zero. Be sure to carry out Re-Zero with the fluid flow positively kept still.
- If control launches during a Re-Zero sequence, it would set the measured flowrate to zero, disabling valid operations subsequently. Once Re-Zero is turned off, keep the fluid flow still with the valve closed for at least 12 seconds.

○ Flow control start / stop

This product starts feedback control and supplies the liquid when the set flow rate is set to 2% F.S._SP (analog input range) or higher. When the set flow rate is set to less than 2% F.S._SP (analog input range), control is stopped and the valve is fully closed.

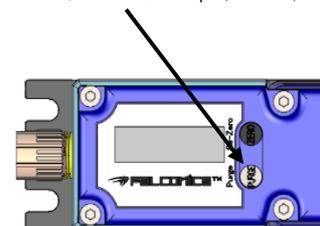
(10) Purge method

By pressing the purge button on the top of the product, the valve on the product can be fully opened.

<How to operate>

- Remove the rubber cap from the top of the product and press the purge button with a thin stick of 3 mm or less in diameter.
- While pressing the purge button, the valve will be fully open.
- When the purge button is released, the product returns to normal operation (fully closed control).

Purge Button/Rubber Cap (White)



⚠ Attention

- It takes approximately 2 seconds for the product to move the valve from fully closed to fully open. Therefore, the button must be held down for at least 2 seconds to fully open the valve.

(11) LCD display

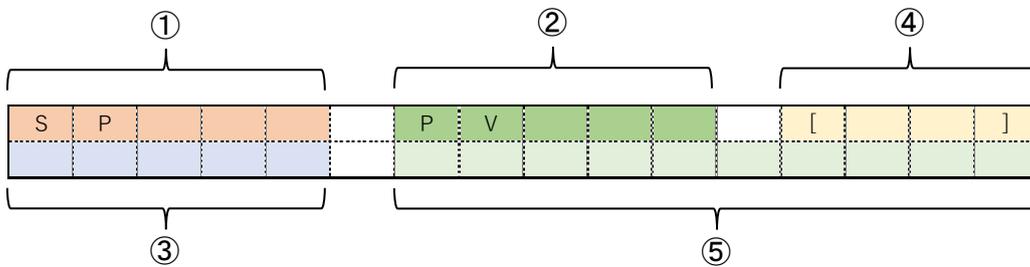
The LCD displays the operation status, error status, and current flow rate.

- Startup (point in) time
 - Automatic detection is performed at the valve home position.
 - If automatic detection fails, an error occurs.

Table 11-1 Error content at startup

name	LCD display
Origin Search Error	- AVC500 V1.00 - OriginSearch Err

- Display Contents
 - The LCD displays five pieces of information.



- ① Set flowrate (Number of characters displayed : Maximum 5)
Displays the set flow rate entered into the product. (Unit: mL/min)
- ② Current flow rate (Number of characters displayed : Maximum 5)
Displays the flow rate output value of the product. (Unit: mL/min)
- ③ Operating status (Number of characters displayed : Maximum 5)
Displays the current operating status of the product.

Table 11-2 Operation status

③ Display character	Contents
CLOSE	Valve closure
RUN	Feedback control to flow setting
OPEN	Purge state (valve in specified open position)
ZERO	Zero flow adjustment in progress
HOLD	Holding open position just before operation

- ④Error code (Number of characters displayed : 4)
 Displays an error code indicating the error that has occurred.
 If multiple errors have occurred, the display flashes and changes.
- ⑤Error description (Number of characters displayed : Maximum 10)
 Displays the name of the error that is occurring.

Table 11-3 Error Codes and Error Content Display Character

Name	④Error code	⑤Error Description	LCD display
Flow unit error	[C2]	CommFailed	SP 0 PV 0 [C2] CLOSE CommFailed
Flow alarm	[C4]	Low Flow	SP500 PV 6 [C4] RUN Low Flow
Flow measurement error	[F0]	Bubble	SP 0 PV 0 [F0] CLOSE Bubble
Zero reset error	[F1]	ZeroFailed	SP 0 PV 74 [F1] CLOSE ZeroFailed
Temperature alarm	[F2]	Temp	SP 0 PV 0 [F2] CLOSE Temp
Sensor error	[F3]	Peak Diff	SP 0 PV 0 [F3] CLOSE Peak Diff
Write over error		ZeroCount	SP 0 PV 0 [F3] CLOSE ZeroCount
Zero offset error		ZeroOffset	SP 0 PV 48 [F3] CLOSE ZeroOffset

(12) Errors

Errors occur on this product due to the following events.

If the solutions listed in the table below do not improve the problem, please contact the manufacturer.

< Conditions of error occurrence and troubleshooting >

Error	Occurrence conditions	Causes	Troubleshooting
Valve origin Error	In case valve initialization is not completed after power-on.	Malfunction. Failure of limit sensor.	Reboot of power supply. (Turn on the power again) Contact the manufacturer.
Flow Unit Error	Communication fault between the substrates inside the body.	Abnormality of the board.	Product exchange.
Flow Alarm	In case 3.0 seconds (default) or more elapsed with the measured flow rate remaining as having a variation of $\pm 15\%RD$ (default) or more comparing to the set flow rate.	Reduction in supply pressure. Contamination of foreign matter.	Confirm supply pressure. Valve opening check by application. Fluid passing with the valve fully open
Bubble Error	Flow measurement impossible state lasts 9.5 seconds. (default)	Bubble inclusion in flow sensor.	Fluid passing with the valve fully open
Zero Reset Error	In case zero flow rate adjustment (Re-Zero) failed.	Inability to measure flow rate (bubble inclusion)	Fluid passing with the valve fully open. Zero flow rate adjustment.
Temperature Alarm	Measure the temperature above the set threshold.	Failure of the temperature sensor.	Product exchange.
Sensor Error	Failure of flow meter sensor.	Possibility of deterioration of flow sensor.	Zero flow rate adjustment. Contact the manufacturer.
Write over Error	The accumulated number of zero flow adjustment reaches the upper limit. (1 million times)	Fluctuation of zero flow rate.	Product exchange.
Valve Error	When the deviation amount is equal to or greater than the set threshold value at the time of execution of auto zero execution.	Fluctuation of zero flow rate. Leaked of pinch valve	Zero flow rate adjustment. Contact the manufacturer.

<Motion in case of Bubble Error occurrence>

[Case example: “Open” for auto-purge mode; default for alarm setting]

The valve opening degree prior to the detection of bubbles is held for 1.5 seconds immediately after the detection, and then said degree is held at full open for 8.0 seconds. An alarm is issued total 9.5 seconds after the detection of bubbles. During this period, a flow rate immediately before the detection of bubbles remains displayed. After the alarm is issued, the flow rate is displayed as zero.

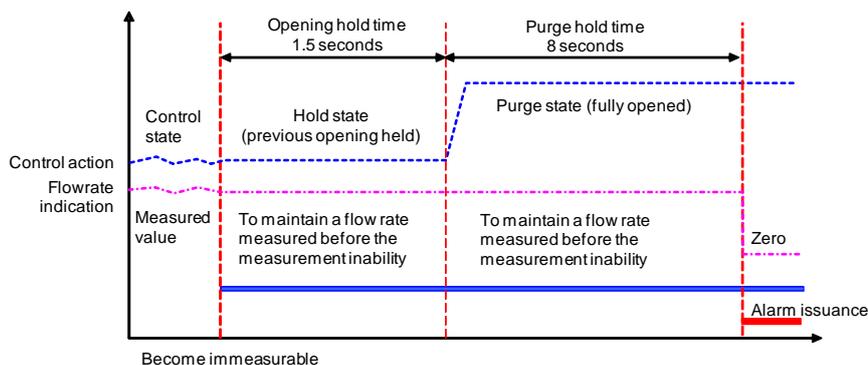


Fig. 12-1 Motion in case of bubble incorporation

Note that if normal measurement is restored during the hold time of opening degree and purge, control is restarted and no alarm is issued.

<Alarm release>

Any alarm is automatically released once alarm occurrence conditions are removed.

In case of no automatic release enabled, see Table 18-1, "Troubleshooting," described later.

(13) Functions

This product has the following functions of which setting is changeable.

Use the adjustment set AVFCS2 (AVFCS2-ADJ0-00000-2) separately sold to conduct adjustment or setting change. For details on each item and how to change the settings refer to the following instruction manual.

- AVFCS2 Adjustment Manual (DTS208)

Function		Measurement ranges	Default values
Alarm	Alarm output logic	Normal or Reverse	Normal
	Flow rate alarm upper limit	0-100%	15%
	Flow rate alarm lower limit	0-100%	15%
	Flow rate alarm delay time	0-750sec	3 sec
Analog input/output	Analog input range F.S._SP	1-1000mL/min	250 / 500
	Analog output range F.S._PV	1-1000mL/min	250 / 500
	Analog output low-cut	-10~20% F.S._PV	1% (500mL/min) 2% (250mL/min)
Valve operation switching	Control setting flow rate range	2-10% F.S._SP	2%
	Hold motion setting	Disable / Enable	Disable
	Flow rate range set for hold	2-50% F.S._SP	—
	Purge motion setting	Disable / Enable	Disable
	Flow rate range for purge	80-100% F.S._SP	—
Auto purge	Function setting	Disable / Enable	Enable
	Function select	Open/Set position/Hold	Open (Fully open)
	Select set position	0.3 - 2.0 mm	2.0mm
	Opening hold time	0-5sec	1.5sec
	Purge hold time	0-20sec	8.0sec

(14) Optional features

This product can be purchased, customized with the following features selected:

1. Set flowrate input and output analog signal type.

The analog signal is selectable from among 4-20mA, 0-5V and 0-10V as specified in the table below.

Item		Specification		
Analog input	Input type	Current 4-20 mA	Voltage 0-5 V	Voltage 0-10 V
	Input impedance	200 Ω	550 kΩ	550 kΩ
	Input bias current	1 mA or less	1 mA or less	1 mA or less
	Allowable input range	0-24 mA	0-12 V	0-12 V
	Measurement accuracy	± 0.1%FS at 4-20 mA	± 0.1%FS at 0-5 V	± 0.1%FS at 0-10 V
	Sampling period	25 msec	25 msec	25 msec
	AD conversion range	2.4 to 21.6 mA	-0.5 to 5.5 V	-1 to 10.1 V
	Resolution	12 bits (22.5 mA F.S) 2,900 divisions	12 bits (5.56 V F.S) 3,600 divisions	12 bits (11.25 V F.S) 3,600 divisions
Analog output	Output type	Current 4-20 mA (external power supply)	Voltage 0-5 V	Voltage 0-10 V
	Resolution	12 bits (20 mA F.S) 4,000 divisions	12 bits (5 V F.S) 1,800 divisions	12 bits (10 V F.S) 3,600 divisions
	Load resistance	600 Ω or less	1 kΩ or more	1 kΩ or more
	Output accuracy	0.1%FS	0.2%FS	0.1%FS
	Defined performance range	4 to 20 mA	0.1 to 5 V	0.1 to 10 V

(15) Extended periods of outage

Before leaving the product out of service for an extended period of time, do the following:

1. Replace the chemical and other fluids in the product with deionized water.
2. Switch off the product.

(16) Inspection items

- Carry out maintenance (inspection) on a scheduled basis.
(Maintenance (inspection) at least once each year is recommended.)
- If faults are noticed, please contact the location listed at the end of the manual.

Points to check
(1) Visual flaws, cracks, deformation and discoloration
(2) Fluid leaks from the flow inlet and outlet (inlet and outlet tubes loosening or not)
(3) Unusual noise while opening and closing
(4) Control signal cable breakage

(17) Storage

- Storage during until use from delivery is following.
 1. Place the product in a room which humidity is within 0 to 80% RH and 10 - 40 degree C of temperature. (No condensation is allowed.)
 2. Do not place the product where exposed to direct sunlight or dust.
 3. Do not place the product where have an impact or vibration.
 4. The product is double-packed after the precision cleaning. Do not open the package before the actual usage.
- If the product is required to remove and store after a certain period of use, please follow the following procedure.
 1. Flash the remaining fluid by high purity water, and be dried enough.
 2. Protect the connectors of both inlet and outlet flow passes for the prevention of damages.
 3. Attach any dust-caps to the signal connectors and communication connectors.

**Attention**

- If the product is improperly stored , it causes failure of product or deterioration of accuracy.

(18) Troubleshooting and remedial actions

Symptom	Problem cause	Remedial action
Product does not operate	Insufficient supply power	Check the supply voltage and current.
	Faulty or broken connection	Make a correct connection.
Fluid won't flow	Set flow not available (4-20mA set flow input)	Check the connection for breakage.
	Low primary supply pressure	Check the primary supply pressure and set it within the specified pressure range.
	Large secondary pressure loss	Replace with a tube having a less pressure loss.
Erratic control flow	Pulsating primary supply pressure	Remove the pulsation of the primary supply pressure.
	Insufficient primary supply pressure	Check the primary supply pressure and set it within the specified pressure range.
	Set flow out of range	Use within the specified flow range. 50 to 500mL/min or 25 to 250mL/min
	Air bubbles present	Flush with DIW or otherwise take actions to remove air bubbles.

* Please let us know whenever the product is suspected faulty or to have failed.

(19) Disposal of Remaining and Waste Materials



Attention

Pass remaining and waste materials on to a specialized disposer for disposal.
(Their combustion would result in toxic gas generation.)

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Super 300 Type Pillar Fitting™ is the registered trademark or trademark of Nippon Pillar Packing Co., Ltd.

AVFCS2

Flow controller

ASAHI YUKIZAI CORPORATION

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<http://www.asahi-yukizai.co.jp>

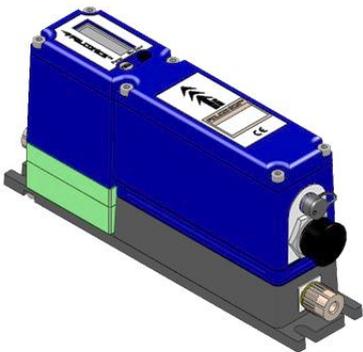


AVFCS2
Flow controller
Adjustment Manual

User's Manual

Table of Contents (Page)

1	Cautions on the product	1
2	Purpose.....	3
3	Prerequisite Items.....	3
4	Calibration Procedure Outline	4
5	Aging	5
6	Installation.....	6
7	Connection	10
8	Software Start-up.....	11
9	Functions	12
10	Measuring Actual Flow-rate	27
11	Correcting Linearization	29
12	Disconnecting Calibration Kit.....	33



(1) Cautions on the product

Be sure to comply with the product specifications, precautions, and so on when using the product.



Warning : Wrongful use of these products could death or severe injury.



Attention : Wrongful use of these products could cause material damage.



Warning

- ❑ ASAHI YUKIZAI CORPORATION. is trying to increase product qualities and reliabilities, but do not assure product perfectibilities. Particularly, when you are going to use the product in a facility that is seriously related to human lives, bodies, and/or properties, you must take appropriate safety designing and measures against possible troubles and accidents. If you use the product in such a facility without any written permission from ASAHI YUKIZAI CORPORATION. ASAHI YUKIZAI CORPORATION is not liable for damages and losses.
- ❑ Peruse and comprehend this manual and technical information before selecting, piping, installing and operating this product.

Cautions on product design and selection



Warning

1. Design the system and select the product in the specified ranges considering medium, temperature, pressure, and other operating conditions. (Using the product out of specification may result in breakage.)
2. For suitability of product materials and process media, see the Medium Suitability List in the latest **Dymatrix™** catalog (AV-V-029-EJ). For suitability of other media to the product materials, call ASAHI YUKIZAI CORPORATION. When using a compressible medium, its safety will not be warranted.
3. When using the product for foreign matter-contained fluid, install filter. (If omitted, the valve may go out of control.)
4. When using the product for crystalline substance-contained fluid, consult us. (If omitted, the valve may go out of control.)
5. Always use the product in the specified pressure range.
6. Always use the product in the specified medium temperature range.
7. Always use the product in the specified ambient temperature range. Check the suitability of the product materials to the ambient atmosphere. Always keep product surfaces clean away from the medium.
8. For the specification of fitting portion: operating pressure, temperature and ambient temperature, see the relevant fitting instruction manuals issued by each fitting manufacturer.
9. Provide an escape valve on the system. Do not make the system hermetically sealed.
10. Provide a maintenance clearance around the product.

Cautions on installation and piping



Warning

1. Peruse and comprehend this manual before installing and piping the system.
2. Fully flush clean the inside of pipes and remove foreign matters before installing and piping them.

3. Always check the coupled pipe system for leaks and make sure there is no leak from the joints.
(For the checking, use hydrostatic pressure. If you use compressed air, its safety will not be warranted.)
4. Do not give any excessive pulling, compressing, and bending forces on valves.
5. Do not put any weighty stuff or objects on the valve.
6. Always flow medium in a specified direction when the flow direction is marked on the product.
7. For "air to open" actuator, open a port with no pilot pressure to the atmosphere.
8. Keep the product away from fire, flammables and high temperature objects. (If omitted, that may result in deformation, breakage and a fire.)
9. Do not use valves at places where are vulnerable to flooding.

 **Attention**

1. Do not give an impact to the product by throwing, dropping, or otherwise. (That may damage the product.)
2. Do not scratch, pierce, or otherwise damage the product with a knife or other sharp object, when unpacking. (That may damage the product.)

Precautions for use

 **Warning**

1. Use the product in the specified ranges considering medium, temperature, pressure, and other operating conditions. (Using the product out of specification may result in breakage.)

 **Attention**

1. For suitability of product materials and process media, see the Medium Suitability List in the latest **Dymatrix™** catalog (AV-V-029-EJ). (Some chemicals may damage the product.) For suitability of other media to the product materials, call ASAHI YUKIZAI CORPORATION.
2. A water hammer may occur at a certain pressure. Adjust the on/off operating speed by speed controller.
3. A pump cavitation may occur in a certain operating condition. In such a case, check and review the medium pressure and piping conditions
4. Do not apply negative pressure to valves.
5. The product is precisely washed and packed in double-clean bag assuming the product will be installed in a clean room. Be careful not to contaminate the product when unpacking it.
6. For the flow rate adjusting type and bypass type, do not overtighten their handles.
7. Always use clean pilot air with no organic solvents and corrosive gas contained
8. Always flow medium in a specified direction. The flow direction of this product is specified.

Precautions for maintenance

 **Warning**

1. Drain the medium from the system before starting maintenance.
2. Remove the medium from valves and pipes and fully clean their insides with DIW and air before starting maintenance.
3. Do not disassemble the product. When disassembled, the product may deteriorate its performance and specifications and will not be warranted.
4. To run the product in the best status, periodically check valves and coupling for leaks.

(2) Purpose

This operation manual describes the procedure how to calibrate AVFCS2.

It is necessary to read and comprehend operation manuals of "AVFCS2 - Installation (DTS207)" in advance of adjustment.

This Calibration Kit performs the functions below through communication with AVFCS2.

- ◆ Monitoring function
Displays current flow rates and flow chart which shows transitions of nearest history under control of AVFCS2.
- ◆ Logging function
Flow rate, valve operation, and internal temperature is acquirable.
Moreover, data can be saved.
- ◆ Parameter setting function
Enables setting of various parameters related to motions of AVFCS2.

(3) Prerequisite Items

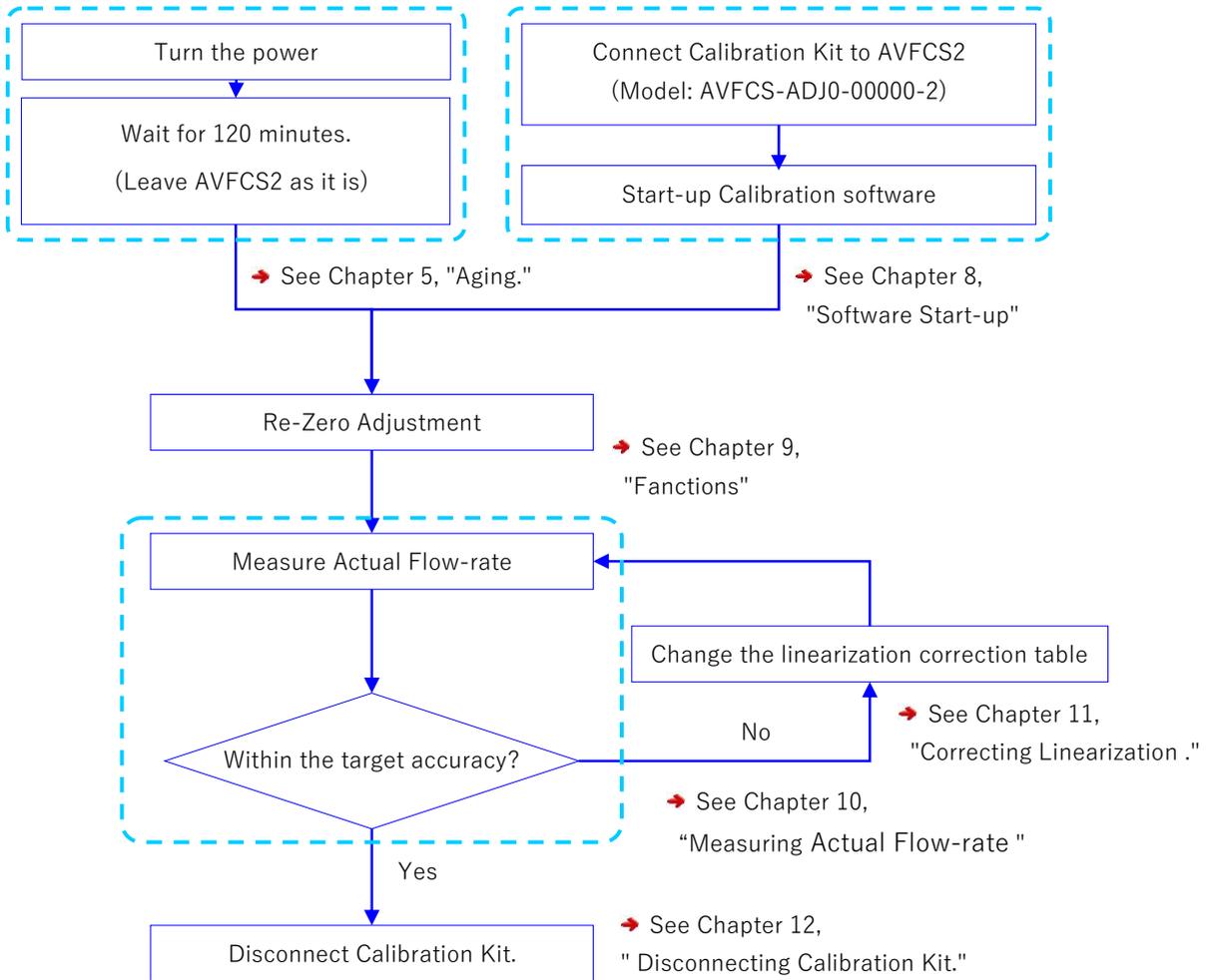
The calibration procedure in this operation manual requires the following items besides AVFCS2.

- Calibration Kit (AVFCS2-ADJ0-00000-2) for AVFCS2
 - PC
 - Stop Watch and Measuring Cylinder, Electronic Balance or other measuring devices to measure actual flow rates
 - Notebook, PC or other media can be taken a memo.
-
- ◆ Calibration Kit for AVFCS2
 - (1) Communication cable
 - (2) AVFCS2 software CD-ROM
 - (3) USB/RS-485 converter (fabricated by JW-system. Co., Ltd.)
 - Convertor
 - USB cable

 - ◆ Prepare a PC to be installed the software, and AVFCS2 which is turned the power on for monitoring and calibration.

(4) Calibration Procedure Outline

AVFCS2 is calibrated as following flow.

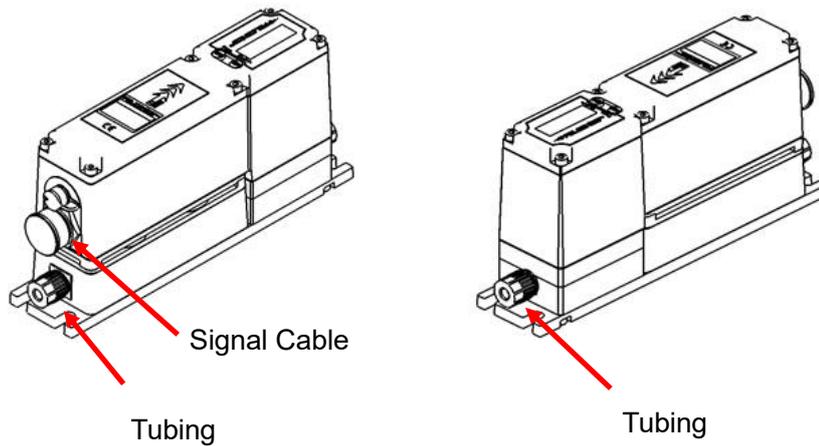


(5) Aging

Install AVFCS2, connect cable and tubing, turn the power.

Procedure 1: Installing AVFCS2 and connecting cable and tubing

- Install AVFCS2, connect a signal cable and tubing, following the procedure in "AVFCS2 - installation (DTS207)".



Reference

- This control system requires Signal cable, tubing for liquid.

Procedure 2: Turning the power

- Check the safety of the tool and environment then turn the power.

Procedure 3: Aging

- Wait 120 minutes after turning the power on.

It is recommended to note the time that you turned on.



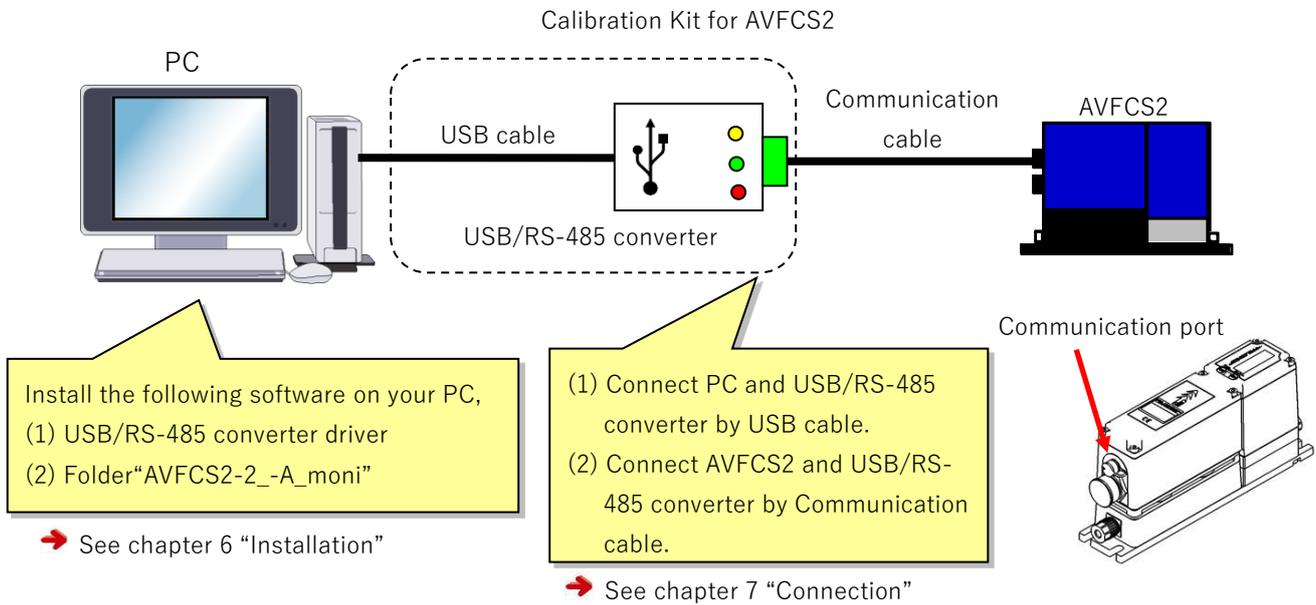
Attention

- Do not shut the power off during aging.
- In case the power is shut off by accident, restart the 120 minutes time after the unit is turned back on.

(6) Installation

6 – 1 Outline of system configuration

The composition of a system is shown in the following figure.

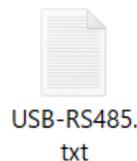


6 – 2 Installation of USB/RS-485 converter driver

For using this set, installation of the USB/RS-485 converter driver and this software is required. The following describes how to install them.

This installation procedure can be skipped if the software has been installed already.

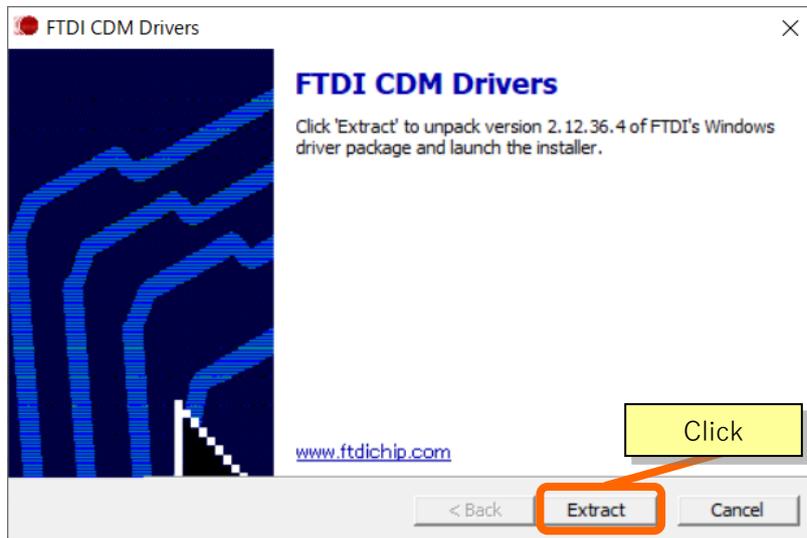
1. Check that the USB cable of the USB/RS-485 converter is not stuck in the port, and insert the software CD-ROM into the CD-ROM driver of your PC.
2. Open the "USB-RS485.txt" file from the "Driver" folder in the software CD-ROM and access the URL listed.



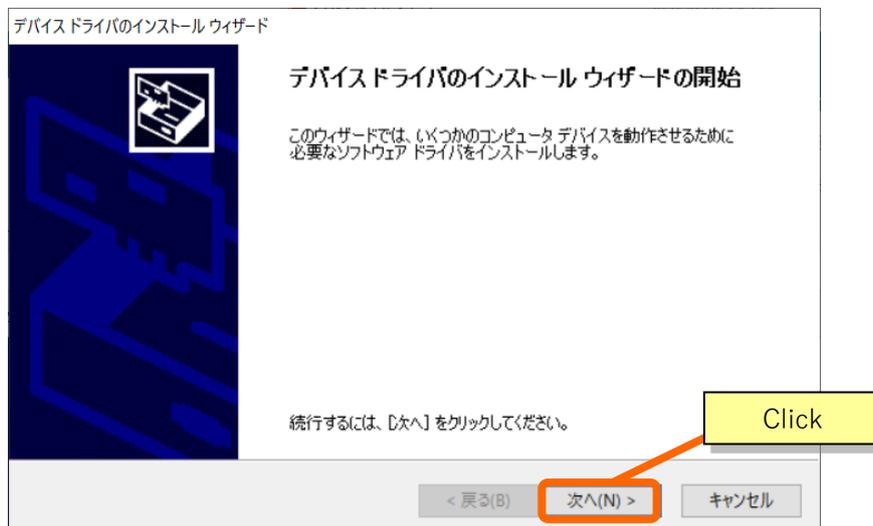
3. Download the driver from the URL listed and save it to any directory on your PC.
4. Unzip the downloaded "zip" folder and open the file in the folder.



- When this screen appears, click "Extract".
The folder and file name of the driver downloaded from the URL may change.



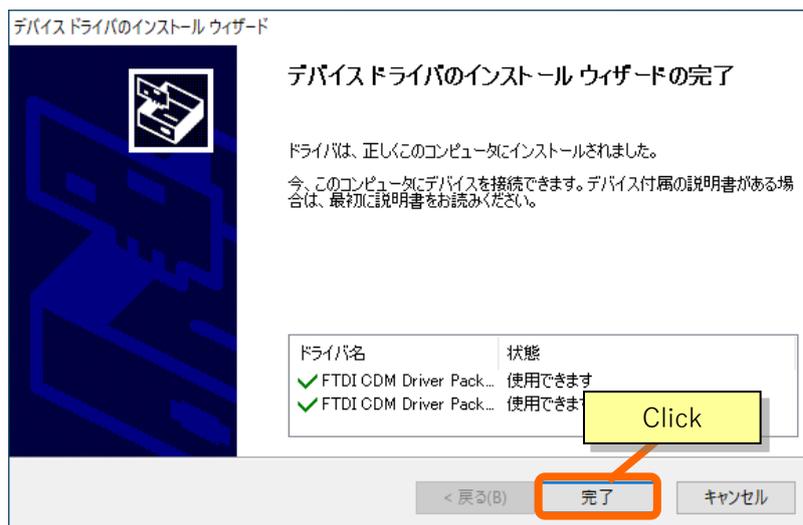
- When this screen appears, click the orange frame.



7. When this screen appears, click in the order from ① to ②.



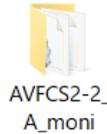
8. Driver installation is finished. Click the orange frame and close the screen.
If the installation fails, please contact the maker of the driver you want to install.



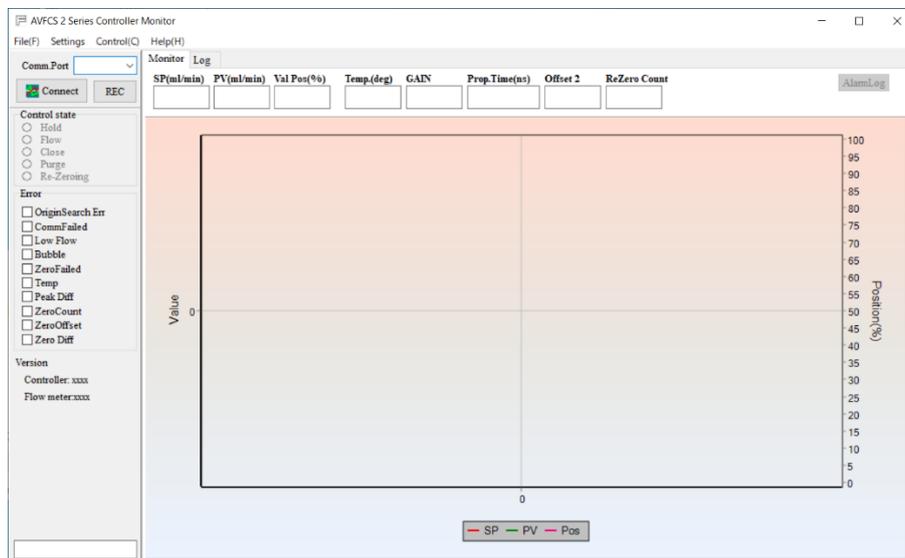
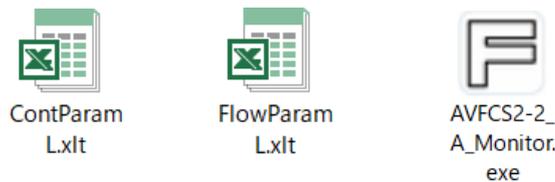
6 – 3 Installation of Calibration software “AVFCS2-2_A_Monitor”

Copy “AVFCS2-2_A_Monitor (software for AVFCS2 adjustment)” to your PC.

1. Place the “AVFCS2 software CD-ROM” in the CD-ROM driver of your PC.
2. Save the “AVFCS2-2_A_moni” folder (icon shown below) stored in the CD-ROM in an arbitrary directory in the hard disk drive.



3. Installation is now completed. Three files exist in the folder. “ContParamL.xlt,” “FlowParamL.xlt,” and “AVFCS2-2_A_monitor.exe” (of which icons are shown below). Verify that this software starts by double-clicking “AVFCS2-2_A_monitor.exe” and the following screen is displayed. Upon verification, terminate the software.



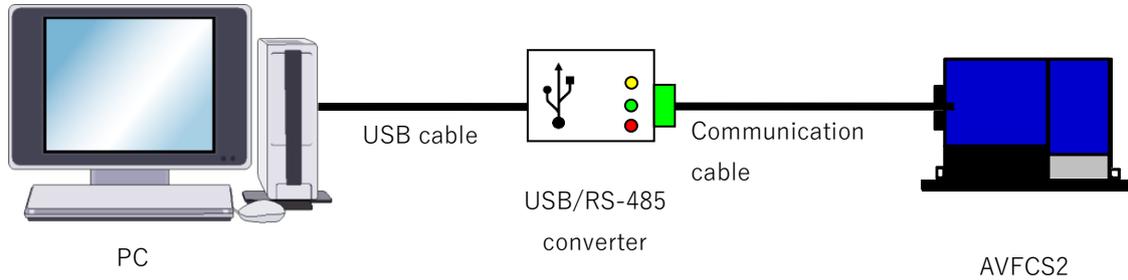
Attention

- Do not start up this software directly from the " AVFCS2 software CD-ROM ".
Be sure to start up from the file saved on the hard disk. If started from the CD-R, the software may not run correctly.
- Be sure to use each file without changing the folder structure. If the configuration in the file changes, it will not work properly.

(7) Connection

Calibration Kit for AVFCS2 works while communicating with AVFCS2.

The connection for communication between AVFCS2 and PC is connected as shown in below.



1. Connecting “Communication cable” to “USB/RS-485 converter”

Connect “Communication cable” to “USB/RS-485 converter” as shown in below.



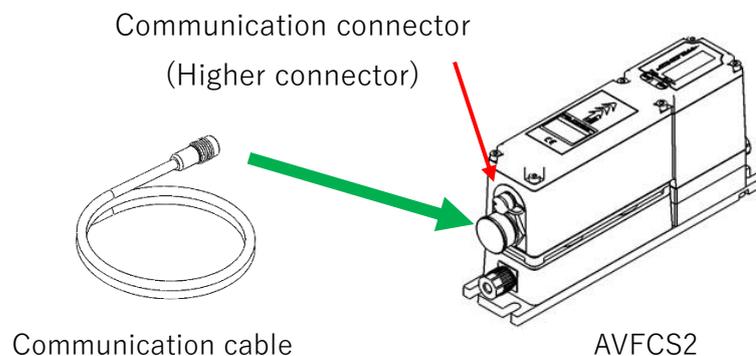
Mark on USB/RS-485 converter	Mark (color) of communication cable
1+	A (red)
1-	B (white)
G	G (black)

2. Connecting “USB/RS-485 converter” to PC

Connect “USB/RS-485 converter” and “PC” by “USB cable”. (If “USB cable” is already connected, disconnect the cable once then reconnect again.)

3. Connecting “Communication cable” to “AVFCS2”

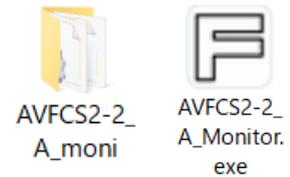
Connect the end connector of “Communication cable” to the communication connector of “AVFCS2”.



(8) Software Start-up

The following describes the startup method of the AVFCS2 calibration software (AVFCS2-2_A_monitor.exe), and the setting and connection methods of serial communication.

- 1) Verify the existence of the “AVFCS2-2_A_moni” folder in the hard disk drive. Otherwise, copy it in the drive (any directory usable).
- 2) Double-click the “AVFCS2-2_A_monitor.exe” icon in the “AVFCS2-2_A_moni” folder.
- 3) The software starts.



- 4) Select a COM port (COM3 selected in the example).

(1)

(2)

(3)

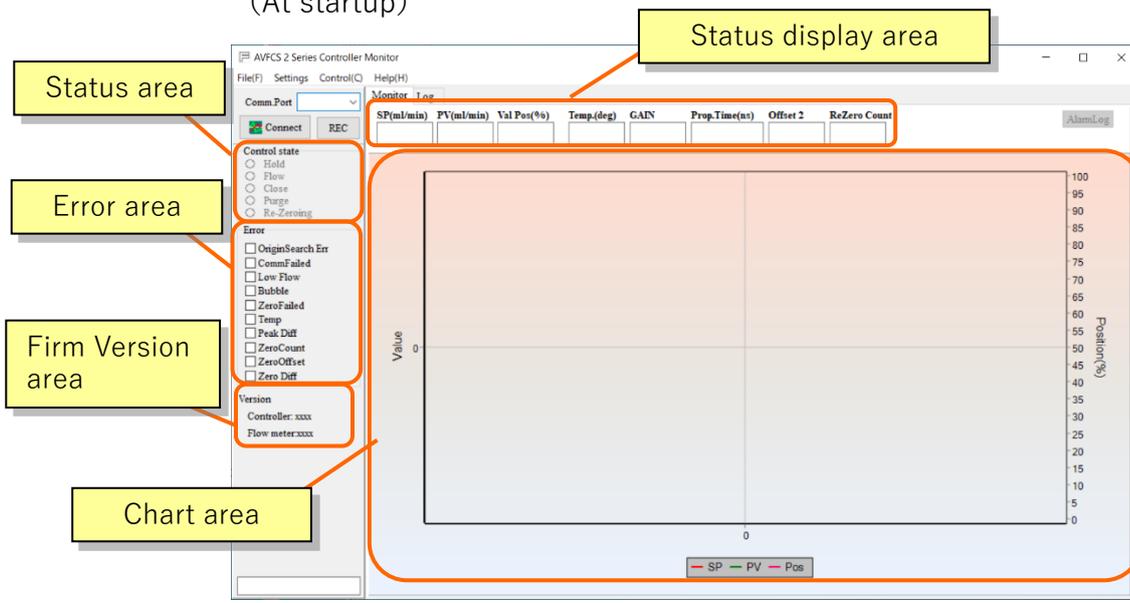
(4)

(9) Functions

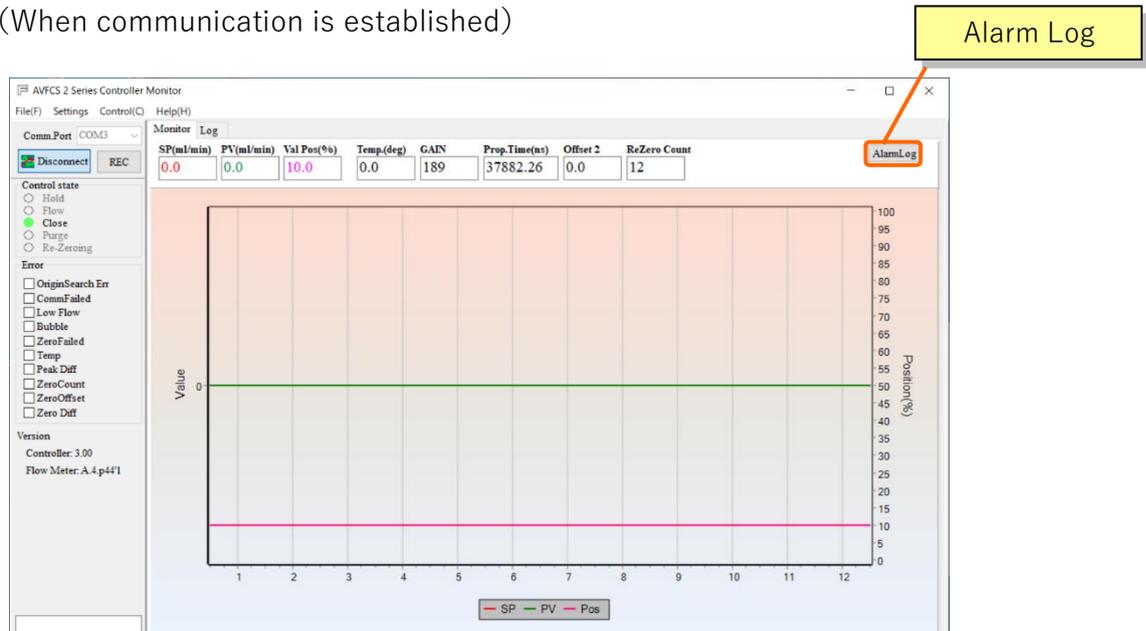
9 – 1 Monitoring function

This function monitors the flow rate and parameters in real time. The following explains how to use it.

(At startup)



(When communication is established)



< Chart area >

Chart graph which shows nearest history are displayed in this area so that their transitions can be seen at a glance. The data of the chart is updated every 0.5 second. The nearest 100 points data for 50 seconds is displayed in the chart.

The horizontal axis of the chart represents a time period (in seconds) elapsed from the start of monitoring. The left vertical axis represents a flow rate in the unit of milliliters per minute. The range is automatically adjusted. The right vertical axis shows valve positions.

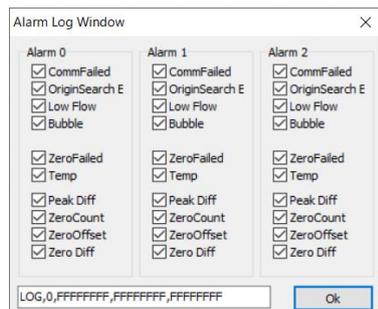
< Status display >

- SP (mL/min) : Displays the current SP (set flow rate value) with the monitor in operation.
- PV (mL/min) : Displays the current PV (current flow rate value) with the monitor in operation.
- ValPos(%) : Displays the current valve position as a ratio to the specified position with the monitor in operation.
- Temp(deg) : Displays a value on the AVFCS2 internal thermometer with the monitor in operation.
- GAIN : Displays the sensitivity of the AVFCS2 internal sensor with the monitor in operation (reference value).
- Prop.Time : Displays an average value of the ultrasonic wave propagation time of the AVFCS2 internal sensor with the monitor in operation (reference value).
- Offset2 : Indicates a deviation amount from the zero flow rate during zero flow rate adjustment. Implementing zero flow rate adjustment by using the “Auto Re-Zero adjustment” function changes the value. (reference value)
- Re-Zero Count : Count of implementing zero flow rate adjustment(reference value)

< Alarm Log button >

This function can check the error history of products that occurred in the past.

Save up to 3 items, the history will be deleted from the old one.



< Control Status area >

This window displays the status of AVFCS2. A mark will appear in the current status.

- Hold : Holding the valve position.
- Flow : Liquid control is in progress.
- Close : Valve is fully closed.
- Purge : Valve is fully opened.
- Re-Zeroing : Zero-adjustment is in progress.

⚠ Attention

- Do not operate anything until the "Re-Zeroing" check mark disappears in the "Control State" area. The flow meter in AVFCS2 may be damaged if the liquid is flown while in progress of zero-adjustment.

< Error area >

Displays the status of the AVFCS 2 when an error occurred.

For details of the error, refer to AVFCS2 Installation manual (DTS207)

< Firm Version area >

Displays the version of AVFCS2 firmware.

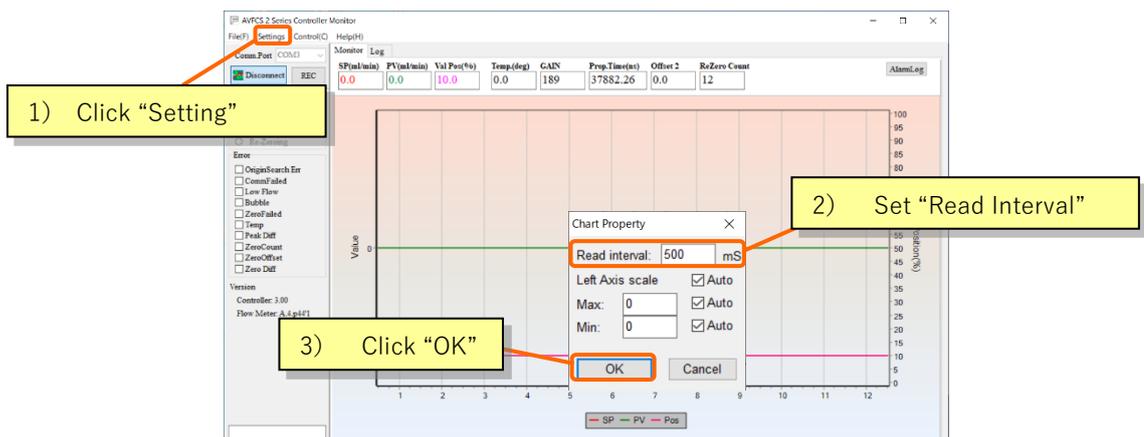
- Controller xx.xx : Controller's firmware version
- Flow meter xx.xx : Flowmeter's firmware version

9 – 2 Logging function

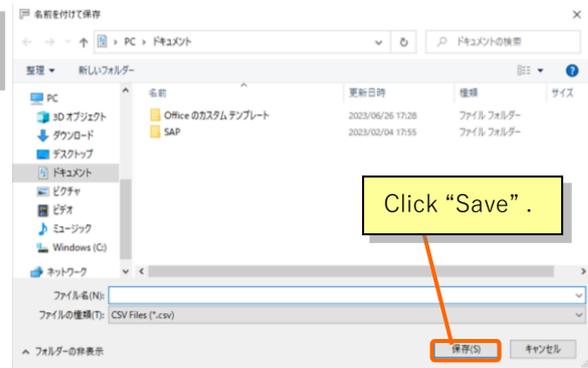
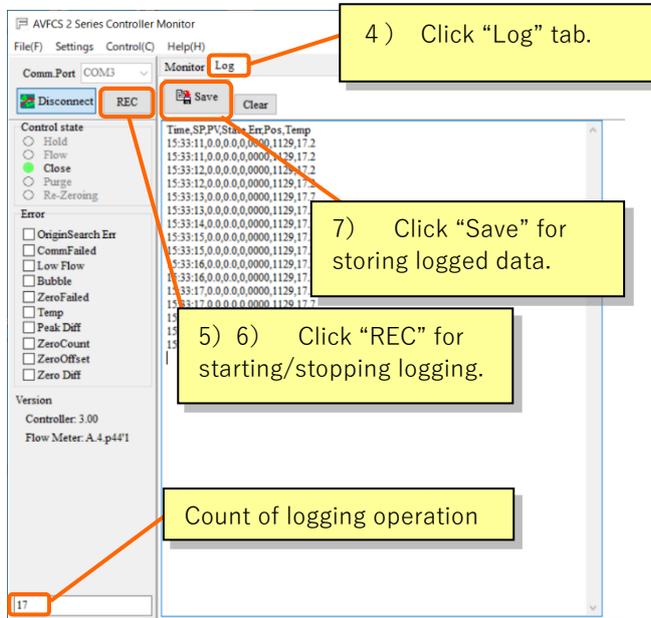
This is a function for logging the set flow rate and the current flow rate.

- 1) Click [Setting] to open the [Chart Property] window.
- 2) Set a sampling interval for logging by using [Read Interval] in the [Chart Property] window.
- 3) Click [OK].

Setting range of Read Interval: 500 ms to 300,000 ms (0.5 s to 5 min)



- 4) Click the [Log] tab.
- 5) Click [REC] to start logging. The content of logging is displayed in the Log window.
- 6) Click [REC] again to stop logging.
- 7) Logged data can be saved in the CSV format by clicking [Save].



<Detail of logging data>

hr:min:sec, aaa.a, bbb.b, ccc, d, eeee, ffff, gg.g

- (1) Logging time : Hours: minutes: seconds
- (2) Flow rate setting value (SP) : aaa.a (mL/min)
- (3) Current flow rate value (PV) : bbb.b (mL/min)
- (4) Motor control speed
- (5) Valve status 0: Stop; 1: Control in progress; 4: Fully open; 5: Fully closed
- (6) Error status : Hexadecimal number in 4 digits *1
- (7) Valve opening degree : Ratio specified as fully open value being 100%
- (8) Internal temperature (Temp.) : gg.g (deg)

*1 For details, separately contact us.

This function is for setting various parameters. The use method is described below.

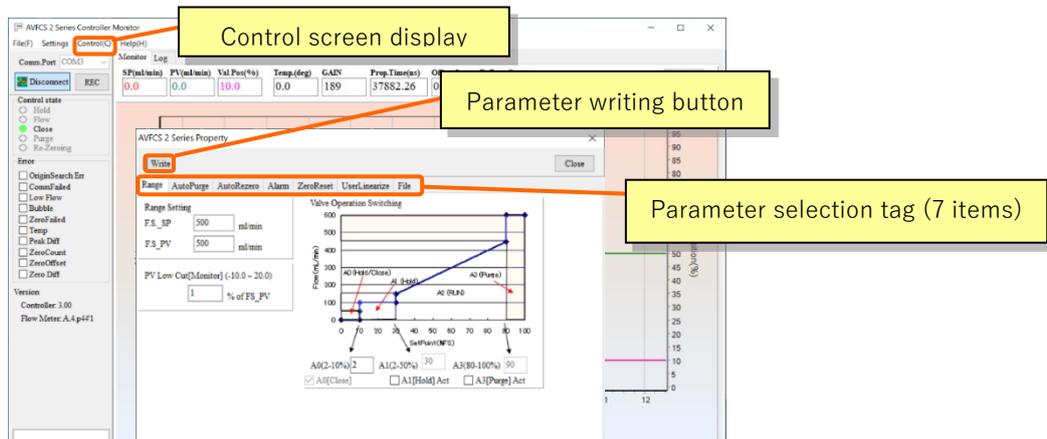
List of parameters settable and operable

	Function	Setting ranges	Reference
Analog input/output	Analog input range F.S._SP	1-1000mL/min	Chapter 9-4
	Analog output range F.S._PV	1-1000mL/min	
	Analog output low-cut	-10~20% F.S._PV	
Valve operation switching	Control setting flow rate range	2-10% F.S._SP	Chapter 9-5
	Hold motion setting	Disable / Enable	
	Flow rate range set for hold	2-50% F.S._SP	
	Purge motion setting	Disable / Enable	
	Flow rate range for purge	80-100% F.S._SP	
Auto purge	Function select	Disable / Enable	Chapter 9-6
	Operation select	Open/Set position/Hold	
	Select set position	0.3 - 2.0 mm	
	Opening hold time	0-5sec	
	Purge hold time	0-20sec	
Alarm	Alarm output logic	Normal or Reverse	Chapter 9-7
	Flow rate alarm upper limit	0-100%	
	Flow rate alarm lower limit	0-100%	
	Flow rate alarm delay time	0-750sec	
Auto Re-Zero adjustment	Function select	Disable / Enable	Chapter 9-8
Re-Zero adjustment	Re-Zero adjustment	—	Chapter 9-9
User Linearize	Flow rate calibration	Number of calibration points: Max 10 points	Chapter 9-10
Parameter saving	Export and save setting parameters	—	Chapter 9-11

■ Displaying the Control screen

The above-listed parameters are divided by tags.

The setting items are orderly described on the next page and thereafter.





Attention

- Be sure to click the "Write" button after changing the parameters. If you do not press the "Write" button, the changes will not be reflected.

9 – 4 Parameter setting function <Analog input/output>

<Analog input range>

The analog input range (F.S._SP) determining a set flow rate is changeable.

Settable range: 1 to 1000 mL/min

However, an upper limit value is limited. The settable range of the flow rate is 1.8 times the range at delivery.

Example: If a flow rate range of 25 to 250 mL/min is set at delivery, the upper limit is settable to 450 mL/min at most.

Example: If a flow rate range of 50 to 500 mL/min is set at delivery, the upper limit is settable to 900 mL/min at most.



Attention

- The guarantee of flow rate accuracy is the flow rate range at the time of delivery.
- Conduct adjustment or setting by considering the control flow rate and connected equipment used, as there is effect from the resolution of analog signals.

<Analog output range>

The analog output range (F.S._PV) determining a current flow rate is changeable.

Settable range: 1 to 1000 mL/min

However, an upper limit value is specified as limited, similarly to the analog output range.

The settable range of the flow rate is 1.8 times the range at delivery.



Attention

- The guarantee of flow rate accuracy is the flow rate range at the time of delivery.
- Conduct adjustment or setting by considering the control flow rate and connected equipment used, as there is effect from the resolution of analog signals.

<Analog output low-cut>

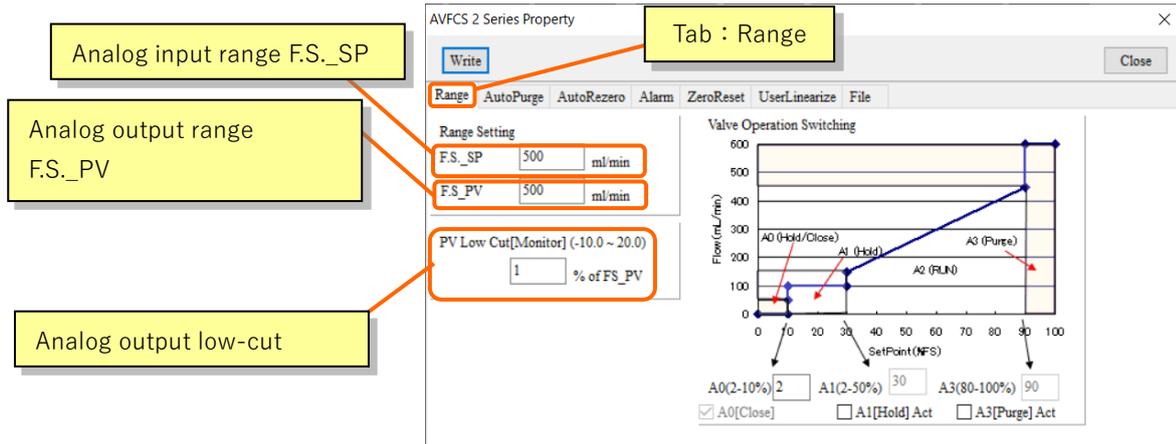
This function forcibly set zero for analog output of XX% or less with respect to the range F.S._PV of the current flow rate (measured flow rate).

Settable range: -10 to 20% F.S._PV



Attention

- Care should be taken that if a value exceeding the flow rate range desired to use is set, analog output becomes zero even with liquid flowing.



9 – 5 Parameter setting function < Valve motion switching >

<Valve operation switching>

- Set input amount for control stop (A0)

Feedback control starts for supplying liquid on this product when the set flow rate is set to 2%F.S._SP (analog input range) or more. The control stops and the valve closes totally when the set flow rate is set to less than 2%F.S._SP (analog input range).

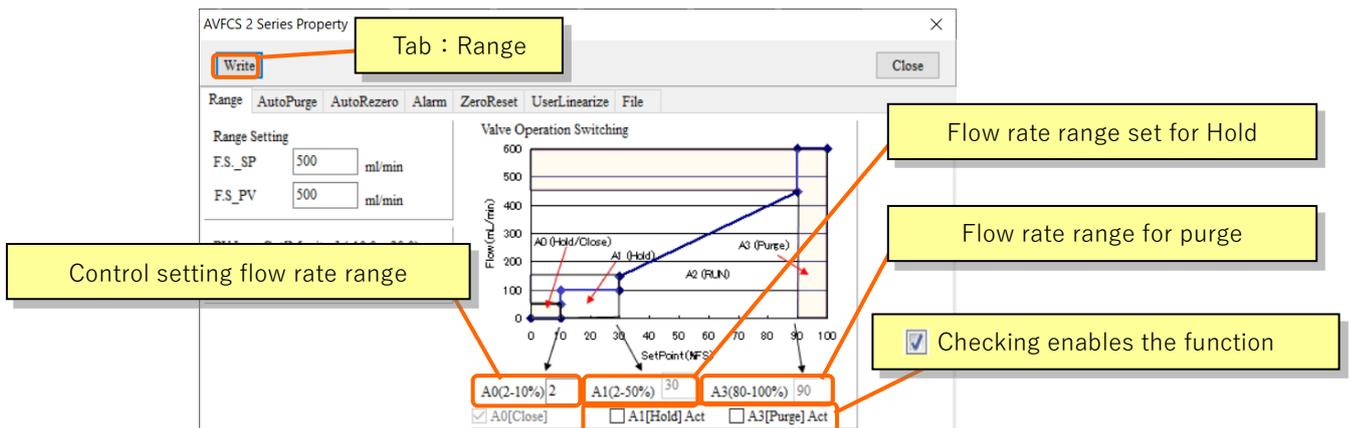
The set flow rate for stopping the control is settable in the following range:

- Motion at the time of control stop : Valve closed (closing motion)
- Set flow rate to stop the control : Changeable in a range of 2 to 10% (integer only)

- Relationship between set flow rate input and valve motion (A1, A3)

The following kinds of valve action can be assigned to this product according to the size of set flowrate input:

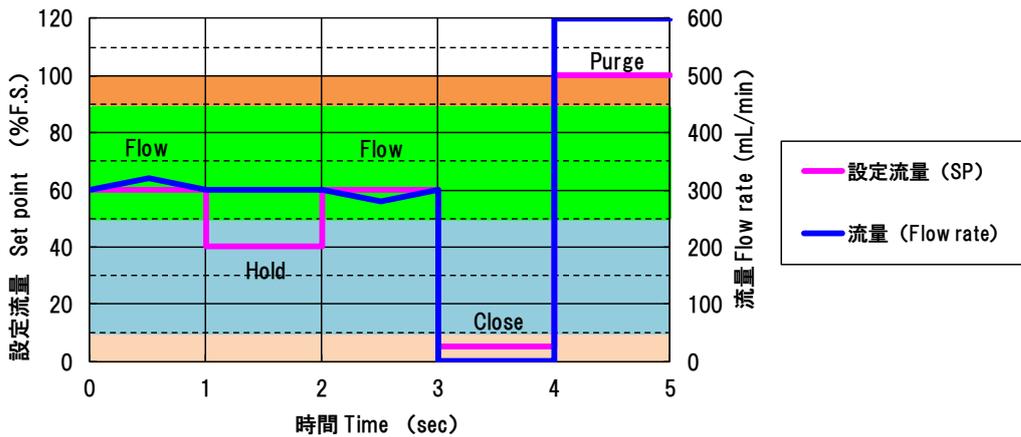
Valve action name	Action	Selection range
Hold	Holds the opening in effect just before the hold action	Operation enabled/disabled Operation range (any value from control stop to 50%)
Flow	Set flow rate feedback control	—
Purge	Fully open	Operation enabled/disabled Operation range (any value from 80 to 100%)



The following exemplifies setting and illustrates consequent motions.

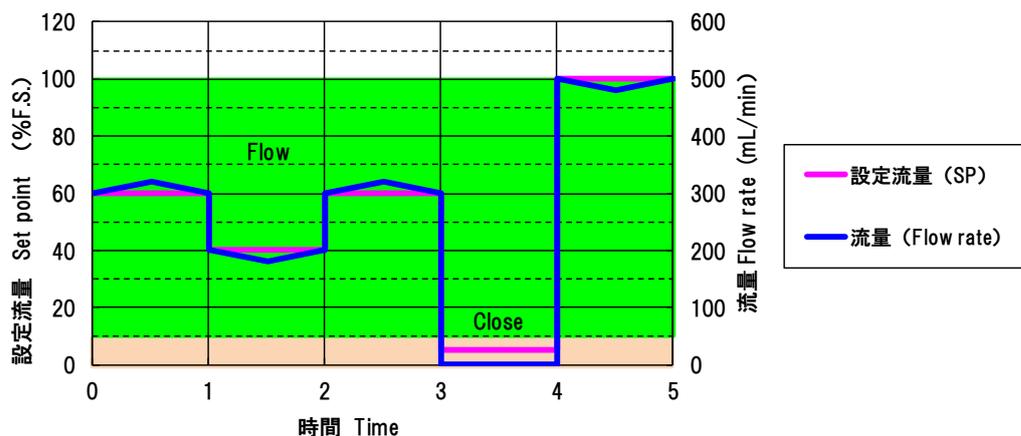
Sample settings and operation image (1)

- Analog input range : 500mL/min
- Flow rate range : 50 to 500mL/min
- Action with control stopped : Operation enabled, "Close" 10% set flow rate
- Hold action : Operation enabled, 50% operation range
- Purge action : Operation enabled, 90% operation range



Sample settings and operation image (2)

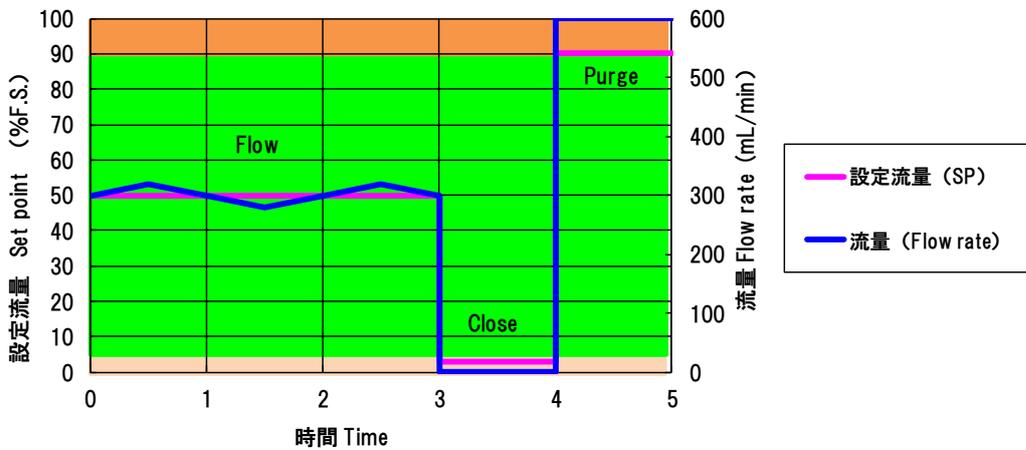
- Analog input range : 500mL/min
- Flow rate range : 50 to 500mL/min
- Action with control stopped : Operation enabled, "Close," 10% set flow rate
- Hold action : Operation disabled
- Purge action : Operation disabled



In the example below, the Purge operation and the analog input range (FS_SP) are set to a value larger than the maximum flow rate, so that the control flow rate can be secured within the delivery flow rate range of 50-500 mL/min, and the purge operation (fully open) You can do it.

Sample settings and operation image (3)

- Analog input range : 600mL/min
- Flow rate range : 50 to 500mL/min
- Action with control stopped : Operation enabled, "Close," 5% set flow rate
⇒ 30mL/min and less
- Hold action : Operation disabled
- Purge action : Operation enabled, 90% operation range
⇒ 540mL/min and more



Caution

- Please note that the set flow rate for valve switching operation is % of the analog input range (F.S._SP).
- Be sure to also use closing operation when using hold operation. Otherwise, the flow rate control might be disabled.

<Auto-purge function>: Valve motion at bubble error occurrence

In case bubbles and/or foreign matter is incorporated into inside the flow meter to cause disabled measurement (independent from control ON/OFF), the valve opening degree prior to the bubble detection is held for 1.5 seconds (default) immediately after the detection and then a motion is executed toward an opening degree corresponding to the operation setting for eight seconds (default: fully open).

An alarm is issued total 9.5 seconds after bubble detection. During this period, a flow rate immediately before the detection of bubbles remains displayed. After the alarm is issued, the flow rate is displayed as zero.

Function selectable range

- Function : disable or enable
- Operation setting : Open (Fig. 1: default), Set position (Fig. 2), Hold (Fig. 3)
- Valve set position range : 0.3 to 2.0 mm (operation setting: Only at set position)
- Hold time range [Hold Time1] : 0 to 5 sec (default: 1.5 sec)
- Purge hold time range [Hold Time2] : 0 to 20 sec (default: 8 sec)

Fig. 1: Open (Fully open)

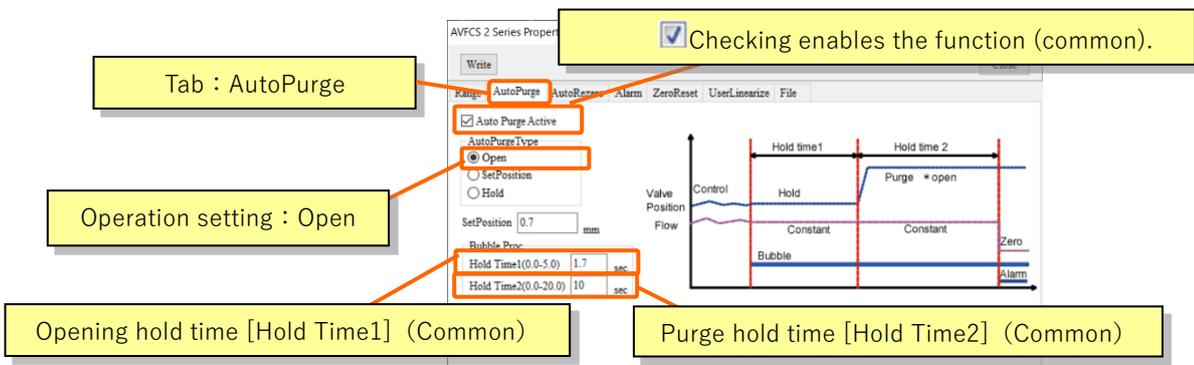


Fig. 2: Set position

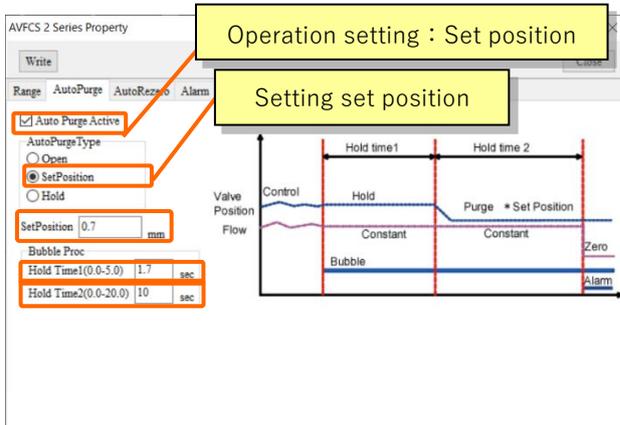
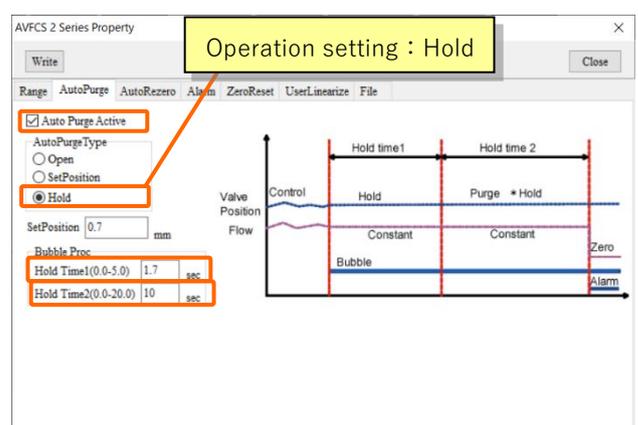


Fig. 3: Hold



<Alarm>

• Alarm output logic

For alarm output, selection can be made with not only standard contact A (normally open) but also contact B (normally closed).

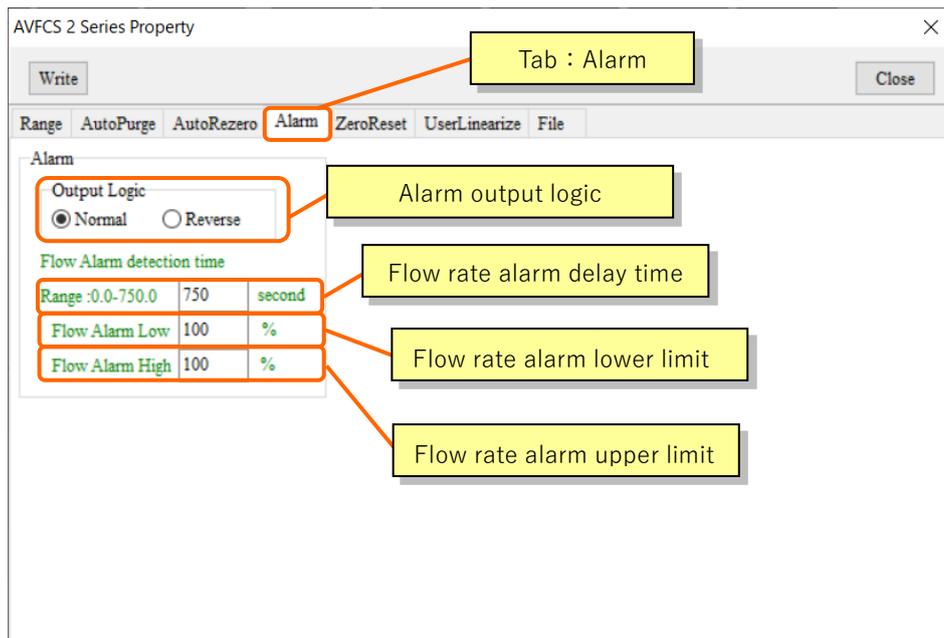
* Contact B becomes valid about 500 ms after power-on due to the structure of flipping up the logic on software.

• Upper/lower limit value and alarm delay time of the flow rate upper/lower limit error

An alarm is issued in case a measured flow rate varies from the set flow rate by $\pm 15\%RD$ or more and remains as is for 3 seconds or more during control in progress. An amount of the variance and time for this event are settable.

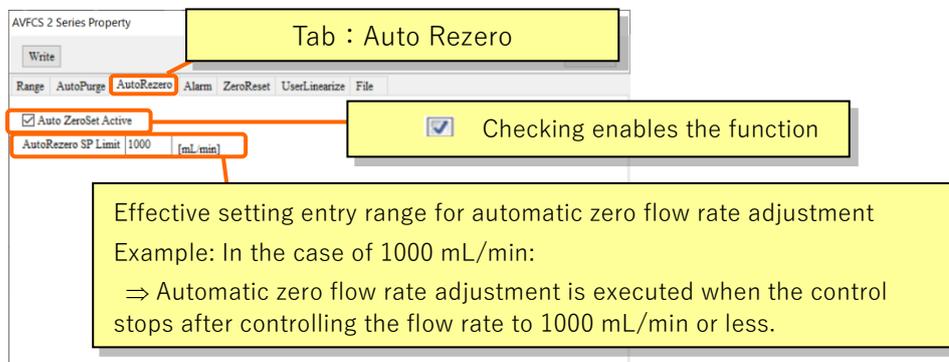
Setting range of an amount of the variance: 0 to 100%RD (integer value)

Setting range of time: 0 to 750 s (integer value)



9 – 8 Parameter setting function < Auto Re-Zero adjustment >

AVFCS2 is equipped with a function that automatically executes zero flow rate adjustment in case 12 seconds or more elapses after the control stops (valve fully closed). No adjustment is executed in less than 12 seconds. Note that the Re-Zero adjustment button and Zero Reset described later are prioritized.



Attention

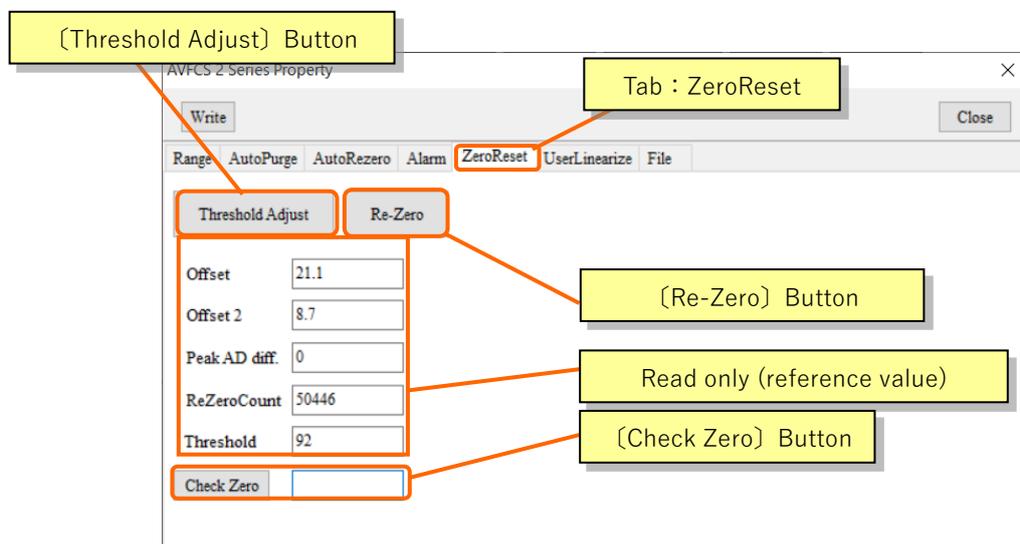
- AutoZeroSet Active is usually used with display of “”.
- Without the display thereof, the accuracy might be unable to be maintained.

9 – 9 Parameter setting function < Re-Zero adjustment >

This software has a function for manually adjusting the zero flow rate. No change of parameters under this tag is allowed due to being specified only for read.

[Re-Zero] button : Clicking starts zero flow rate adjustment.

[Check Zero] : Clicking calculates the current zero flow rate average value (Reference value).

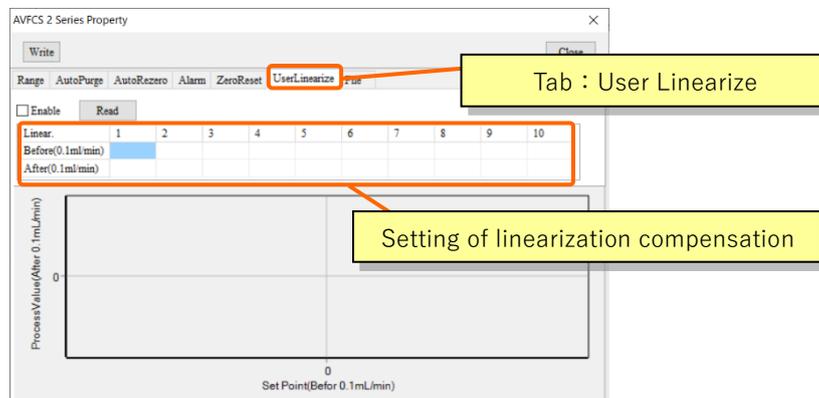
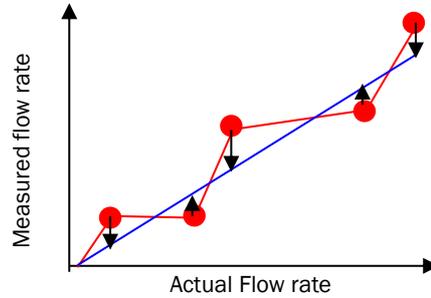


 **Attention**

- Be sure to conduct zero flow rate adjustment (Re-Zero) with the liquid at rest. In addition, do not flow the liquid until completing the adjustment.
- Conduct zero flow rate adjustment (Re-Zero) in the following cases:
 - (1) Case of deviation in the zero flow rate
 - (2) Case of first installation after purchasing
 - (3) Case of reactivation after prolonged halt
 - (4) Case of change in liquid type
- Generally, Threshold Adjust is not used. (If used, it requires implementing linearization compensation again.) Implementing Threshold Adjust may improve the stability in measurement of special liquid if the fluctuation in measurement of the liquid is extremely large comparing to that of water. For restoring the default value, implement Threshold Adjust with the tank being filled with pure water at 23 to 25°C.

9 – 1 0 Parameter setting function < User Linearize >

The User Linearize screen is used for setting of linearization compensation. The linearization compensation is defined as a function to compensate a measured flow rate to an actual flow rate by entering measured flow rate and actual flow rate at multiple points as shown in the illustration below. Linear approximation is applied to ranges between compensation points.



⚠ Attention

- Please refer to Chapter 10 "Measuring Actual Flow-Rate" and Chapter 11 "Correction Linearization " for details on operation.

9 – 1 1 Parameter setting function < Saving parameters >

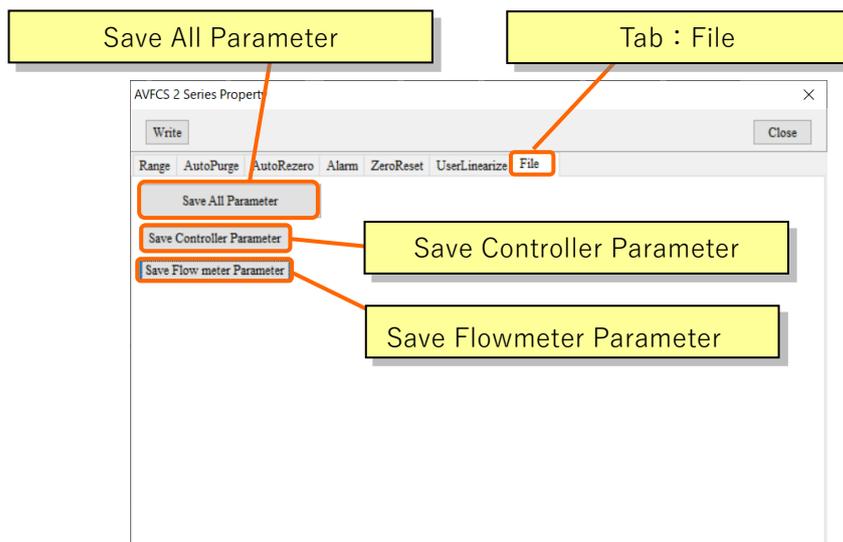
You can save the set AVFCS2 (controller, flow meter) parameters as a CSV file. There is a method to save individually or collectively.

<How to save parameters individually>

- 1) Click the [File] tab and then click 「Save Controller Parameter」. Excel will start up and the parameters of the valve controller will be read.
- 2) Click 「Save Flow meter Parameter」. A new sheet is created in Excel started up in 1) and the parameters of the flow meter section are read out.
- 3) Save the Excel file in any directory.

< How to save parameters collectively >

- 1) Click 「Save All Parameter」 to start Excel and read the parameters of the valve controller and flow meter.
- 2) Save the Excel file in any directory.



⚠ Attention

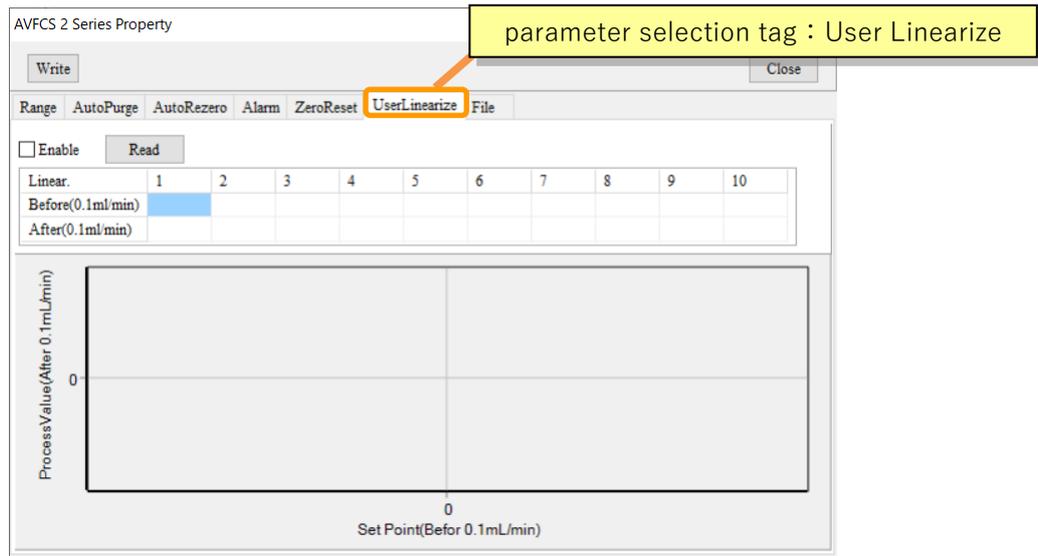
- As described in Chapter 6-3, when using the software, copy the entire folder stored on the software CD to any location and use it without changing the folder structure. If the structure in the folder changes, you will not be able to save the parameters.

(10) Measuring Actual Flow-rate

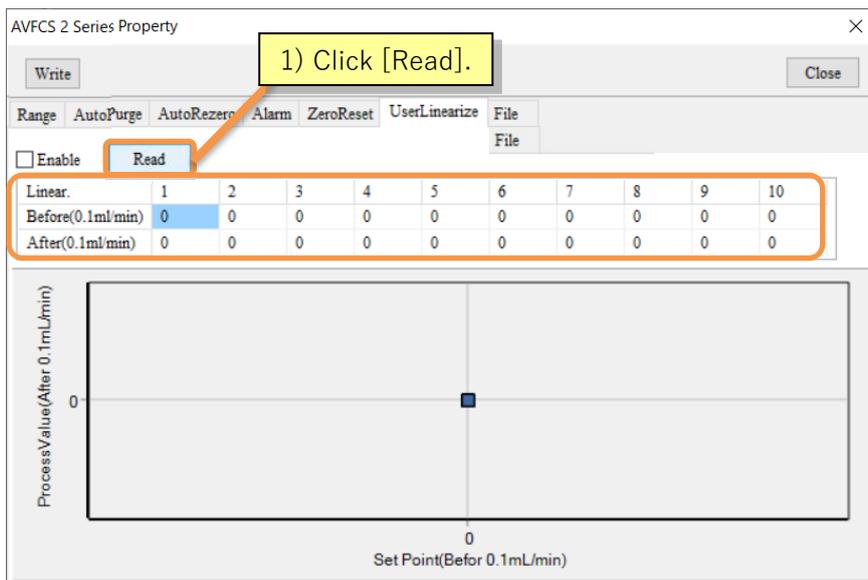
Record the flow rate both setting point for AVFCS and actual measured flow rate in each calibration point. For example shown in below procedure, the liquid volume actually fed for one minute should be measured by a measuring cylinder at each calibration points (50, 100, 200, 300, 400, and 500 mL/min).

Procedure 1: Preparing for the measurement

Change the Contol screen to the User Linearize screen.

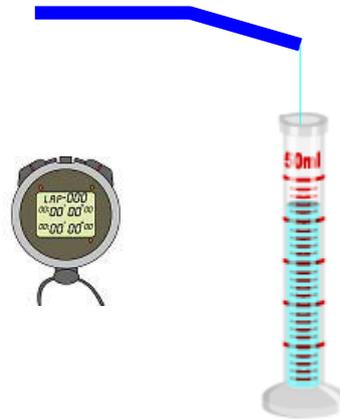


- Implement the following for new re-linearization correction.
 - 1) Click the [Read] button to read the User Linearize table in AVFCS2. Only zero is written therein at delivery.



Procedure 2: Measuring actual flow rate at calibration point of 50 mL/min

- Input the set point as 50 mL/min for AVFCS2 by operating the equipment which AVFCS2 is installed. Wait for a while until the flow rate looks steady.
- Start to measure the liquid volume by using a stop watch and a measuring cylinder to find out actual flow rate.



- After the measurement, stop the flow then note the number of volume.
- In this example, the actual measured volume is assumed as 52.1 mL/min at the calibration point of 50 mL/min.

Set Flow Rate (mL/min)	50	100	200	300	400	500
Actual Flow Rate (mL/min)	52.1					

Procedure 3: Measuring flow rates at calibration points of 100, 200, 300, 400, and 500mL/min

- Repeat Procedure 2 to measure at the other calibration points then note the results.
- In this example, the actual measured volumes at each point are assumed as shown in below table.

Set Flow Rate (mL/min)	50	100	200	300	400	500
Actual Flow Rate (mL/min)	52.1	101.0	201.2	305.1	407.8	502.7

Procedure 4: Checking the accuracy

- Check if differences between Set Flow Rate and Actual Flow Rate at each calibration point are within the targeting accuracy.
- If the differences at every calibration point are within the targeting accuracy, the calibration will be unnecessary. Go to Chapter 12, "Disconnecting Calibration Set."

(11) Correcting Linearization

Changing the calibration parameters for correcting linearization (linear approximation), the software "AVFCS2-2_A_monitor" will be used.

There are two different procedures to correcting linearization; one is for newly correcting. Another is for re-correcting. Both procedures are explained as below.

In this example, the actual measured volumes at each point are assumed as shown in below table.

Set Flow Rate (mL/min)	50	100	200	300	400	500
Actual Flow Rate (mL/min)	52.1	101.0	201.2	305.1	407.8	502.7

Procedure 1: Procedure for newly correcting linearization

- Change the Contlol screen to the User Linearize screen.
- Write the recorded results into the table.

Enable

Linear.	1	2	3	4	5	6	7	8	9
Before(0.1ml/min)	0	0	0	0	0	0	0	0	0
After(0.1ml/min)	0	0	0	0	0	0	0	0	0

- 1) Multiply the number of each Set flow rate by 10, then write it onto the [Before].

Set Flow Rate (mL/min)	50	100	200	300	400	500
Actual Flow Rate (mL/min)	52.1	101.0	201.2	305.1	407.8	502.7

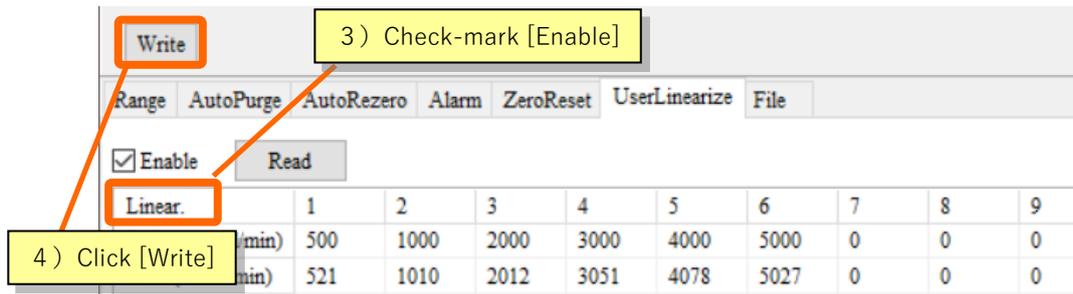
Linear.	1	2	3	4	5	6	7	8	9
Before(0.1ml/min)	500	1000	2000	3000	4000	5000	0	0	0
After(0.1ml/min)	0	0	0	0	0	0	0	0	0

- 2) Multiply the number of actual flow rate by 10, then write it onto the [After].

Set Flow Rate (mL/min)	50	100	200	300	400	500
Actual Flow Rate (mL/min)	52.1	101.0	201.2	305.1	407.8	502.7

Linear.	1	2	3	4	5	6	7	8	9
Before(0.1ml/min)	500	1000	2000	3000	4000	5000	0	0	0
After(0.1ml/min)	521	1010	2012	3051	4078	5027	0	0	0

- 3) Check-mark [Enable] to make linearization compensation effective.
- 4) Click the [Write] button to transmit data to AVFCS2.



⚠ Attention

-Be sure to click the [Write] button after check-marking [Enable].
 Linearization compensation becomes effective by writing with the [Write] button.

Procedure 2: Procedure for re-correcting linearization

- Calculate the differences (B – A) between "A: Set Flow Rate" and "B: Actual Flow Rate" at each calibration point, then note the result as number of "C".

A: Set Flow Rate (mL/min)	50	100	200	300	400	500
B: Actual Flow Rate (mL/min)	52.1	101.0	201.2	305.1	407.8	502.7
C: B – A	2.1	1.0	1.2	5.1	7.8	2.7

- Divide the existing [After] value (that is already written for linearization correction) by 10, then note the results as number of "D". In this example, the existing numbers at "After" are assumed as shown in below table.

Linear.	1	2	3	4	5	6	7	8	9
Before(0.1ml/min)	500	1000	2000	3000	4000	5000	0	0	0
After(0.1ml/min)	512	992	2034	2999	3988	4781	0	0	0



A: Set Flow Rate (mL/min)	50	100	200	300	400	500
B: Actual Flow Rate (mL/min)	52.1	101.0	201.2	305.1	407.8	502.7
C: B – A	2.1	1.0	1.2	5.1	7.8	2.7
D: After	51.2	99.2	203.4	299.9	398.8	478.1

- Add the number of "C" to the number of "D", then note the result as numbers of "E".

A: Set Flow Rate (mL/min)	50	100	200	300	400	500
B: Actual Flow Rate (mL/min)	52.1	101.0	201.2	305.1	407.8	502.7
C: B - A	2.1	1.0	1.2	5.1	7.8	2.7
D: After	51.2	99.2	203.4	299.9	398.8	478.1
E : C + D	53.3	100.2	204.6	305.0	406.6	481.8

- Multiply the number of "E" by 10, then write the results onto the [After], instead of existing number.

E : C + D	53.3	100.2	204.6	305.0	406.6	481.8
-----------	------	-------	-------	-------	-------	-------

Linear.	1	2	3	4	5	6	7	8	9
Before(0.1ml/min)	500	1000	2000	3000	4000	5000	0	0	0
After(0.1ml/min)	533	1002	2046	3050	4066	4818	0	0	0

- Click the [Write] button to update all values to AVFCS2.

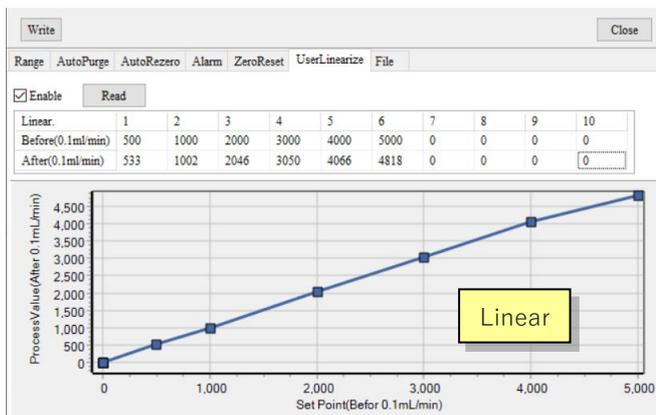


Reference

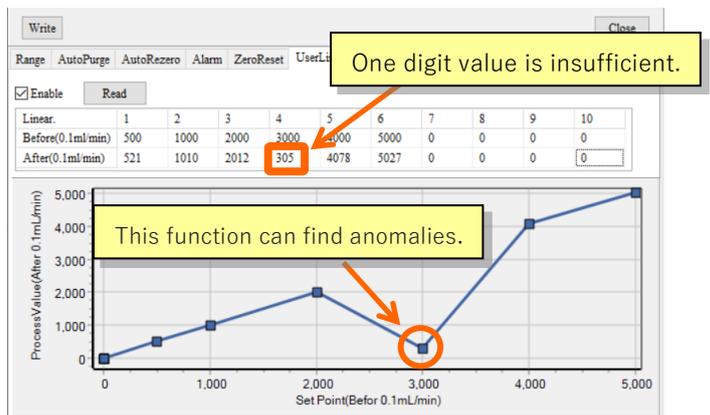
If the accuracy after correcting linearization is not enough, it might be better to increase the number of calibration points to get better accuracy.(Max:10 points)

- To prevent incorrect input of numerical values, the entered numerical values are graphed.

Adequate example



Inadequate example



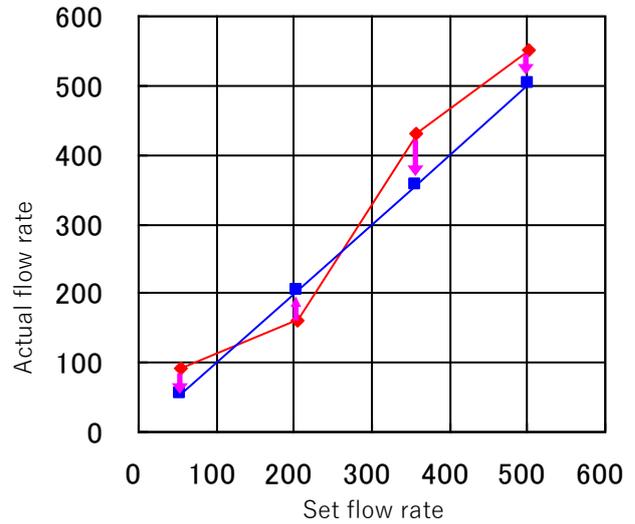
Reference: Remarks on correcting linearization procedure

The linearization function corrects the set flow rate values as actual flow rate values by entering actual measured results at each calibration point. The values in middle between each calibration point are approximated linearly.

For example, if there are result between the set flow rate and actual flow rate as shown in below table, they can be corrected by writing the “set flow rate” into [Before] ,and the “actual flow rate” into [After].

Set Flow Rate	Actual Flow Rate
53.8	90.5
202.2	160.4
355.9	430.4
501.7	550.2

Unit: mL/min



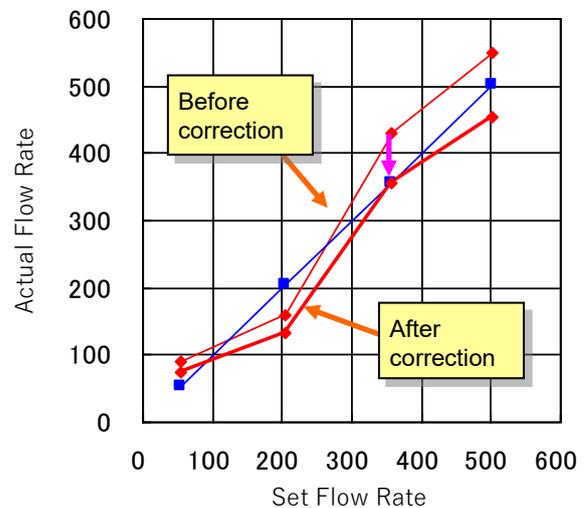
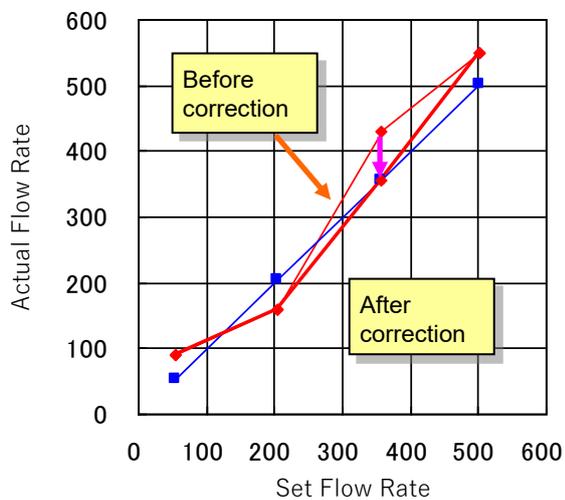
For example, let's assume only a point of (355.9, 430.4) is far from the target accuracy. If only this point is corrected again, the accuracies of the other value sets may be affected. To prevent this error, the points in higher and lower of targeting point should be corrected again.

<Adequate example>

Before	2042	3559	5017
After	1604	4304	5502

<Inadequate example>

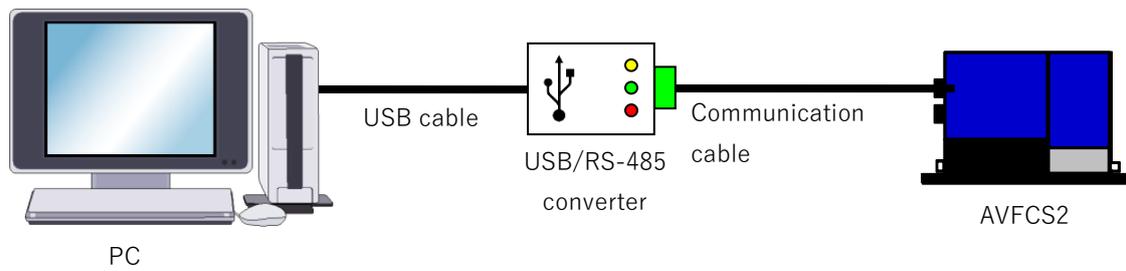
Before	3559
After	4304



(12) Disconnecting Calibration Kit

Close "AVFCS2-2_A_monitor" window and disconnect Calibration Kit.

- Operate the software to disconnect the COM port.
- Close the software window.
- Disconnect "USB cable," "USB/RS-485 converter" and "communication cable" as shown in below.



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AVFCS2

Flow controller

ASAHI YUKIZAI CORPORATION

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