USF

Operation Manual
for
USF200S-G08/G10

⚠ **Warning**	For your safety in operation, please read thoroughly, and be familiar with this Operation Manual before using.

⚠ **Warning**	Please always keep this Operation Manual at hand for your quick reference when necessary.

TOFLO CORPORATION

114-R06

Contents

Before using

⚠ Warning

- Before using the Ultrasonic Flowmeter typed USF200S Series, please be sure to read thoroughly, and to be familiar with this Operation Manual.
- Please always keep this Operation Manual at hand for your quick reference when necessary.
- For the instructions about how to fulfill the original usage of the Ultrasonic Flowmeter and the instructions specified in the Operation Manual, comply with them upon fully understanding their contents instructed in this Operation Manual.

Strictly observe the Instructions stated above. Failure to heed this warning may result in serious personal injury and accident.

<< Operation Manual >>

- The contents of the Operation Manual are subject to change due to the improvements of performance and function of the products without prior notice.
- Neither all nor partial of the Operation Manual can be printed or duplicated in any other form without permission.
- When lost the Operation Manual, please feel free to contact us at the nearest sales office.
- Every effort has been made in relating to the contents of the Operation Manual, but if you found out any doubtful point and mistake, or omission by any chance in this Operation Manual, we would like to request you to contact us at the nearest sale office.

1. Safety precaution

⚠ Warning	Before using, please read this Operation Manual with caution for your safety operation, as this Manual contains important instructions to be surely observed.

⚠ (Design precaution)

① Operate the Ultrasonic flowmeter at the specified voltage.
If using it at too low voltage, it may cause malfunction, and if using at too high voltage, it may cause damage to the device or fire.

② Operate the Ultrasonic flowmeter within the rated piping pressure.
If using it in excess of the rated pressure, it may cause to burst the detection part made of Teflon.

③ Operate the Ultrasonic flowmeter within the specified temperature. Operation at excessive temperature may cause malfunction, damage to the devices or fire.

④ Always keep the detecting tube filled fully with fluid. If not, ultrasonic wave is shut off with gas and cannot be sent and received from the Ultrasonic flowmeter, and disabled it for the flow measurement. Also even if it enabled to measure, it might cause it to read accurately and/or malfunction.

⑤ For the installing attitude of the detection part, study it with reference to this Operation Manual. Every precaution should be taken so as not to cause trapping of air bubbles or liquid.

⑥ When fixing the detection part with the longitudinal fixing holes as illustrated in a separate item of 4-3. a. study how it should be installed considering the dimensions of joints to be used.
⑦ Design with reference to this Operation Manual, when connecting input/output signals to the Ultrasonic flowmeter.
If overloading such as running overcurrent and applying excess voltage to the input signals, they may cause damage to the devices, and also they may cause malfunction, if not applied appropriate current and voltage.
⑧ When communicating by using RS-485, communication error may sometimes appear, depending on the PC performance and communication speed. Avoid using it at extremely high speed.

⚠ (Installation precaution)

① Unpack the detection part in a place where is in a clean air, because that it has been packed in a clean room after cleaning. Handle carefully not to deposit the dust to it.
② Use screws for secure the detection part by using the holes located in two places.
Do not use it in a state of being floating in a midair, because the excessive force is exerted on the both sides of the tubes of the detection part, at inlet and outlet.
③ Every precaution should be taken for flow direction of the fluid on the detection part. If made up pipe in reverse, it would turn the flow display upside-down relating to the plus and minus, and also the 4-20mADC output would be fixed to the 4mA.
④ Install the flow control valve at the outlet portion of the detection part. If there is a throttle such as a valve at inlet, air bubble (Cavitation) will appear due to the pressure reduction and may fails to measure.
⑤ Do not install the electrical part in places where condensation of humidity will occur and where water splashes, as it has not been constructed in the structure of the water-proof and moisture-proof.
⑥ Do not use the detection part with immersing it in liquid.

⚠ (Wiring)

① Securely connect the wires to the electrical part in confirmation of the terminal numbers.
Correct wiring should be done with reference to this Operation Manual, because wrong wiring may result in damage to the device and malfunction.
② Connect wires to the terminal block on electric part so as not to exert tensile force on it.
If not, it may cause disconnection.
③ Wiring should be made away from electric power line. If not, it may cause it to read inaccurately and malfunction due to noises.
④ Do not let the output terminal short-circuit.
If not, it may cause damage to the device.
⑤ Do not make a mistake in connecting the two coaxial cable connectors coming from the detection part to the electrical part so as not to mistake inlet side for outlet side.
Connect so as to agree with the cover colors of coaxial cable connectors, because there are color designations of the black and red in the connectors of the electrical part. If connected in the reverse order, it would turn the flow display upside-down relating to the plus and minus, and also the 4-20mADC output would be fixed to the 4mA.

⚠ (Operating environment)

① In no event should the Ultrasonic flowmeter be used under the atmosphere of explosive gases. If not, it may cause explosion disaster.
② Do not use the Ultrasonic flowmeter in a place where surge will occur.
If using in the places where electromagnetic valve and rotary machine are located and producing a large surge, it may cause damage to the devices and malfunction.
③ Operate the Ultrasonic flowmeter within the specified operating ranges of temperature.
If operated at exceeded temperature, the device is overheated and may cause damage or fire.
④ Operate the Ultrasonic flowmeter in the environment where is unaffected by electromagnetic induction. Strong electromagnetic induction may cause it to read inaccurately and malfunction.
⑤ Operate the Ultrasonic flowmeter in the places where is 80% or lower in humidity and where condensation of humidity will not occur.
If the electrical part is condensed, it may cause damage and malfunction.
⑥ Operate the Ultrasonic flowmeter in a place where is less the mechanical vibration.
If affected, it may cause disconnection of the cable.

⚠ (Fluid)

① In no event should any inflammable fluid be used. It may cause explosion or fire.
② Do not allow air bubble to enter into the fluid.
Air bubbles in fluid may interrupt ultrasonic wave, unstable in flow measurement and fails to measure.
③ Do not adhere air bubbles to the inside of the tube of the detection part.
If air bubbles occurred in the fluid of extremely slow velocity, air bubbles adhere to the sending and receiving surface of ultrasonic wave in the tube of the detection part, and may disable it for flow measurement.
④ Do not mix foreign matters into fluid.
Foreign matters in fluid may interrupt ultrasonic wave, unstable in flow measurement and fails to measure.
⑤ It is too viscous in the fluid to measure.
⑥ Flow accuracy may be affected depending on the operating fluid and temperature.

⚠ (Installation instructions on fittings)

① Since the tube length is appropriately designed according to each type of flowmeter, please use it without cutting.
② In installing the fittings which the sleeve is pressed into the tube and which the tube is deformed in shape, do it fully after warmed up. Insufficient warming up may cause crack and damage to the tube.

⚠ (Others)

The cap in the detection part is constructed water-proof, and tightened at specified torque.
In no event should the cap be turned. Otherwise, water-proof effect will not only be lost, but may be affected to the sensitivity to ultrasonic waves.

We highly appreciate your purchasing Ultrasonic flowmeter typed USF200S.
We would like to request your to read the Operation Manual thoroughly, and use the ultrasonic flowmeter.

2. General description

USF200S Series Ultrasonic flowmeter consists of the electrical part (Control part) and the detection part (Sensor part).
The electrical part controls the sending and receiving controls of ultrasonic waves, and measures flowrate from the propagation time difference between ultrasonic wave which transmits along the flow and that of which transmits against the flow. The vibrators are arranged at the both end of flow path of the detection part, respectively to be oscillated by ultrasonic waves, and it has the structure where fluid flows between that.
By applying the ultrasonic waves to the flowmeter fluids can be measured in no contact with fluid. Also the material in contact with liquid is Teflon and most suitable for the flow measurement which is required for the purity in liquids.

3. Accessories and confirmation of products

3－1. Confirmation of accessories

Check to ensure that the following items are all set.

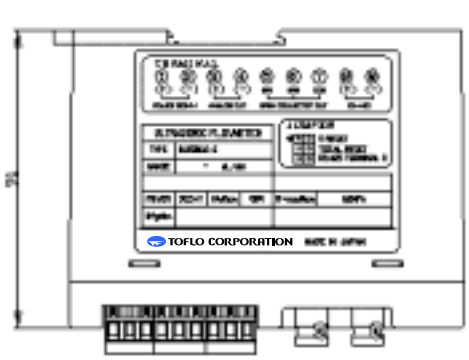
- Electrical part of the Ultrasonic flowmeter ‥‥‥ One unit
- Detection part of the Ultrasonic flowmeter‥‥‥One unit
- Jumper socket‥‥‥‥‥‥One piece

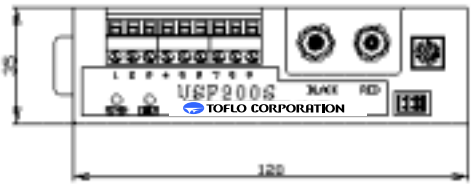
3－2. Confirmation of products

The products are comprised of the detection part and the electrical part where has been configured for use with the detection part. Make sure the products to ensure that the detection part and the electrical part are the conforming products to the manufacturing number, respectively.

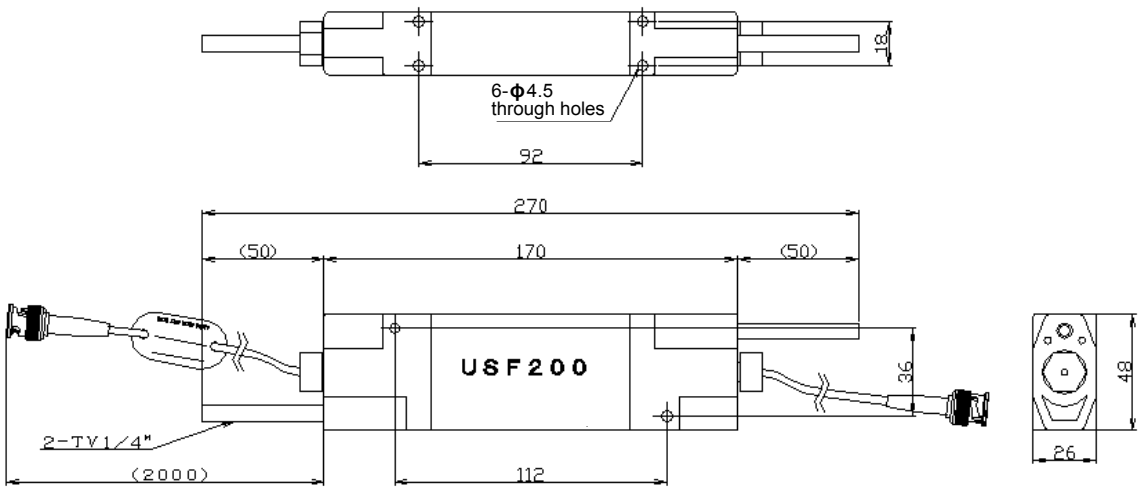
Appearance

Electrical part

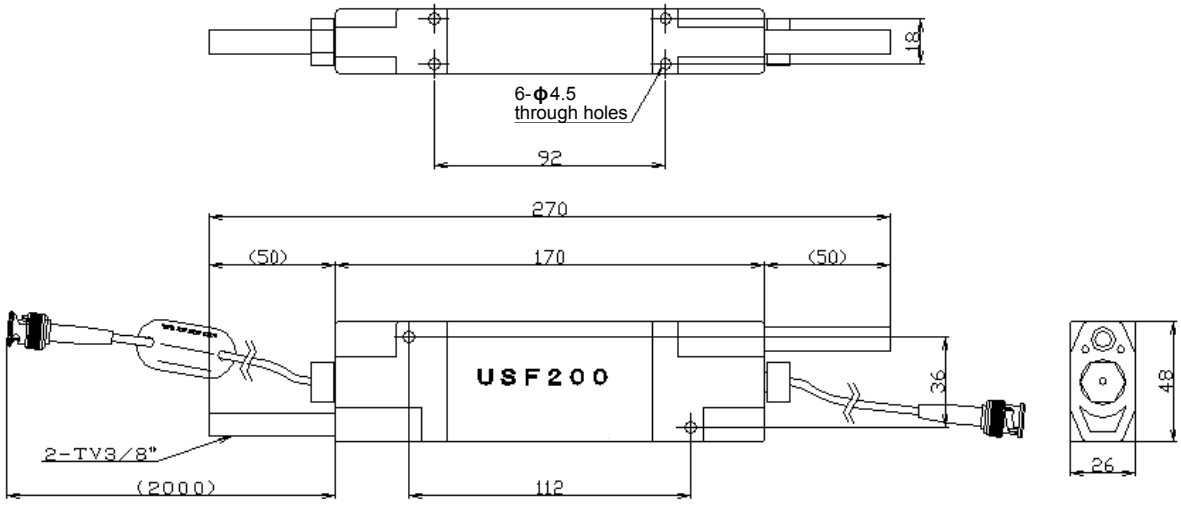




Detection part



USF200S-G08



USF200S-G10

3－3. Performance

- Ｆｌｏｗ　ａｃｃｕｒａｃｙ：±1% at FS (Flowrate equivalent to pure water)
  ※ The flow accuracy mentioned above is that of instantaneous flowrate.
- Ｗｉｔｈｓｔａｎｄ　ｐｒｅｓｓｕｒｅ：0.5MPa(G)
- Operating temperature ranges：0 - 50℃ (Non condensing)

－Electrical part－

- Ｄｅｔｅｃｔｉｎｇ　ｍｅｔｈｏｄ：Propagation time difference method
- Ｉｎｐｕｔ　ｓｉｇｎａｌ：Integrated value reset input and zero-point reset input
  (Reset through jumper pin and RS-485 interface)

● Ｏｕｔｐｕｔ　ｓｉｇｎａｌ：

Output at 4-20mADC‥‥‥Selectable from instantaneous/ integrating pulses

○ Instantaneous flowrate: Individual flowrate is settable at 4mA and 20mA, respectively.

○ Integrated flowrate: Settable up to 32000ml for upper limit(20mA) arbitrarily.

(Max load resistance: 800Ω)

Open collector output 1 ‥‥‥Selectable from frequency/integrating pulses and comparative output

○ Frequency output

Setting of frequency at FS ‥‥‥ At the time when the flowrate is at full scale, frequency can be set up to 100 to 3000Hz at FS of flowrate at its option.

Setting of flowrate at upper limit ‥‥‥At the time when the frequency is at full scale, the flowrate can be set up to 32000ml/min at its option.

○ Integrating pulse

Setting of integrating pulse range‥‥Range of pulse per one pulse can be set up to 800msec at its option.

Setting of integrating pulse flowrate ‥‥‥Flowrate per one pulse can be set up to 200ml at its option.

○ Comparative output

Settable either upper limit or lower limit of the instantaneous flowrate and integrating flowrate

Setting ranges to instantaneous flowrates ‥‥‥0 – 32000ml/min

Setting ranges to integrating flowrates‥‥‥0 – 32000ml

Open collector output 2‥‥‥Settable from abnormal output/comparative output

○ Abnormal output

It is to output, when disabled it for flow measurement due to the mixing of air bubbles

○ Comparative output

The same as those of the comparative output on open collector output 1.

Sink current：Max100mA

Impressed voltage：Max+35V (VOL＝1.3V)

● Backup ： EEPROM

● Power supply voltage: Power supply voltage: 24VDC±10%

－Detection part－

● Heat resistance：80℃

● Materials in contact with liquid: New PFA

● Cable length: Standard specification:3m (Coaxial cable covered by Teflon)

For any specification other than that of standard, it is specified in the delivery specification.

4. Installation

4－1. Installation location

The following locations should be selected for installing the electrical part and the detection part.

- In a place where is less mechanical vibration.
- In a place where no corrosive gases will exist.
- In places where ambient temperature is between 0 ℃ and 50 ℃ and is not subjected to direct sunlight.
- In a place where is not subjected to direct high radiation heat
- In a place where is not affected by electromagnetic induction disturbance.
- In a place where is below 80% in humidity and where condensation of humidity will not occur.

4－2. Installation attitude of the detection part

- For the installing attitude, it is recommended to install the detection part as illustrated in Fig. 1 and Fig.2
- In case of Fig. 4 and 5, it is anticipated to entrap air at the time when air bubbles are mixed.
- It may be affected on the flow accuracy according to the installation direction.

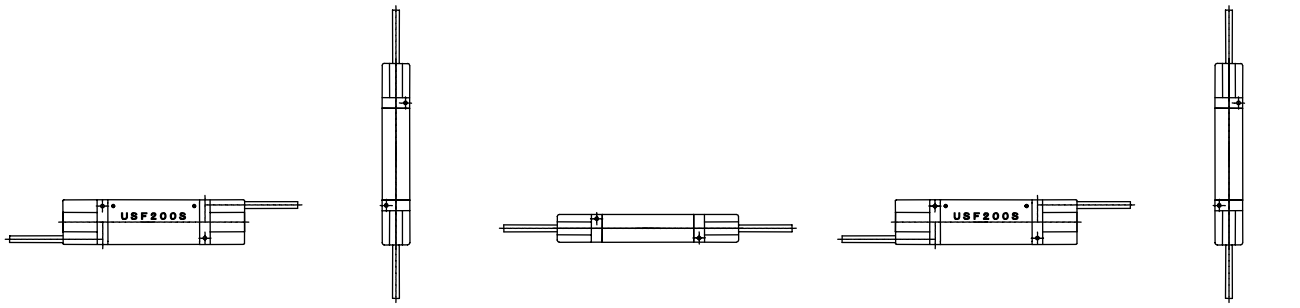
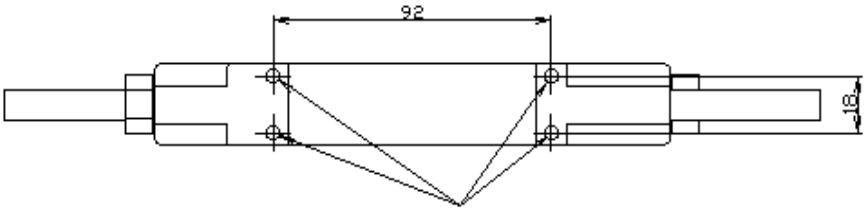


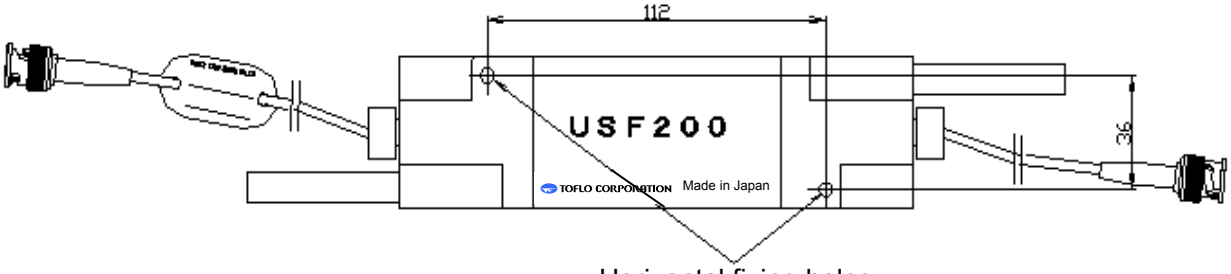
Fig. 1 (◎)　Fig. 2 (◎)　Fig. 3 (○)　Fig. 4 (X)　Fig. 5 (X)

4－3. Installing the detection part

- Coaxial cable connectors coming from the detection part are distinguished by using different colors.
- Every precaution should be taken for wiring to ensure that red color is connected to the inlet side of the fluid and black is connected to the outlet side.
- Do not cut and extend the cable.
- Securely fix the detection part by using M3 screws to two or more places according to either illustrations below.

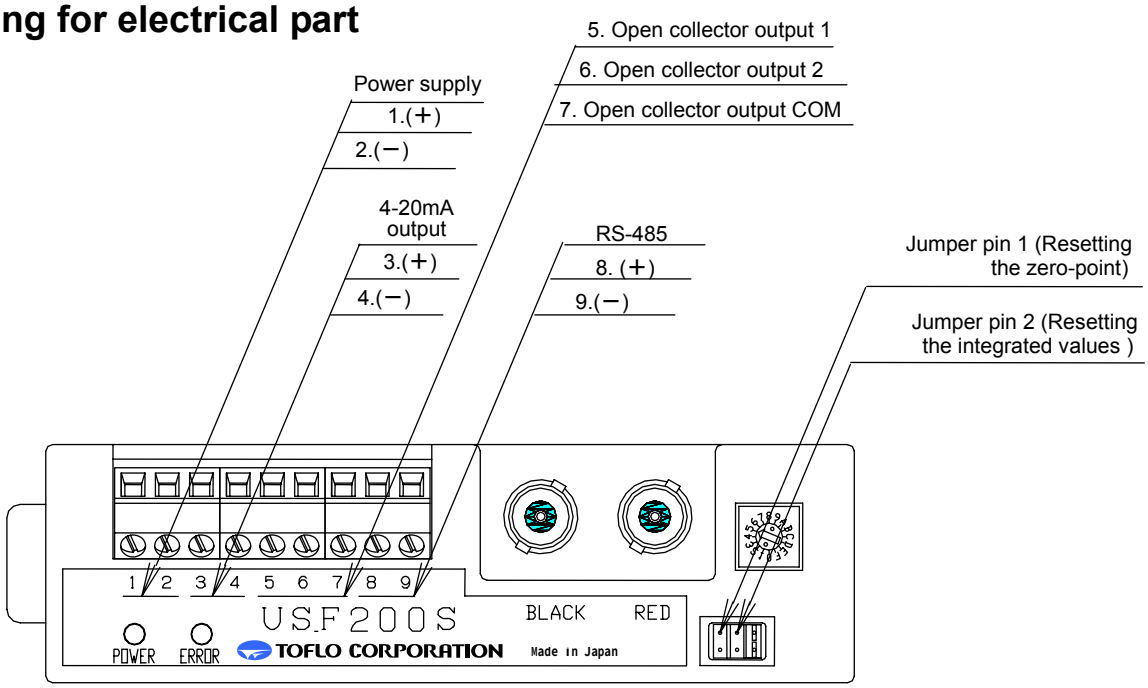


Longitudinal fixing holes



Horizontal fixing holes

4-4. Wiring for electrical part



Wire up with reference to the illustration above.

● When wiring, peel off wire sheath, insert wires into the top holes located on each terminal pin number, then tighten screws securely with a small slotted screwdriver.

⚠ When wiring or inspecting, be sure to turn off the power. If not, it may cause an electric shock.

4－4－1. Connection to the power supply (Terminal block to be used: Numbered ① - ②)

Operate power supply voltage at ＋24VDC.
(Permissible ranges: Between ＋21.6VDC and ＋26.4VDC)
Wiring should be made so as not to make a mistake because that Pin No. ① is plus, and No. ② is GND.

4－4－2. Connection to the current output (Terminal block to be used: Numbered ③ - ④)

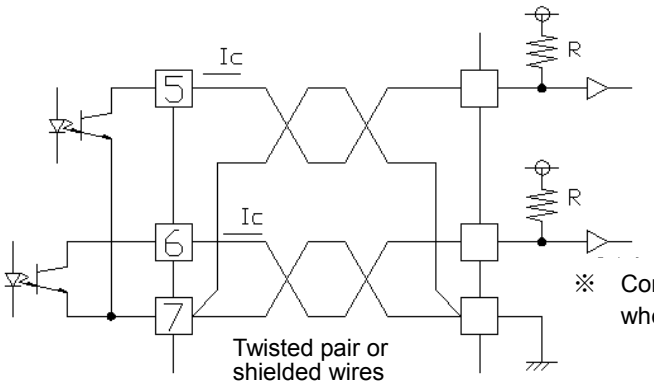
The current output of 4-20mADC can be inputted directly to the industrial standard of 4-20mA input. When converting to the 1-5VDC, put the metal film resistor(250Ω 1/4W±1%) into the both end of input at 1-5V. Provided that the resistance error of 1%, in this case, comes to be included. As pin number ③ is plus and the pin number ④ is GND, connect them correctly.

4－4－3. Connection to open collector output(Terminal block to be used : Pin number ⑤ to ⑦ and ⑥ to ⑦)

There are two systems in connection to the open collector output, one is for frequency / integrating pulse outputs whose terminal block is pin numbered ⑤ to ⑦ and the other is for abnormal output whose terminal block is pin numbered ⑥ to ⑦. Only a kind of output per one system is settable. It is necessary to provide pull-up resistor in the outside, as it is the open collector output isolated by photocoupler.

Sink current Ic is max 100mA. If it is supposed to malfunction by causing noises from the outside, it is usual to determine the resistor R to make the Ic larger, and determine to make the R range 5-30mA normally.

The impressed voltage is max 35V for pin number ⑤ to ⑦ and the pin number ⑥ to ⑦. VoL of open collector output is 1.3V.



※ Consideration should be taken for VoL, when entering.

4－4－4. RS-485(Terminal block to be used: Pin number ⑧ to ⑨)

The product allows to set and reset, etc. various kinds of parameters by using RS-485. RS-485 connectors for communications can be carried out only by connecting them to the terminal block of pin number ⑧ to ⑨. For further information regarding the specifications on communications , please feel free to contact us.

4－4－5. Connection to the zero-point reset (Jumper pin 1)

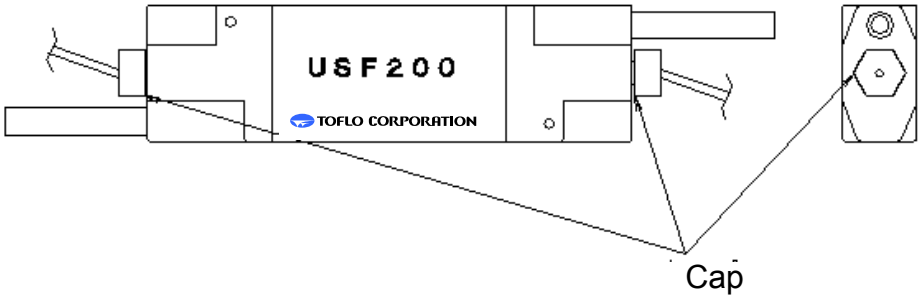
To reset zero-point, short circuit once the jumper pin 1 (On the left side of the electrical part as one faces) from the open status, and make it open status again by using jumper socket attached, and the reset can be carried out by using RS-485 of the communicating function, too.

4－4－6. Connection to the integration reset input (Jumper pin 2)

To reset the integrated values, short circuit once the jumper pin 2 (On the left side of the electrical part as one faces) from the open status, and make it open status again by using jumper socket attached, and the reset can be carried out by using RS-485 of the communicating function, too.

5. Handling instructions

⚠ ●Never turn the cap of the detection part, as it is water-proof.



The cap is tightened at specified torque. Never turn the cap.

Otherwise, water-proof effect will be lost, and will be given an influence on the sensitivity of ultrasonic waves.

⚠ ● The electric part is paired with the detector. When purchasing plurality of the products, it is required to use the same manufacturing No. so as to agree with each other.

⚠ ●The calibration has been done for the instantaneous flow indicating value and the actual value, and for the 4-20mA by using master flowmeter, when shipping from factory. Any changes of the compensated value parameters, etc. should not be made.

⚠ ● Operate the Ultrasonic flowmeter within the rated temperature and pressure.

6. Flow measurement

After completed to install the electrical part and electrical wiring, and also completed to make up pipe to the detection part, then turn on the power and flow the fluid.
LED on electrical part lights up and indicates error (fail), when flowing no fluid, but enters into the flow measuring status, when starting flowing fluid.

- Selection can be made either for instantaneous value or integrated value in the output.

※Output at 4-20mADC

The 4-20mA is outputted from the external terminal in proportion to the instantaneous flow indication on the plus side, however on the minus side of instantaneous flow indication it is fixed to 4mA.

※Precaution at the time when measuring flowrate

- If air bubble exists in fluid, ultrasonic waves are obstructed and the ultrasonic flowmeter may result in erroneous measurement or disabled for flow measurement.

- If air bubble is present in extremely slow velocity, air bubble will adhere to ultrasonic wave-receiving –face within the tube of the detection part and disable it for flow measurement.
- When flowing the fluid into the initial flow path (when setting up the system), air bubbles are mixed, and when the velocity is extremely slow in flowing, small air bubble may adhere to ultrasonic wave-receiving –face within the tube of the detection part, and it can cause it to read inaccurately and/or disable it for flow measurement. For this reason, wash out the air bubbles by means of repeating opening and shutting the valve.
- Turn on the power supply of the electrical part, when the detection part is filled with fluid and the velocity is at 0. If turned on at the time when the fluid is running, errors may occur in the initial setting at the time when setting up, and may disable it for flow measurement.

7. Setting of parameters

The following setting of parameters in USF200S can be made by using RS-485 communicating function which is provided with our application software USF TERM for setting up parameters, and also the setting can be made by RS-485, too. (In this case communication software is additionally needed.)
For further information regarding parameters, see the Operation Manual for USF TERM.

Outline of the parameter setting items

○ Initial setting
  ① Analog output calibration
  ② Channel address
  ③ Communication port

○ Setting of reset
  ① Zero-point adjustment
  ② Resetting integrated values

○ Setting of DT ADJ
○ Setting of linearization
○ Setting of output
  ① Analog output
  ② Setting of pulse output
  ③ Fail
○ Setting of functions
  ① Number of times of moving average
  ② Sampling time
  ③ Low cut
  ④ Speeding up of moving average

— To the customers who are using an integrating functions —

When using the integrating functions, please use it after having turned on the moving average speeding-up function.
If it is used in the state that the moving average speeding up function has been set to the OFF, it may cause larger margins of errors for the amount of the real liquids than those set to ON state.

— How to set a function of the speeding up and how to calculate the threshold for speeding up —

High-speed function of the moving average is a function to speed up the response for the great fluctuation. To enable this function, set the ON/OFF selection items to the ON status, and set the threshold.
This threshold becomes a setting value which is to be used according to the situations with the two conflicting functions, high-speed response and flow stability, changing over automatically on the flow display. If inappropriate setting values are set, as it may affect the integrating function, please calculate appropriate value in reference to the following descriptions.

G 08 Operating flow ranges 1 – 50mL/min □ 5mL/min to be fixed.
51 – 300mL/min □ 10% of the operating flowrates (RD10%)
G10 Operating flow ranges 5 – 100mL/min □ 10mL/min to be fixed.
101 – 5000mL/min □ 10% of the operating flowrates (RD10%)

10 percent of the DTADJ values have been configured as a default value at the factory when shipping (FS10%).
For more information about the setting values, see the instruction manual on the USF TERM.

8. Trouble shooting

Symptoms	Cause	Measures to take
The ultrasonic flowmeter does not output.	Abnormal power supply and current	Verify power supply voltage, then supply the rated voltage and current. It is considered that voltage is too high to burn out.
	Disconnection of connected wires to ① to ②in electrical part or failure to make contact.	Verify the connected wires ① to ② in terminal block
	Jumper is inserted.	Remove the jumper.
Abnormal output is in the “ON” position, or output fluctuates greatly.	Coaxial cable connector in electrical part fails to make contact.	Correctly install the coaxial cable connector.
	Coaxial cable coming from detection part disconnected.	Replace in combination with the electrical part and detection part.
	Coaxial cable disconnected within detection part.	Replace in combination with electrical part and detection part.
	Air bubbles adhered to the sending and receiving surfaces of the ultrasonic wave in detection part.	Wash out air bubbles by increasing velocity once.
	No liquid exists within tube of detection part.	Run the fluid into the tube of detection part
Integrated flowrate output remains “0”.	Flowrate is regarded as zero due to larger setting of LOW CUT.	Set up LOW CUT to make it to minimize as required.
Integrated flowrate output remains “0”. (Not integrated).	Electrical part is failure.	Replace in combination with electric section and detecting section.
	Flowrate is regarded as zero due to larger setting of LOW CUT.	Set up LOW CUT to make it to minimize as required.
Integrated flowrate output increases and decreases, regardless fluid is standing-still,	Zero-point in instantaneous flow indication Is shifted to plus side or minus side.	Make zero-point adjustment in a state that fluid is standing-still. If the zero-point deviation is not adjusted, enter LOW CUT.
Frequency / integrating pulse outputs do not conform to 4-20mADC output.	Calibration parameter (Setting value) at 4-20mA output is not correctly set up.	Consult with our service or sales person in charge.
4-20mA output does not output.	Disconnection of connecting wires ③ to ④ in electric part or failure to make contact.	Verify the connected wires ③ to ④ on terminal block

Integrated flowrate does not become zero(Reset).	Disconnection of connected wires to jumper pin 1 (Left) or failure to make contact.	Verify the connected wires to jumper pin 1(Left).
	Abnormal communication in RS-485	Verify the connected wires ⑧ or ⑨ on terminal block
Open collector output is not produced.	Disconnection of the connected wires ⑤ to ⑦ on terminal block of electrical part, or failure to make contact.	Verify the connected wires ⑤ to ⑦ on terminal block
	Disconnection of the connected wires ⑥ to ⑦ on terminal block of electrical part, or failure to make contact.	Verify the connected wires ⑥ to ⑦ on terminal block
	Parameters not set up correctly.	Correctly input required.

※ If you found out abnormality or failure in this ultrasonic flowmeter, please contact us.

9. Error display

If abnormality arises during the flow measurement, red LED in electrical part lights up and the abnormal output is produced.

Abnormal output: It will appear, when sending and receiving wave forms cannot be received.
It will appear, when time difference of sending and receiving waves cannot be measured.

The followings are considered as the factors.

- A great deal of air bubbles are contained in fluid.
- Air bubbles are deposited on the ultrasonic wave-sending and receiving surface of the detection part.
- Viscosity of the fluid is too high to flow.
- Too excessive flowrate
- There is no fluid within the tube of the detection part
- Coaxial cable connector coming from the detection part has been removed.

10. Warranty

Warranty period:

The warranty period shall be for one year from the date of your purchase.
(For one year commencing with the next month of the month shipped from factory)

Scope of warranty:

When trouble for which we are liable occurrs during the warranty period, we will repair or replace it free of charge. Provided that in case of the following items they shall not be covered by warranty.

① In case that it is incorrectly handled and used in an extraordinary conditions and environment.
② In case that it emerges from the causes except the product we delivered,
③ In case that it is improperly remodeled and repaired by any person other than our company.
④ In case that it is due to natural calamity, disaster and others where are not responsible for us.

In addition the warranty said above means the warranty of the single unit of the product we delivered. As to the damage triggered by the trouble of the delivery goods it cannot be warranted.

Warranty
for
Ultrasonic flowmeter typed USF200S-G08/G10

Model		Serial No.	

Warranty period	**For One year**	**Date purchased** **Month day Year**	**To customer:** Please fill out the warranty card with a ball-pointed pen immediately after purchasing, and keep it with care. **To dealer:** Please fill out the delivery date to customer and your dealer's name completely, and hand it over to your customer.
To customer	**Customer's address**		
	Name of customer		**Name of dealer** (Dealer's name, address and Tel No.)

※This warranty does not become effective, until the both of customer and dealer fill out the card.

11. Where to contact

TOFLO CORPORATION

Headquarters: 3-17 Minamidaira, 4-chome Hino City, Tokyo 191-0041
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