

# Vortex Flow Meter Plug-In Installation Owner's Manual



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# 1.0 GENERAL INFORMATION

This manual will assist you in installing, using and maintaining your SURE vortex flow meter. It is your responsibility to make sure that all operators have access to adequate instructions about safe operating and maintenance procedure.



## Warning

For your safety, review the major warnings and cautions below before operating your equipment.

1. Use only fluids that are compatible with the housing material and wetted components of your meter.
2. When measuring flammable liquids, observe precautions against fire or explosion.
3. When handling hazardous liquids or gas, always follow the fluids manufacturer's safety precautions.
4. When working in hazardous environments, always exercise appropriate safety precautions.
5. During meter removal, fluids may spill. Follow the fluids manufacturer's safety precautions for clean up of minor spills.
6. When tightening the meter, use a wrench only on the wrench flats.
7. For best results, calibrate the meter at least 1 time per year.

## Product Description

LUCB series Vortex flow meters are designed for measuring the volume/mass flow of liquids, gases and steam based on Karman vortex principle.

Adopting advanced differential algorithm along with measurement of isolation, shielding and wave filtering, LUCB series vortex flow meters have the advantages of immunity on vibration and noise. Meanwhile, the liabilities of LUCB series vortex flow meters are well guaranteed by unique sensor packaging technology.

Upon receipt, examine your meter for visible damage. The meter is a precision measuring instrument and should be handled carefully. Remove the protective plugs and caps for a thorough inspection. If any items are damaged or missing, contact SURE.

Make sure the vortex flow model meets your specific needs. For your future reference, it might be useful to record this information on nameplate in the manual in case it becomes unreadable on the meter.

## 2.0 SPECIFICATIONS

### Accuracy:

Liquid:	±1.5% of reading
Gas:	±1.5% of reading
Vapor Stream:	±1.5% of reading

### Materials:

Housing:	Standard - 304 Stainless Steel
Shedder Bar:	1Cr18Ni9Ti
Converter housing and case cover:	Aluminum Alloy

### Output Signal: (Where applicable)

Sensor:	Pulse signal (Low Level: $\leq 1\text{V}$ ; High Level: $\geq 6\text{V}$ )
Transmitter:	4 to 20 mA DC current signal

**Signal Transmission Distance:**  $\leq 500\text{ m}$

**Electrical Connections:** ISO M20×1.5 Female

### Explosion Proof Level:

Standard:	ExdIIBT6
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**Protection Level:** IP65

**Vibration:**  $\leq 1.0\text{ g}$



## 3.0 OPERATION CONDITIONS

### Ambient:

Temperature:	-10°C to +55°C
Pressure:	86 to 106 KPa
Relative Humidity:	5% to 90%

### Power Supply:

Sensor:	+12V DC (Optional: +24V DC)
Transmitter:	+24V DC
Field Display Type:	Integral 3.2V Lithium Battery or +24V DC

### Fluid Temperature and Pressure:

Temperature:	Standard: -20°C to +70°C Optional: -20°C to +250°C; -20°C to +350°C
Pressure:	Fluid pressure should be limited according to flange rating.

### Measurable Flow Rate Range:

#### 3.1 For general liquid and gas: (See table 1)

Table 1. Measurable Flow Range for liquid and gas

Nominal Diameter		Liquid	Gas
(mm)	(in.)	Flow (m <sup>3</sup> /h)	Flow (m <sup>3</sup> /h)
250	10"	80-1150	1060-10600
300	12"	130-1400	1540-15400
400	16"	180-2700	2700-27000
500	20"	280-4200	4240-42400
600	24"	410-6100	6100-61000
700	28"	580-7300	7800-78000
800	32"	720-10800	10850-108500
900	36"	970-12000	13000-130000
1000	40"	1130-16900	17000-170000
1100	44"	1450-18000	19000-190000
1200	48"	1630-24400	24400-244000
1300	52"	2020-25300	27000-270000
1400	56"	2350-29500	31000-310000

*Note: The flow range for gas in table 1 is defined at Operating state.*

### 3.3 For Superheated Vapor:

1. Density: According to Table 3 (Density of Superheated Vapor) get the density at temperature and Absolute Pressure (Gage Pressure + 1)
2. Volume Flow: Calculating corresponding volume flow at given mass flow by the formula 1 below.

$$Q(m^3/h) = G(kg/h) / \rho(kg/m^3) \quad (\text{Formula 1})$$

*G: MassFlow;  $\rho$ : Density*

Table 3. Density of Superheated Vapor

Absolute Pressure (Mpa) \ Temperature (°C)	140	180	220	260	300	340	380	420	460
0.15	0.78	0.71	0.65	0.6	0.56	0.52	0.49	0.46	0.44
0.2	1.05	0.95	0.87	0.8	0.75	0.7	0.65	0.62	0.58
0.25	1.32	1.19	1.09	1	0.93	0.87	0.82	0.77	0.73
0.3	1.59	1.43	1.31	1.21	1.12	1.05	0.98	0.93	0.87
0.36	1.92	1.73	1.58	1.45	1.35	1.26	1.18	1.11	1.05
0.4		1.93	1.75	1.62	1.5	1.4	1.31	1.23	1.16
0.5		2.42	2.2	1.99	1.88	1.72	1.64	1.54	1.46
0.6		2.93	2.66	2.44	2.26	2.1	1.97	1.85	1.75
0.7		3.44	3.11	2.86	2.64	2.46	2.3	2.16	2.04
0.8		3.96	3.58	3.27	3.02	2.82	2.64	2.48	2.34
0.9		4.5	4.04	3.69	3.41	3.17	2.98	2.79	2.63
1.0		5.04	4.52	4.12	3.8	3.53	3.5	3.1	2.93
1.4			6.46	5.85	5.37	4.98	4.65	4.37	4.05
1.8			8.51	7.64	7	6.46	6.02	5.64	5.31
2.0			9.58	8.56	7.81	7.21	6.71	6.28	5.91
2.4				10.45	9.48	8.72	8.1	7.57	7.12
2.8				12.41	11.19	10.26	9.51	8.88	8.34
3.2				14.46	12.94	11.83	10.94	10.2	9.57
3.6				16.61	14.76	13.43	12.39	11.54	10.91

## 4.0 MODEL AND SELECTION

### Model

#### 4.1 Vortex Flow Sensor/Transmitter

LUCB-□N Type Sensor: 12 to 24V DC Power Supply; Pulse Output

LUCB-□A Type Transmitter: 24V DC Power Supply; 2-wire 4 to 20 mA Output

Basic Type (Without Explosion Proof) and Explosion Proof Type are optional for LUCB-□N and LUCB-□A.

#### 4.2 Intelligent Integrated Vortex Flow Meter (Refer to photo on page 1)

- ◆ 4 digital instantaneous flow display
- ◆ 8 digital totalizer flow display (Resettable)
- ◆ With Explosion Proof (Level: ExdIIBT6)
- ◆ 3-Point Correction and Non-linearity Compensation on K-Factor

*Note: The K-Factor represents the number of output pulses transmitted per cubic meter (Optional: Liter and Gallons) of fluid passing through the vortex meter. Each vortex has a unique K-Factor. However, vortex meters are not functionally consistent throughout the full flow range of the meter. Therefore, correction and non-linearity compensation on K-Factor can enhance accuracy.*

LUCB-□B Type: powered with 3.2V10AH lithium battery (Battery life = 4 years); no output

LUCB-□C Type: 24V DC Power Supply; 2-wire 4 to 20 mA Output (Optional: RS485)



## Model Selection (See Table 4)

Table 4. Model Selection Guidance

Model Suffix Code							Description
LUCB-	/□	/□	/□	/□	/□	/□	
Connection type	1						Simple Plug-in Type
	2						Plug-in with Ball Valve
Medium	Gas	1					
	Liquid	2					
	Vapor	3					
Nominal Diameter (Code)			02				250mm
			03				300mm
			04				400mm
			05				500mm
			06				600mm
			07				700mm
			08				800mm
			09				900mm
			10				1000mm
			11				1100mm
			12				1200mm
			13				1300mm
			14				1400mm
			15				1500mm
Structure Type				Z			Integrated type (Optional: N; A; B; C)
				F			Remote type (Optional: N; C)
Function Type				N			Basic Type: +12V to +24V DC Power Supply; Pulse Output
				A			4 to 20 mA current output
				B			Battery Power Supply with filed Display
				C			Field Display and 4 to 20 mA current output
				C1			Field Display and RS485
Explosion Rating					N		Standard type, none explosion-proof
					E		Explosion-proof, ExdIIBT6



## 5.0 CAUTIONS FOR INSTALLATION

### Mounting Positions

Vortex flow meters should be installed at the place in compliance with the requirements below:

- ◆ Easy maintenance
- ◆ No strong vibration
- ◆ No electromagnetic interface
- ◆ Away from heat source



**Warning:** Precaution for direct sunshine and rain when the meter is installed outside.

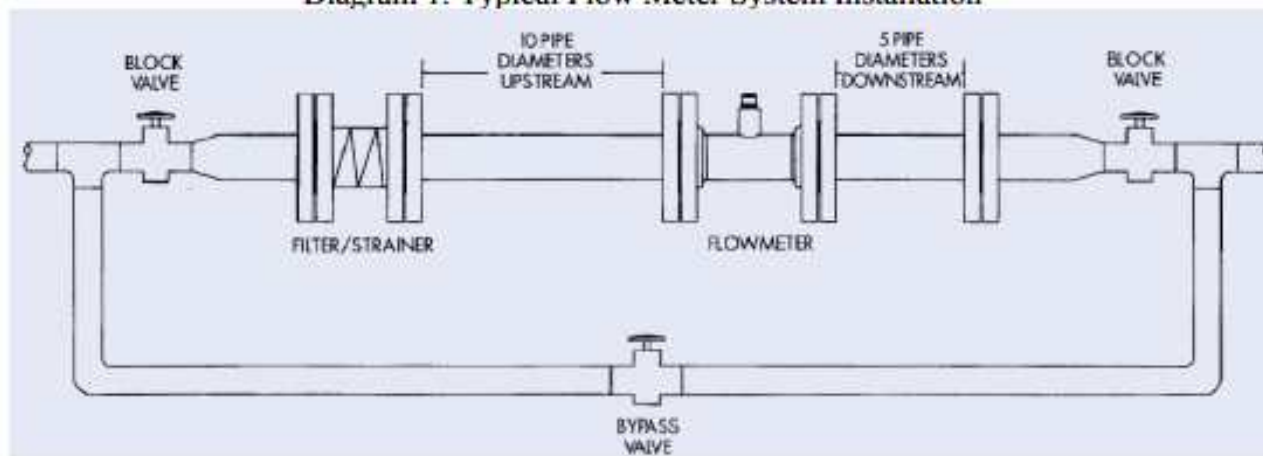
### Mounting Orientation

All SURE vortex flow meters are designed to measure flow in only one direction. The direction is indicated by the arrow on the body.

### Required Lengths of Straight Runs

Flow altering device such as elbows, valves and reducers can affect accuracy. See diagram 1 for typical flow meter system installation.

Diagram 1. Typical Flow Meter System Installation

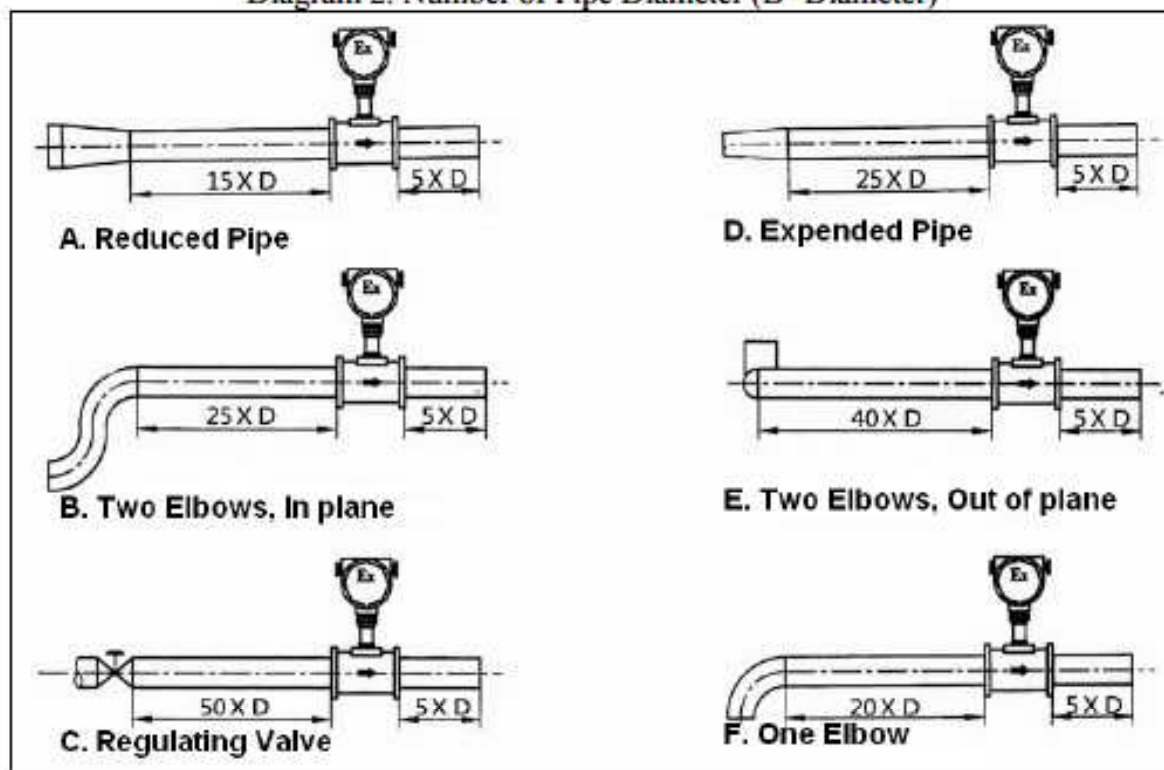


The recommended guidelines are given to enhance accuracy and maximize performance. Distance given here are minimum requirements; double them for desired straight pipe lengths.

- Upstream: allow a minimum straight pipe length at least 10 times the internal diameter of the pipe.
- Downstream: allow a minimum straight pipe length at least 5 times the internal diameter of the pipe.

See diagram 2 for straight pipe length requirement when there is altering device.

Diagram 2. Number of Pipe Diameter (D=Diameter)



### Anti-Cavitation (When the fluid is liquid)

Cavitation can be caused by entrained air, and it can seriously damage the shedder on a vortex flow meter. An amount higher than about 100 mg/l of entrained air or gas can produce error. In addition, cavitation can be caused by too little backpressure on the flow meter. For SURE vortex flow meters, you should provide a backpressure (downstream pressure) of at least 1.25 times the vapor pressure, plus 2 times the pressure drop through the flow meter. See formula 1.

$$P_b \geq 1.3 \times P_v + 2.7 \times (P_{in} - P_{out}) \quad (\text{Formula 2})$$

In formula 2: ( $P_b$ : Back pressure;  $P_v$ : Vapor Pressure;  $P_{in}$ : Inlet Pressure;  $P_{out}$ : Outlet Pressure)

Create backpressure by installing a control valve on the downstream side of the meter at the proper distance detailed above.



### Special Notice

- ◆ When the meter contains removable coverplates. Leave the coverplate installed unless accessory modules specify removal. Don't remove the coverplates when the meter is powered, or electrical shock and explosion hazard can be caused.

## **Recommendation Installation Procedure**

(1): Firstly, satisfy the installation requirements of straight pipe sections. Make a hole with diameter 100mm.

(2): The installation verticality of the flow transmitter on pipes should be no more than  $5^{\circ}$ .

(3): The installation requirements to the velocity measuring probe: when inserting the velocity measuring probe into pipelines, it needs to adjust the depth of insertion, to make the center of the velocity measuring probe fit with the central axis of the pipelines. The deviation should not exceed  $\pm 0.05D$  (D: Diameter of the pipeline).

(4): The included angle between the centre line of the velocity measuring probe and the axis of the pipelines should not exceed  $5^{\circ}$ .

(5).The mount point of the flow transmitter should be fixed on the position that meets the length requirements of the straight pipe sections; use  $\Phi 109 \times 4.5$  down pipe sections to weld with pipelines and no obvious inclination is found by visual assessment after the pedestal is welded.



## 6.0 ELECTRICAL WIRING






### **Warning: Electrical Hazard**

Disconnect power before beginning installation.

### **Vortex Flow Sensor/Transmitter (Type: LUCB-□N, LUCB-□A)**

- ◆ Basic Type: LUCB-□N (See Table 6)

Table 6. Terminal wiring for LUCB-□N

Terminal Symbols	Description
Red Wire 	Power Supply: "24V+"
White Wire 	Power Supply: "24V-"
Yellow Wire 	Pulse Output

- ◆ Explosion Proof Type: LUCB-□N & LUCB-□A (See Figure 2)

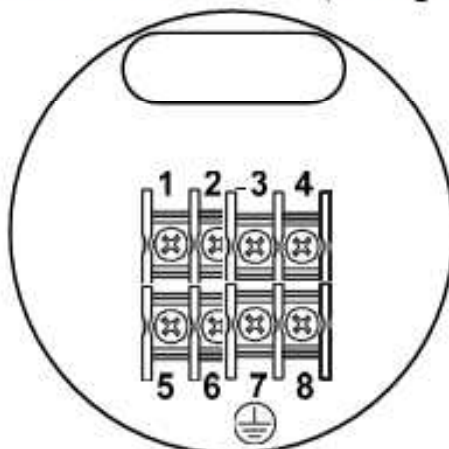


Figure 2. Terminal Configuration LUCB-□N & LUCB-□A

Table 7. Terminal wiring for LUCB-□N & LUCB-□A

Terminal Symbols	LUCB-□N	LUCB-□A
2	Power Supply: "24V+"	Power Supply: "24V+" (4-20mA + )
3	Power Supply: "24V-"	Power Supply: "24V-" (4-20mA - )
6	Pulse Output	
7	Connect shielded wire	Connect shielded cable

*Note: Terminal 1, 4, 5, 8 is unused.*

## Intelligent integrated Vortex Flow Meter (Type: LUCB-□C)

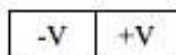


Figure 3. Terminal Wiring for LUCB-□C

Table 8. Terminal wiring for LUCB-□C

Function (Optional)	Terminal Symbols	Description
(2 wires) 4 to 20 mA Output	V+: 24V	Current Output 4 to 20 mA DC (+)
	V-: GND	Current Output 4 to 20 mA DC (-)

## 7.0 OPERATION AND SETUP

### Basic Type: LUCB-□N Vortex Flow Sensor

The sensor has been calibrated and qualified prior to leave the plant. Connections between this sensor and secondary instrument: At first check whether the sensor's output characters (pulse's frequency, amplitude and width) can match secondary instrument's input characters. Set secondary instrument's parameter according to sensor's K-Factor.

### A Type: LUCB-□A Vortex Flow Transmitter

According to customer's requirement, the current output for zero and full-scale flow has been adjusted prior to leave the plant.

### B Type: LUCB-□B Intelligent Vortex Flow Meter

Parameter Setup: (Authorized Engineer only)



**Warning:** Don't change the parameter unless get the approval from distributor or SURE company. Even minor change on parameter can affect accuracy.

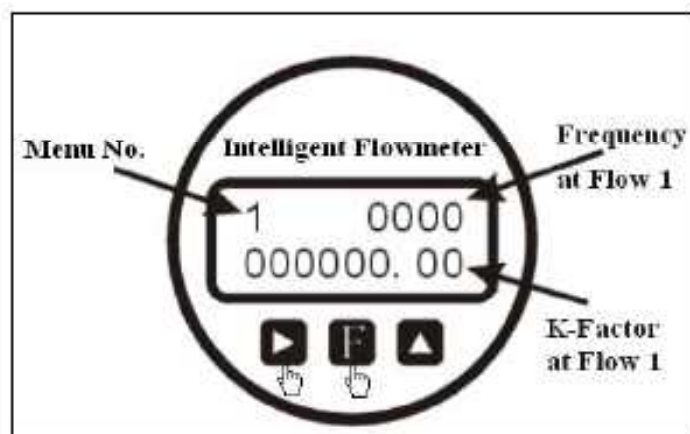


Figure 4. Enter Parameter Setup

To enter parameter setup, press and hold the and buttons until the display changes.

Press to change cursor position: cursor-right

Press to change value

Press to advance to next menu.

Press and hold to exit and save setting.

To reset totalizer flow, at Operating state press and hold





## C Type: LUCB-□C Intelligent Vortex Flow Meter (4 to 20 mA output)

### C1. Meter display panel

XXXXXXXXXXXX.XXm <sup>3</sup>
XXXXX.XXm <sup>3</sup> /h
T= XXX.X °C
P= XXXXX.XXkPa

Main LCD

The first line: Cumulant (Total Flow); 2 decimal display and automatic carry of decimal points. The unit comes in line with the non-time-part of instantaneous flow rate unit; the second line: instantaneous flow rate; reserve 2 decimals and the flow unit is presented in Menu Setup; the third line: the measured value of the temperature, which reserves 1 decimal display; the fourth line: the measured value of the pressure, which reserves 2 decimal display.

F=XXXX.XX Hz
I= XX.XX mA
Password: oo

Subsidiary LCD

The first line: Flow frequency signal; the second line: output current display; the third line: password entering set state. Type the password with the adding one key of “+” and the shift key of “<”; press the enter key of “E” to enter the set state of user parameter.

### C2. Menu operation

“S” — Selection key: In working status, it is used for the switches among different display screens. In the state of setup, it is used for selecting set parameters.

“+” — Adding key: In the state of setup, pressing the key can add 1 to the current flicker bit.

“<” — Shift key: In the state of setup, press the key to make the flicker bit shift one bit to the left.

“E” — Enter key: In the state of setup, press the key to store the input data into EEPROM and the mouse pointer returns to the rightmost.

Note: In parameter settings, the display contents can be stored only by pressing the enter key of “E”, or else, the setting is null.

### C3. Menu settings

Menu Display	Options and Range of Values
Flow Unit Selection	0: m <sup>3</sup> /h 1: m <sup>3</sup> /m 2:l/h 3:l/m 4:t/h 5:t/m 6:kg/h 7:kg/m
Multi-segment Broken Lines	Choose "Y" to make linear corrections to the meters and set corresponding parameters at the position setting the options of the correction coefficients of the gases (liquids) broken lines.
Algorithm Selection	01: Volume flow of conventional liquids 02: Liquid volume of temperature compensation 03: Volume flow of conventional gases 04: Gas volume of compression coefficient 05: Volume flow of thermal-pressure coefficient 06: Conventional mass flow 07: Mass flow of temperature compensation 08: Mass flow of compression coefficient 09: Mass flow of multi-segment broken lines 10: Temperature compensation of saturated steam 11: Pressure compensation of saturated steam 12: Temperature and pressure compensation of overheated steam
Broken Line Gas-Liquid Selection	When selecting gas or liquid corrections, set corresponding parameters at the position setting the options of the correction coefficients of the gases (liquids) broken lines.
Flow Coefficient	Set the meter coefficient with the unit of P/m <sup>3</sup>
Maximum Output Flow	When the meter outputs current signals, it needs to set the value and the value cannot be zero.
Platinum Resistance Selection	Select the platinum resistance of 0-Pt100 and 1-Pt1000
F(n)= 0000.00Hz Broken Line Correction F(n)= 0000.00Hz	Set the correction coefficients of the gases (liquids) broken lines.
d=1.00kg/m <sup>3</sup> Setting Density d=1.00kg/m <sup>3</sup>	Density setting
Reset Cumulant Y-Yes, N-No	Reset Cumulant (Total Flow)
Maximum Pressure: PMax	Set the upper limit value of the pressure
PMin 0000.00 kPa Minimum Pressure PMin 0000.00 kPa	Set the minimum value of the pressure
Freq out F=0100.00 Hz	Set the frequency output value (three-wire system)
D= S 02.00 Damping Time D=S 02.00	Set the damping time of the output value (for two-wire system only)
RS485 Communication No.	RS485 Communication No. ((for three-wire system only)
HARTADD 00 Set HARTADD 00	HART address (for two-wire system only)
Qmin% 0. 00 Minimum Output Flow Qmin% 0. 00	Set the flow lower limit of the percentage
Reset Password	Reset Password



## c4. Calibration settings

It needs to get special password from the supplier to enter the state of production settings. You can quit from the state when the system is powered down or reset.

Order	Screen Display	Definition	Remarks
H1	Init DATA 0	Initialize the setting data to coarse value: 0 refers to prohibition, 1 refers to permission.	The prohibition is "1" after delivery.
H2	Battery About 1100	Measure the battery pressure.	Only VT3W has.
H3	TPOFF=0 TPON=1	TPOFF=0 without temperature and pressure display TPON=1 with temperature and pressure display	Temperature and pressure settings can involve in the calculation.
H4	1000Ω 约 02300 1000Ω About 02300	Resistance value when it is labeled Pt1000	JSK disconnects and 1000Ω standard resistance is added between +TR and TR-.
H5	100Ω 约 02300 100Ω About 02300	Resistance value when it is labeled Pt100	JSK disconnects and 100Ω standard resistance is added between +TR and TR-.
H6	PMax >01000	Label maximum pressure channel	Silicon piezo-resistances of JRL and JRH disconnect and are in short circuit.
H7	PMin <00100	Label minimum pressure channel	Silicon piezo-resistances of JRL and JRH disconnect and are in short circuit.
H8	20mA About 03200	Set the parameter with the output current of 20mA	The output is 20mA after changing the parameter.
H9	16mA About 02500	Set the parameter with the output current of 16mA	The output is 16mA after changing the parameter.
H10	12mA About 01800	Set the parameter with the output current of 12mA	The output is 12mA after changing the parameter.
H11	8mA About 01200	Set the parameter with the output current of 8mA	The output is 8mA after changing the parameter.
H12	4mA About 00600	Set the parameter with the output current of 4mA	The output is 4mA after changing the parameter.
H13	Patm=0 P0=1 0	Set the pressure input type 0=gauge pressure; 1=absolute pressure	Use the keys of "+", " ", "E"
H14	Non=0 Adj=1 0	=0 pulse output without compensation =1 pulse output with real-time compensation	Only VT3W has.
H15	Tc ≡ ℃ 0000.0	When outranging, the temperature constant is displayed.	Used for setting constant value temperature
H16	Pc ≡ kPa 00000.00	When outranging, the pressure constant is displayed.	Used for setting constant value pressure



## 8.0 TROUBLESHOOTING

Symptom	Probable Cause	Solution
Measurement is not accurate	1. Parameter wrong 2. Pipe is not fully filled	Check the parameters (Transmitter, detector factor and size) Check if meter is fully filled
Flow rate indication is unstable	1. Vibration Problem 2. Air 3. Amplifier location – outside electrical interference	Add support to the line near the meter to damp the vibration Make sure fluid does not contain air bubbles Make sure amplifier is not too close to sources of electrical interference
No Display	1. No power 2. Incorrect power 3. Wiring connections	Apply correct power Check power value Check power input/output connections

## **Limited Warranty Policy**

SURE hereby provides a limited warranty against defects in materials and workmanship. This product includes a 1-year warranty. The warranty period shall begin on the date of the original new equipment purchase. Warrantor's obligation hereunder shall be limited to repairing defective workmanship or replacing or repairing any defective parts.

In the event Purchaser believes the SURE product is defective, the product must be returned to SURE, transportation prepaid by Purchaser, within the appropriate warranty period relative to the product. If SURE's inspection determines the workmanship or materials are defective and the required maintenance has been performed and, has been properly installed and operated, the product will be either repaired or replaced, at SURE's sole determination, free of additional charge, and the goods will be returned, transportation paid by SURE, using a transportation method selected by SURE.

Prior to returning the product to SURE, Purchaser must obtain a Returned Material Authorization (RMA) Number from SURE's Customer Service Department within 30 days after discovery of a purported breach of warranty, but not later than the warranty period; otherwise, such claims shall be deemed waived.

If SURE's inspection reveals the SURE product to be free of defects in material and workmanship or such inspection reveals the goods were improperly used, improperly installed, and/or improperly selected for service intended, SURE will notify the purchaser in writing and will deliver the goods back to Purchaser upon receipt of Purchaser's written instructions and agreement to pay the cost of transportation. If Purchaser does not respond within thirty (30) days after notice from SURE, the goods will be disposed of in SURE's discretion.

SURE does not warrant the product to meet the requirements of any safety code or other jurisdiction, and Purchaser assumes all risk and liability whatsoever resulting from the use thereof, whether used singly or in combination with other machines or apparatus.

This warranty shall not apply to any SURE product or parts thereof, which have been repaired outside SURE's factory or altered in any way, or have been subject to misuse, negligence, or accident, or have not been operated in accordance with SURE's printed instructions or have been operated under conditions more severe than, or otherwise exceeding, those set in the specifications.

FOR NON-WARRANTY REPAIRS OR CALIBRATIONS, consult SURE for current repair/calibration charges. Have the following information available BEFORE contacting SURE:

1. P.O. number to cover the COST of the repair/calibration,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.