Operation Manual

for

USF300C

USF300C-G15

USF300C-G20

⚠ **Warning**	Before using, please read through the Operation Manual with caution for your proper and safety operation with your full understanding.

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

TOFLO CORPORATION

146-R05

Table of Contents

Before using the Ultrasonic flowmeter,

⚠ Warning

- Before using the Ultrasonic flowmeter, read this manual carefully to become familiar with how it works.
- Please always keep this Operation Manual at hand for your quick reference when necessary.
- Relating to the original usage of this Ultrasonic Flowmeter and the instructions stated in this Operation Manual, fully understand the contents instructed , and always comply with them.
- Strictly observe the instructions stated above. Failure to do so may result in injury and accident.

<< As to the Operation Manual >>

- The contents of the Operation Manual are subject to change due to the improvements of the product performance and functions without prior notice.
- It is prohibited partially or totally to reprint or make copies the Operation Manual without permission.
- Please feel free to contact us at the nearest sales office, if lost the Operation Manual.
- 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 Manual, we would appreciate it if you could contact us at the nearest sales office.

1. Safety precaution

⚠ **Warning**	Since the following items include important contents in order to use the product properly and safely, be sure to read it thoroughly before using, and be sure to comply with them.

⚠ (Design precaution)

① Operate the ultrasonic flowmeter under the specified voltage.
Should the voltage be too low in voltage, it may cause a malfunction, but too high in voltage, it may cause a damage to the devices, or fire.

② Operate the ultrasonic flowmeter within the rated piping pressure.
Should it be used in excess of the rated pressure, it may cause burst of the detector part made of Teflon.

③ Operate the ultrasonic flowmeter within the specified temperature or lower. Should it be used in excess of the rated temperature, it may cause malfunction and damage to the devices, or fire.

④ Always keep the detecting tube filled fully with fluid. If not, it could not send and receive because ultrasonic wave be shut off with gas, and would be disabled the Ultrasonic flowmeter for the flow measurement. Should the flow measurement be made, it could cause it to read out inaccurately.

⑤ For installation attitude of the detector part, study how to install with reference to this Operation Manual.
A care should be taken not to cause trapping of air bubbles or liquid.

⑥ When connecting input/output signals to Ultrasonic flowmeter, design the wiring with reference to this Operation Manual. If running current excessively, applying overvoltage and exerting overload on input signal, it may cause damage to the devices, and also it may cause malfunction should the current and voltage be applied inappropriately.

⑦ During communicating by means of RS-485, communication error may appear depending on the PC performance and communication speed.
Avoid operating the Ultrasonic flowmeter at extremely high speed.

⚠ (Installation precaution)

① Unpack the detector part in a place where is in a clean air, because it has been packed in a clean room after having cleaned. Handle carefully not to deposit dust, etc., on it.

② Securely fix the detector part to the slotted holes located in four places with screws.
Should it be used in a state of being floating in a midair, the excessive force could be exerted on the both tubes of the detector part, at inlet and outlet.

③ A flow direction of the fluid calls a great attention when mounting the detector part. Should the pipe be made up in the reverse direction, plus / minus could be upside down in the flow indication, and the output at 4-20mADC could be fixed to 4mA.

④ The flow control valve should be installed to the outlet side of the detector part. If a throttle, such as valve, is provided at inlet side of the detector part, air bubbles may occur due to pressure reduction (cavitation) , and may disable the detector part for flow measurement.

⑤ Do not install the electronics part in places where condensation of humidity will occur and water is spraying, because it has not been constructed waterproof and moisture-proof.

⑥ The detector part is not allowed to use it while immersed in liquid.

⚠ (Wiring)

① Securely connect the wires to the electronics part upon careful confirmation of the terminal numbers.
Correct wiring should be done with reference to this Operation Manual, because faulty wiring may result in damage to the device and its malfunction.

② Connect wires to the terminal block on electronics 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 allow the output terminal to short-circuit.
If not, it may cause damage to the device.

⑤ Correctly connect two coaxial cable connectors coming from the detector part to the electronics part so as not to mistake IN side for OUT side.

Since the connectors coming from the electronics part are color-coded(red and black), connect them so as to conform to the color of the coaxial cable connector cover. If connected reversely, plus / minus is upside down in the flow indication, and 4-20mADC output is fixed to 4mA.

⚠（Operating environment）

① In no event may the ultrasonic flowmeter be used in explosive atmosphere.
If not, it may cause explosion disaster.

② Do not use the ultrasonic flowmeter in a place where surge will occur.
If using such solenoid valve or rotary unit in a place where a significant surge will occur, it may cause malfunction and damage to the devices.

③ Operate the ultrasonic flowmeter within the range of the operating temperature specified.
If operated in excess of the temperature, the device will be overheated, and it may cause damage or fire.

④ Operate the ultrasonic flowmeter in environments where are free from affecting by lectromagnetic induction. Strong electromagnetic induction may cause it to read inaccurately and malfunction.

⑤ Operate the ultrasonic flowmetert in places where is 80% or lower in humidity and where the condensation of humidity will not occur. If the condensation has been built up on the electronics part, it may cause malfunction and damage.

⑥ Operate the ultrasonic flowmeter in a place where is less mechanical vibration.
If subjected to the mechanical vibration, it may cause disconnection of cable, etc.

△（Fluid）

① In no event may any inflammable fluid be used.
It may cause explosion or fire.

② Protect fluid from getting air bubbles mixed.
If not, air bubbles in fluid may reflect ultrasonic wave, thereby causing unstable measurement or disabling it for flow measurement.

③ Avoid producing air bubbles inside the detector tube.
Air bubbles, if getting mixed into fluid which is running at extremely slow speed, may deposit on ultrasonic wave sending and receiving face inside the tube of the detector part, thus disabling it for flow measurement.

④ Do not let foreign matter mix in into fluid.
Foreign matter, if mixed in into fluid, may reflect ultrasonic waves, thereby causing unstable measurement or disabling it for flow measurement.

⑤ Excessive viscosity of fluid may disable flow measurement.

⑥ Depending on the operating fluid and temperature they may affect the flow accuracy.

⚠ (Precaution for installing coupling joint)

① Use the tube as it is without cutting, because the tube length has been designed suitably for use in each ultrasonic flowmeter.

② In the case the ferrules are connected by pressing it into the tube or by letting the tube change the shape, the tube connecting work should not be done until after it has been fully warmed up. If warmed up insufficiently, it may cause crack and damage.

⚠ （**Other applications** ）

The cap on the detector part is waterproofed and tightened at specified torque. In no event may the cap be turned. If not, not alone the water-proof effect may be lost, but the sensitivity to ultrasonic waves may be affected adversely.

We highly appreciate your purchasing USF300C Series Ultrasonic flowmeter. We would like you to read this Operation Manual thoroughly, and use it properly.

2. General description

USF300C Series the Ultrasonic flowmeter is comprised of the electronics part (Part of control) and the detector part (Part of sensor). The electronics part controls the sending and receiving controls of ultrasonic waves, and measures flowrate obtained from the propagation time difference between ultrasonic waves which transmit both along and against the flow. The vibrators are arranged at the both end of the horseshoe shaped flow paths respectively to produce ultrasonic waves in the detector part. Accordingly it has such a structure as the fluids may flow between that flow paths.

By utilizing the ultrasonic waves, it enables us to measure flowrate in noncontact with the fluid, and since the material coming into contact with liquid is made of Teflon, it is most suitable for measuring the highly-purity fluid.

3. Accessories and the product specifications

3－1. Confirmation of accessories

Check to ensure that the following items have been all set.

- Electronics part of the Ultrasonic flowmeter ····· One unit
- Detector part of the Ultrasonic flowmeter·····One unit
- Jumper socket·····One piece

3－2. Confirmation of product specifications

Make certain the delivered product to ensure that the model number and dimensions specified agree with those you ordered.

■ Nominal designation

USF300C-G□

Std.

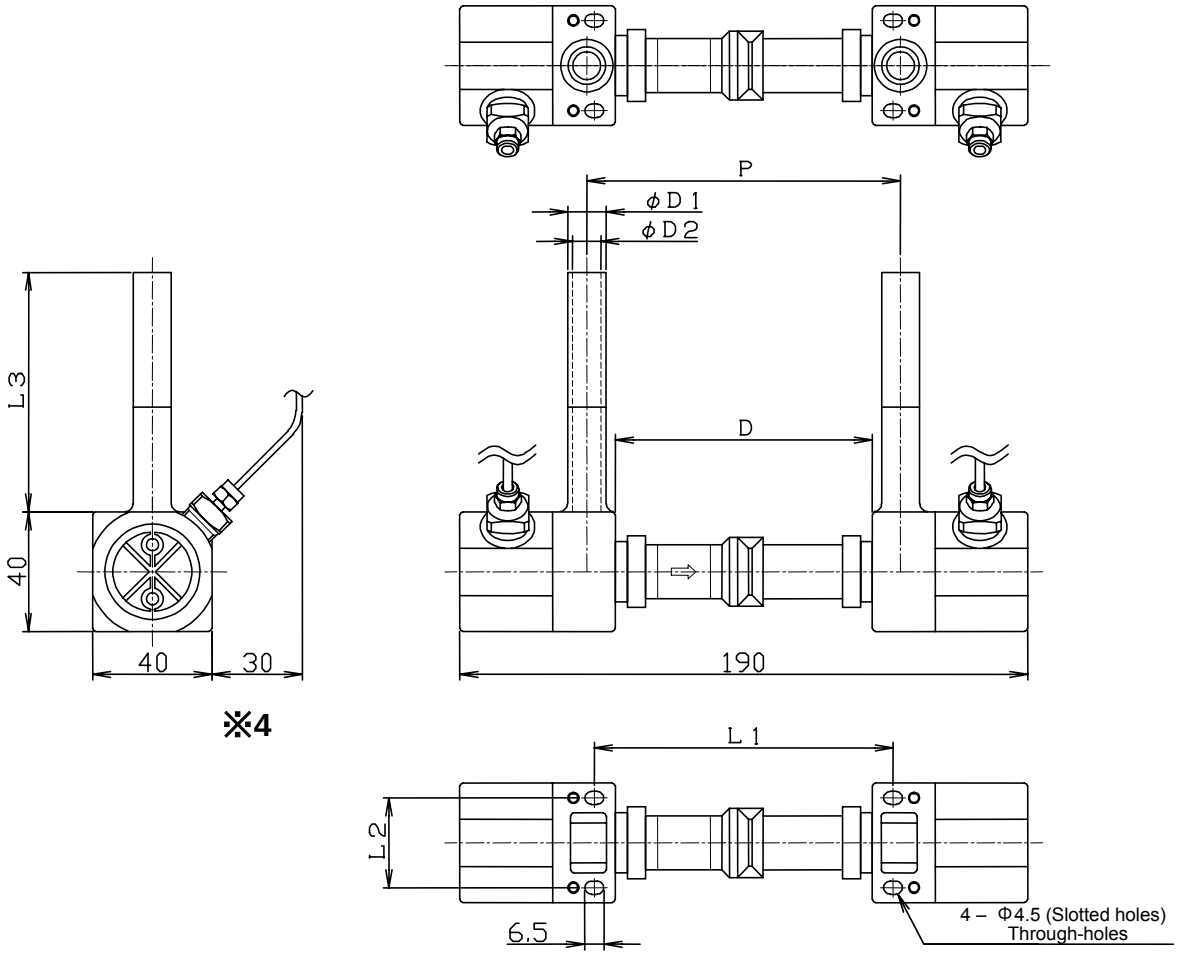
- **15** ···0.5 – 20 L/min (Flowrate equivalent to purified water)
- **20** ··· 2 – 50 L/min (Flowrate equivalent to purified water)

■ Standard dimensions

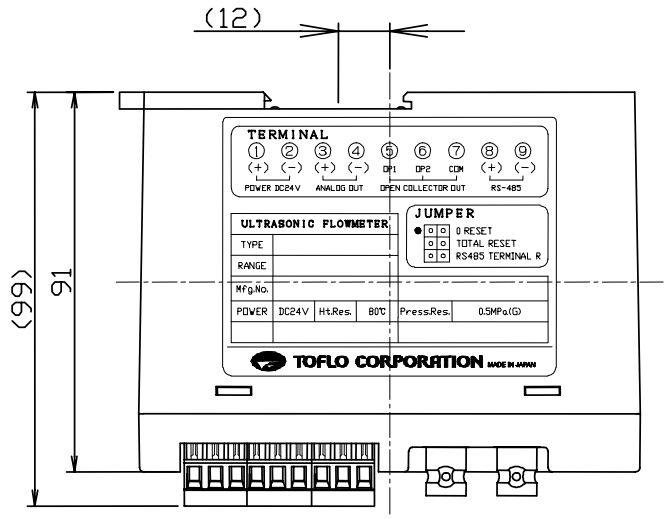
Std.	Flowrates	Dimensions						
		D	L1	L2	L3	P	ϕD1	ϕD2
G15	0.5 – 20 L/min	86	100	30	80	105	12.7	9.53
G20	2 – 50 L/min	72	84	32	100	100	19.0	15.8

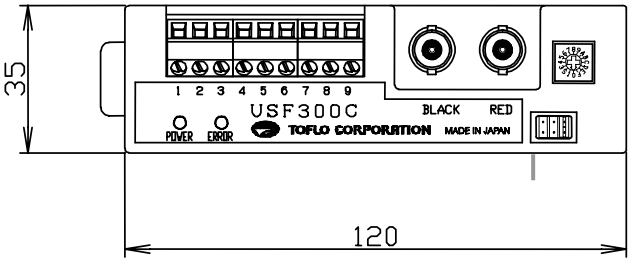
※ 1. The flowrate shown above indicates the one that equivalent to the purified water.
※ 2. The L1 and L2 show the location dimensions of the screw cramp for mounting.
※ 3. To install the coupling joints, the installation should be performed with reference to " Precaution for installing coupling joint " (on page 3).
※ 4. Allow 30 mm or more clearance behind rear considering the water resistant connectors and the coaxial cables.

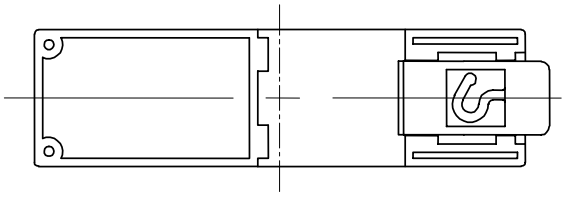
Detector part



Electronics part







35mm wide DIN rail mounting type
(Recommended type: PFP-100N made by OMRON)

3－3. Performance

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

－Electronics part－

- Detection method ：Propagation time difference
- Input signal ：Integrated value reset input and Zero-point reset input
  （Reset by means of jumper pin and RS-485）
- Output signal ： Output at 4-20mADC・・・・・Selectable from instantaneous / integrating flow
  - ○ Instantaneous flowrate: Settable at 4mA and 20mA individually.
  - ○ Integrated flowrate: Up to the upper limits(20mA) 320. 001 settable arbitrarily.
    (Maximum load resistance 800Ω)
    Open collector output 1 ・・・・・・Selectable from frequency/integrating pulse/comparative output
  - ○ Frequency output
    Frequency setting at FS ・・・・・The frequency is settable up to 100 to 3000Hz arbitrarily at the time of the flowrate at FS.
    Setting of upper flowrate limit ・・・・・The flowrate is settable up to 64000ml/min

arbitrarily at the time of frequency at FS.

○ Integrating pulse

Setting of integrating pulse width ・・・・ The pulse width per one pulse is settable up to 800msec arbitrarily.

Setting of integrating pulse flowrate ・・・ The flowrate per one pulse is settable up to 32000ml arbitrarily.

○ Comparative output

Select either upper limit or lower limit in the instantaneous flowrate or integrating flowrate.

Setting range at instantaneous flowrate ・・・・・ 0 – 320.00 l/min

at integrating flowrate ・・・・・ 0 – 320.00 l

Open collector output 2 ・・・・・ Selectable from Fail output / comparative output

○ Fail output

It outputs at the time flow measurement is disabled due to mixing in of air bubbles.

○ Comparative output

Same as “comparative output” in open collector output 1”

Ratings of open collector output

Sink current : Maximum 10mA

Impressed voltage : Maximum ＋35V(V_{OL}=1.3V)

- Backup ： EEPROM
- Power supply voltage: 24VDC±10%
- Consumption current :Less than 0.1A normally (Less than 0.6A at the time of start-up)

－Detector part－

- Heat resistance：80℃
- Material coming into contact with liquid：New PFA
- Cable length: 5m(Coaxial cable coated by Teflon)

4. Installation

4－1. Installation location

Select the following places for installing the electronics part and detector part.

- Location where is less mechanical vibration.
- Location where are no corrosive gases.
- Location where ambient temperature is between 0 ℃ and 50 ℃ and is not subjected to direct sunlight.
- Location where is not subjected to direct high radiation heat
- Location where is unaffected by electromagnetic induction interference.
- Location where is below 80% in humidity and where condensation of humidity will not occur.

4－2. Installation attitude of the detector part

- For the installation attitude, it is recommended to install the detector part as illustrated in Fig. 1 and Fig.2. We, however, recommend to install most in the attitude as illustrated in Fig. 1.
- In the case of Fig. 3, the fluid will be entrapped should it be stopped running. and in the case of Fig. 4, air may be entrapped if air bubbles get mixed.

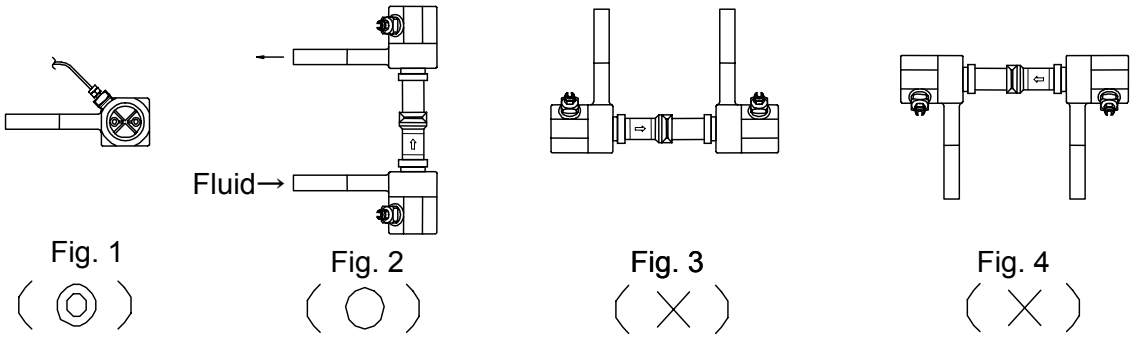
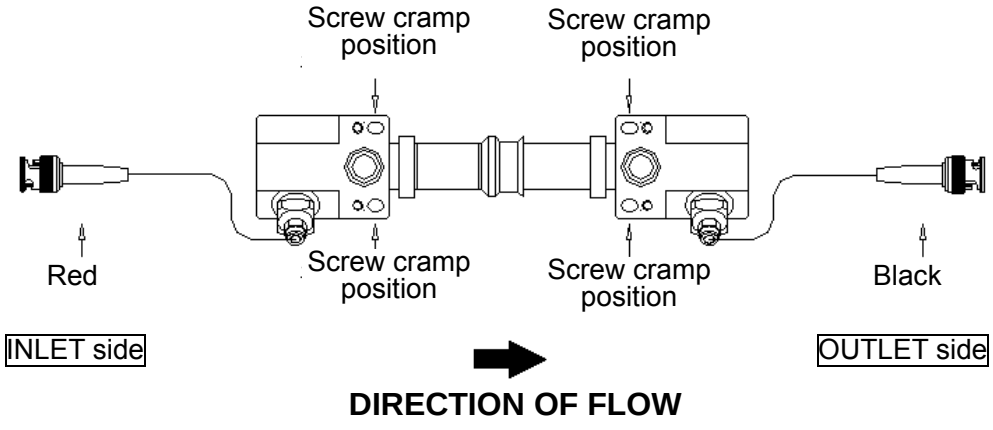


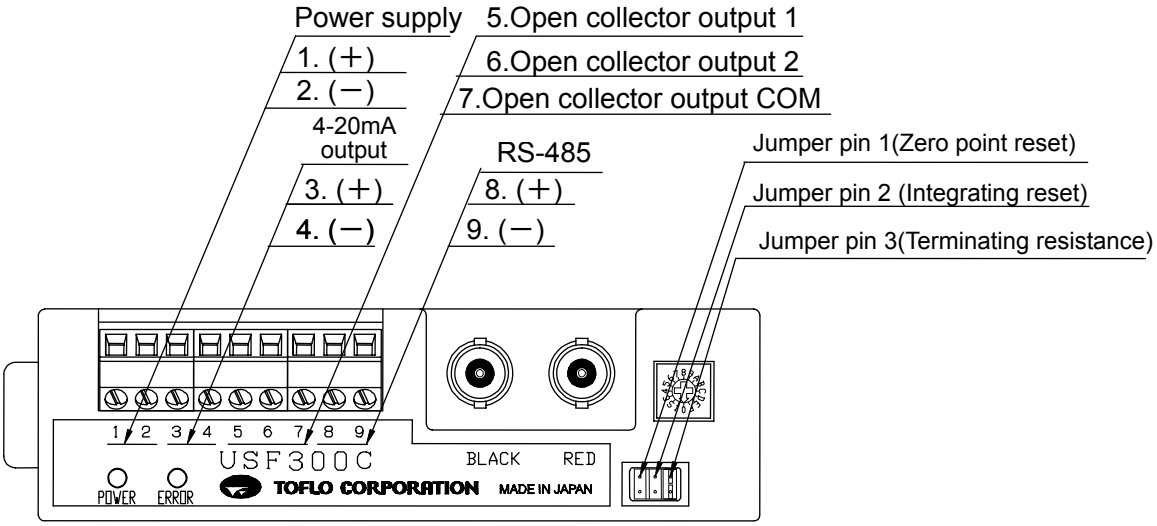
Fig. 1　Fig. 2　Fig. 3　Fig. 4

4－3. Installing the detector part

- Coaxial cable connectors coming from the detector are color-coded.
- Red connector is to connect to IN side, and black connector to OUT side of the fluid.
  A great care should be taken not to make a mistake when installing.
- Securely install the detector part to the four slotted holes arrowheaded in the figure below with pan head screws (M4x50, SUS).
- Do not cut off or extend the cable.



4－4. Wiring for the electronics part



Wiring should be performed with reference to the illustration above.

- When wiring, peel off wire sheath, insert wires into top holes located above the terminal block number, then tighten screws securely with a small size slotted screwdriver.

> ⚠ When connecting wires, make sure that power supply has been turned off. If not, it may cause an electric shock.

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

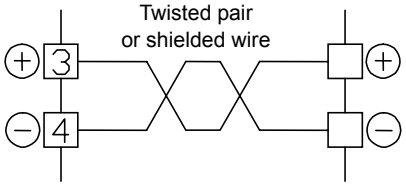
Use the power supply voltage at 24VDC. Consumption current is normally less than 0.1A. (Less than 0.6A at the time of startup). (Allowable range: Between ＋21.6VDC and ＋26.4VDC)

Wiring should be made not to make a mistake, because pin number ① is plus and pin number ② Is GND.

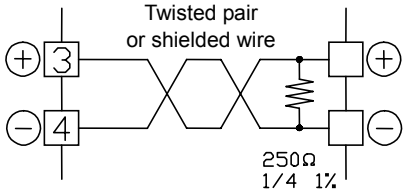
4－4－2. Connection to current output (Terminal block to be used: Numbered ③ - ④)

Current output of 4-20mA can be inputted directly to the industrial standard of 4-20mA input. if changing to the 1-5VDC, put the metal film resistor(250Ω 1/4W±1%) into the both end of input at 1-5V, Provided the resistance error of 1% is, in this case, to be included. Put the metal film resistor(250Ω 1/4W±1%) into the both end of input at 1-5V, if changing to the 1-5VDC, provided the resistance error of 1% is, in this case, to be included. Wiring should be made not to make a mistake, since that pin number ③ is plus, and pin number ④ Is GND.

- **In the case of connecting to Industrial standard of 4-2-mADC input**



- **In the case of connecting to 1-5VDC input**



4－4－3. Connection to open collector output

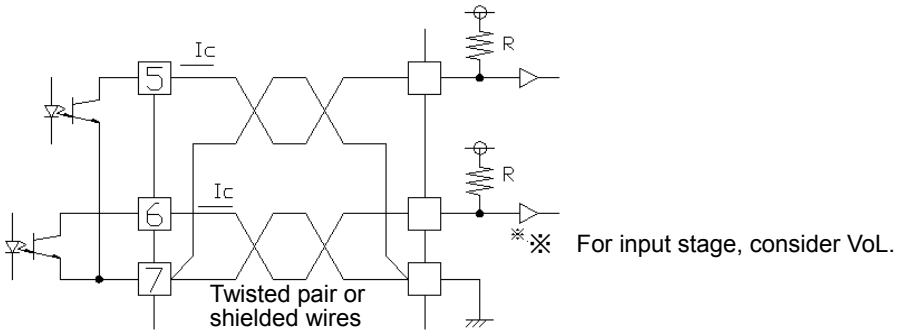
(Terminal block to be used : Numbered ⑤ to ⑦ and ⑥ to ⑦)

There are two systems in the connection to the open collector output, one is for frequency / integrating pulse/comparative output whose terminal blocks are pin numbered ⑤ to ⑦ and the other is for Fail / comparative output whose terminal blocks are pin numbered ⑥ to ⑦.

Only one kind of output can be set per one system. It is necessary to provide with pull-up resistor in the outside, because it is the open collector output isolated by photocoupler.

Sink current Ic is maximum 100mA. If it is supposed to malfunction to be caused by noises from the outside, it is usual to determine the resistor R to make it larger, but determine R to make it about 5-30mA as usual. The impressed voltage is maximum 35V for pin number ⑤ to ⑦ and the pin number ⑥ to ⑦.

VoL in the open collector output is 1.3V.



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

The product allows to set various kinds of parameters and resets and so forth by means of RS-485. Communications with RS-485 is only can be carried out by connecting to the terminal block of pin number ⑧ to ⑨. For further details regarding communicating specifications, please contact us with your specifications.

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

Zero-point reset is executed, if jumper pin 1 (On the left side of the electronics part as one faces) has been once short-circuited from the open status and made it open again by using accessory jumper socket, and also reset can be carried out by using the communicating function of RS-485.

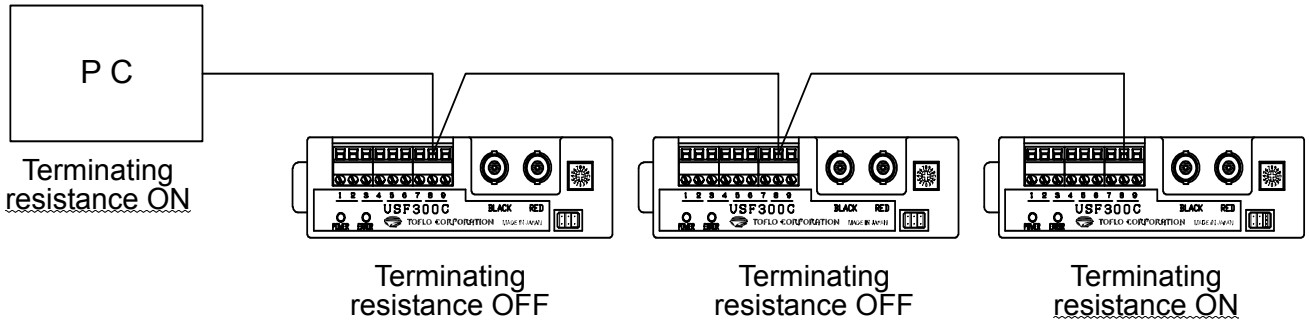
4－4－6. Connection to integration reset input (Jumper pin 2)

Integration reset is executed, if jumper pin 2 (At the center of the electronics part as one faces) has been once short-circuited from the open status and made it open again by using accessory jumper socket, and also reset can be carried out by using the communicating function of RS-485.

4－4－7. Connection to terminating resistance (Jumper pin 3)

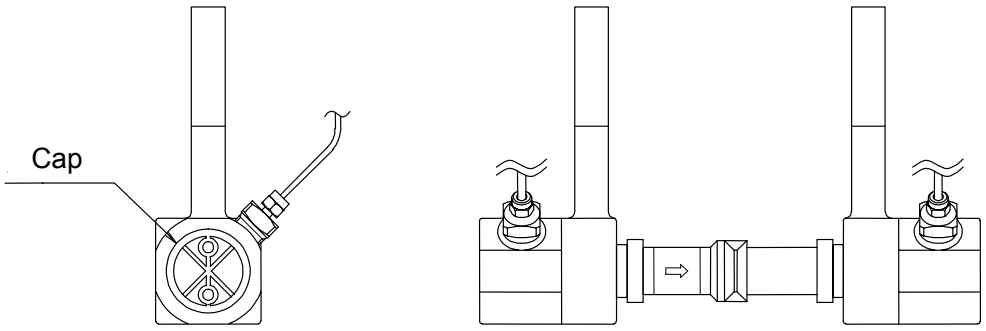
Terminating resistance (100Ω) is turned ON, if jumper pin 3 (On the right side of the electronics part as one faces) has been short-circuited by using accessory jumper socket, and also if removed the jumper socket and made it open, the terminating resistance will be turned OFF.

Should RS-485 be used in a single unit, make the terminating resistance ON and use it, and should it be used in plurality of units, make the terminating resistance at the end of the mains wiring ON, but within the branch line make it OFF, and use them as shown in the figure below.



5. Precaution for handling

⚠ • Never turn the detector cap, since it has been water-proofed.



The detector cap is tightened at specified torque. In no event may the cap be turned.
If not, not alone the water-proof effect may be lost, but the sensitivity to ultrasonic waves may be affected adversely.

⚠ • The electronics part is paired with the detector part. When purchased in plurality of the unit, use them so as to agree with the manufacturing number.

⚠ • The calibration has been carried out for the instantaneous flow indicating value and the actual value, and for the 4-20mA by means of the master flowmeter, when shipping from factory.
Never change the compensated value parameters, etc. of the Ultrasonic flowmeter.

⚠ • Operate the ultrasonic flowmeter under the rated temperature and pressure.

6. Flow measurement

After completed to install the electronics part, electric wiring and piping of the detector part, turn on power and run the fluid.

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

※Output at 4-20mADC

For the instantaneous flow indication on the positive side, 4-20mA is produced from the external terminal in proportion to the instantaneous flow indication, however the instantaneous flow indication on the negative side is fixed to 4mA.

※Precaution for flow measurement

- If air bubble presents in fluid, ultrasonic waves are interrupted, and it may result in erroneous measurement or disable it for flow measurement.

- If air bubble gets mixed in extremely slow velocity, air bubble will be deposited on the ultrasonic wave-sending and receiving –face within the tube of the detector part, and may disable it for flow measurement.
- When initially flowing fluids into the flow path (when setting up the system), air bubbles get mixed, and if flowing in the extremely slow velocity, small air bubbles may be deposited on the ultrasonic wave-sending and receiving –face of the detector part, and it can cause it to measure inaccurately and/or malfunction. For this reason, flush the tube interior away air bubbles by means of opening and shutting the valve when setting up.
- Turn on the power to the electronics part at the time when the detector part is filled fully with fluid and the velocity is at 0. If turned on the power to the detector part at the time when the fluid is flowing, errors may occur in the initial setting when setting up the detector part, thus disabling it for flow measurement.
- Zero adjustment should be set in about one hour aging after turning power on, in a state that the fluid stands still and that air bubbles are not mixed in and under the operating environment where ambient temperature and fluid temperature are stabilized.

7. Setting of parameters

The setting of parameters is performed by using the communicating functions.
The settings can be set by using our parameter setting software USF TERM or RS0485 communicating functions.

Outline of parameter setting itmes

- ○ Setting of reset
  - ① Zero adjustment
  - ② Integrated value reset
- ○ Setting of DT ADJ
- ○ Setting of linearization

○ Setting of output
  ① Analog output
  ② Comparative output
  ③ Integrating pulse output
  ④ Frequency output
  ⑤ Fail output
○ Setting of functions
  ① Number of times of moving average
  ② Sampling time
  ③ Lowcut
  ④ Speeding up of moving average
  ⑤ Open collector output

8. Trouble shooting

Symptoms	Causes	Measures to take
It does not output.	Abnormal in power supply voltage and in current	Check the supply voltage, and apply the rated voltage and current. Burnout is considered due to excessive voltage. .
	Disconnection of the connected wires to ① to ② on terminal block of the electronics part, or failed to make contact.	Check the connected wiring to the terminal block numbered ① to ②.
	Either jumper pin 1 (Zero point reset) or jumper pin 2 (Integrated value reset) has been inserted.	Remove jumper pin 1 (Zero point reset) and jumper pin 2(Integrated value reset).
Fail output is ON-state, or output fluctuates greatly.	Coaxial cable connector in electronics part fails to make contact.	Correctly install the coaxial cable connector.
	Coaxial cable coming from detector part has been disconnected.	Replace the electronics part and detector part in pairs.
	Coaxial cable disconnected within detection part.	Replace the electronics part and the detector part in pairs.
	Air bubbles deposited on ultrasonic wave sending and receiving surface of detector part.	Flush tube interior away air bubbles by increasing velocity once.
	No liquid existed within tube of detector part.	Flow fluid into the tube of detector part.
Instantaneous flowrate output remains “0”.	Due to larger setting of LOW CUT the flowrate is regarded as “0”.	Set LOW CUT to the minimum necessary.

Integrating flowrate output remains “0”. (Not integrated).	Failure in electronics part	Replace the electronics part and detector part in pairs.
	Due to larger setting of LOW CUT the flowrate is regarded as “0”.	Set LOW CUT to the minimum necessary.
Integrating flowrate output increases and decreases, even though fluid is state of rest.	Zero-point in instantaneous flow indication Is shifted either to plus side or minus side.	Set zero-point adjustment when fluid is state of rest. If the deviation from zero-point has not been adjusted, then input LOW CUT.
Frequency / integrating pulse output does not conform to 4-20mADC output.	Calibration parameter (Setting value) of output at 4-20mA has not been correctly set up.	Contact us at our sales office for service
4-20mA output is not produced.	Connected wires to ③ to ④ on terminal block of the electronics part has been disconnected, or failed to make contact.	Check to see if the connected wires on terminal block numbered ③ to ④ have been securely connected.
Integrated flowrate does not come to zero(Reset).	Connected wires to jumper pin 2 (Integrating reset) have been disconnected or failed to make contact.	Check to see if the connected wires to jumper pin 2(Integrating reset) have been securely connected.
	Abnormality in RS-485 communications	Check to see if the connected wires on terminal block numbered ⑧ or ⑨ have been securely connected.
Open collector output is not produced.	Connected wires to ⑤ to ⑦ on terminal block of the electronics part have been disconnected, or failed to make contact.	Check to see if the connected wires on terminal block numbered ⑤ to ⑦ have been securely connected.
	Connected wires to ⑥ to ⑦ on terminal block of the electric part have been disconnected, or failed to make contact.	Check to see if the connected wires on terminal block numbered ⑥ to ⑦ have been securely connected.
	Parameters have not been set up correctly.	Correctly to input.

※ If you found out an abnormality or failure in the ultrasonic flowmeter, please contact us at our sales office.

9. Error display

If abnormality arises during the flow measurement, red LED on the electronics part lights up and Fail output is produced.

Fail output: It appears, when sending and receiving waveforms cannot be received.
It appears, when time difference between sending and receiving cannot be measured.

The factors can be considered as follows.

- A great deal of air bubbles are contained in fluid.
- Air bubbles are deposited on the ultrasonic wave sending and receiving surface of the detector part.
- It is too high in viscosity of the fluid to measure.
- It exceed the flow range specified.
- There is no fluid in the tube interior of the detector part.
- Coaxial cable connector coming from the detector part has been removed.

10. Warranty

Warranty period: It 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 has occurred during the warranty period, we will repair or replace it free of charge. Provided that in the case of the following clauses they shall not be covered by warranty.

① In the case that it is used and handled in improper conditions and environment.
② In the case that it is due to the trouble caused by any product other than 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 for which we are not liable.

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

Warranty card for Ultrasonic flowmeter typed USF300C-G15/G20

Model		Serial No.	

Warranty period	**For One year**	**Date purchased** Year Month day	**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 card does not take effect at all until after the required items are filled out by dealer and customer.

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