SSK521 Insertion Electromagnetic Flowmeter

SSK521 插入式电磁流量计

User Manual

Installation & Operation Manual

SSK521UM-C01 Rev. D

Jilin SSK Electrical Measure & Control Tech. Co., Ltd.

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This document has been prepared and checked with great care. If however it still contains errors, then the user is asked to report these to Jilin SSK.

Installation and User Manual

1 Application and Features

1.1 Introduction and Application

The Insertion Electromagnetic Flowmeter (referred to as "sensor") is used in conjunction with our company's intelligent electromagnetic flow converter and display to form the Insertion Electromagnetic Flowmeter.
The Insertion Electromagnetic Flowmeter is divided into integrated and split types, with the sensor installed at the position on the pipeline where detection is required. The converter and display are installed on the nearby wall, in a bracket-equipped instrument box, or between the instrument and control, with the two connected as a split type using dedicated cables at the sensor's junction box. The integrated converter and display are directly installed at the upper end of the sensor.
The Insertion Electromagnetic Flowmeter is used to measure the flow and total quantity of various conductive liquids in various processes such as industrial, agricultural, water conservancy, environmental sewage monitoring, and urban water supply.

1.2 Features

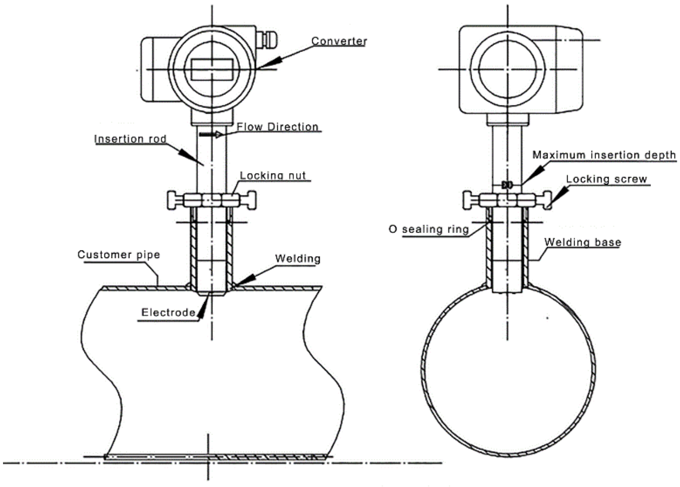
The Insertion Electromagnetic Flowmeter combines the characteristics of a pipeline-type electromagnetic flowmeter and an insertion flowmeter, with the following features:

- Measurement unaffected by changes in fluid density, viscosity, temperature, pressure, and conductivity.
- Utilizes advanced excitation technology, low power consumption, stable zero-point, strong anti-interference ability, and good reliability.
- No additional pressure loss, with a requirement for a small straight pipe length.
- Wide flow measurement range, with the full range flow velocity continuously set between 1.0m/s and 10.0m/s, and the output signal being in complete linear relationship with the flow (velocity).
- The converter and display utilize a 16-bit high-performance microprocessor, with a 2×16 LCD display, convenient parameter setting, and reliable programming.
- The flowmeter is a bidirectional measurement system, with three accumulators that can separately display: forward flow, reverse flow, and the total quantity of the difference between forward and reverse flow.
- The converter and display offer multiple output options: current, pulse, 485 digital communications, (HART optional), and four-channel relay alarm output.
- Suitable for large diameter pipes, DN150～1200mm.
- The sensor body and electrodes have multiple material options.
- Small volume, light weight, convenient transportation, and installation, allowing for continuous flow maintenance and disassembly.
- Cost-effective, with higher performance-to-price ratio for larger pipe diameters.

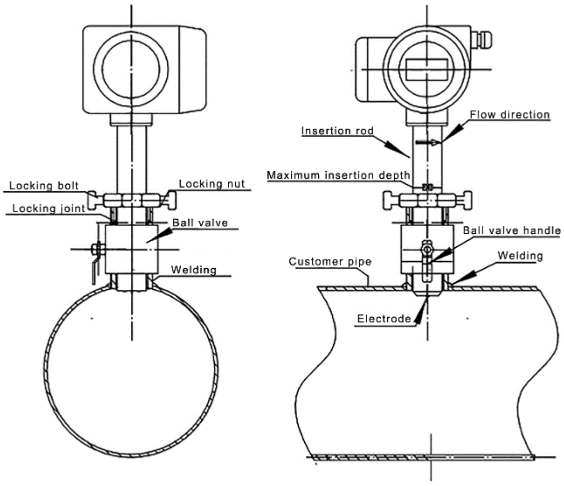
2 Structure and Working Principle

2.1 Structure

Figures (1) and (2) are simplified diagrams of the two types of sensor structures.
The upper end is a junction box, which connected with a special cable and an electromagnetic flow conversion display to form a split electromagnetic flowmeter; If the junction box is replaced by the electromagnetic flow conversion display, the integrated electromagnetic flowmeter is formed. (Not shown in the figure)



(1) Installation diagram without a ball valve



(2) Installation diagram with a ball valve

As shown in the figure, the sensor consists of the following main parts or components.

- Detection head: includes electrodes, excitation coils, iron cores, and leads, with the shell made of polysulfone or F4.
- Insertion rod: connects the detection head to the converter, made of 304 or 316 stainless steels.
- Installation parts: (graduated tube) 304 or 316 stainless steel pipes, welded on user's pipe during installation. Note that the inner diameter of the pipe shall correspond to the DN value on the graduated tube wall when welding the graduated tube, and the graduated line shall be aligned with the inner wall of the pipe. See the graduated tube diagram for details.
- Valve or (nipple): 11/2″ stainless steel ball valve or (nipple) is used to take out or install the sensor under continuous flow (the working pressure shall be less than 0.2MPa).
- Sealing and locking mechanism: including transition piece, compression nut and special sealing rubber ring.

2.2 Working Principle

The working principle is based on Faraday's law of electromagnetic induction, similar the pipeline-type electromagnetic flowmeter. When a conductive liquid passes through at an average flow velocity V and perpendicular to the magnetic field strength B magnetic force lines between two electrodes at a distance L, an electromotive force E is generated at the electrodes. Faraday's law of electromagnetic induction is:

$E=B\times L\times V$ --(1)

The volume flow rate of the fluid flowing through the pipeline is:

$Q_V=\frac{\pi}{4}D^2V$ --(2)

Since the sensor size has been determined, and the pipeline diameter is known, the calibrated sensor volume flow rate Q is directly proportional to the electromotive force E:

$Q_V=K\times E$ --(3)

Where:

The meter factor $K=\frac{\pi D^2}{4\cdot B\cdot L}$, the factor K is obtained from the factory calibration and is already set according to the user's requirements. This parameter is entered into the converter and display. It cannot be arbitrarily changed by the user.

In the above equations:

B: Excitation coil magnetic induction strength

L: Distance between the two electrodes (24mm for this device)

V: Average flow velocity

Q_v: Volume flow rate of the measured fluid

Therefore, if the electromotive force E is measured, the volume flow rate Q_v in the pipeline can be determined.

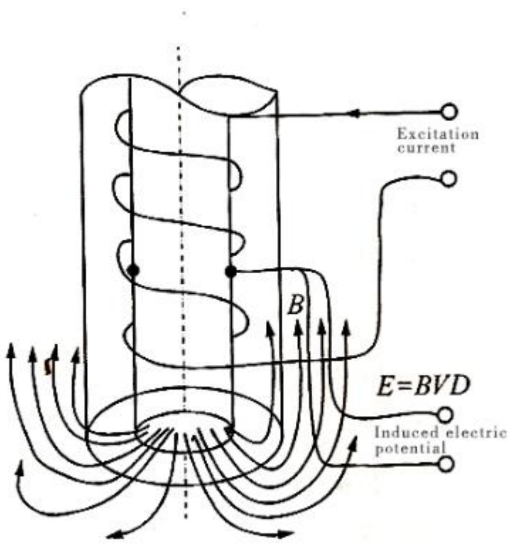


Figure (3) Schematic diagram of working principle

3 Main Technical Parameters and Performance

3.1 Applicable nominal diameter of flow pipeline: DN150~3000mm.
3.2 Working pressure: ≤1.6MPa.
3.3 Operating temperature: ≤70℃.
3.4 Upper limit range of flow velocity: continuously adjustable within 1~10m/s
3.5 Measurement accuracy: ±2.5%
The conductivity of the measured medium is ≥50μs/cm.
3.7 Electrode materials: 316, 316L, Hastelloy, titanium (Ti), etc.
3.8 The maximum distance between the split type and the conversion display is ≤50m.
3.9 Split cable: RVVP type dual-core shielded cable or STT3200 type four-core three-shielded cable.

4 Installation - insertion and removal

Note: As the pressure inside the pipeline exerts an outward thrust on the detection rod, for safety reasons, it is best to install the pipeline under non-pressure conditions.

If the shutdown is not allowed, it is recommended to temporarily reduce the pipeline pressure to ≤0.2MPa during installation.

4.1 Preparation before installation:

After receiving the instrument, users should do the following two things in advance:

4.1.1 Installation work can only be carried out after verification and confirmation of the supply of goods. If any inconsistencies are found in the supply of goods, please contact our company in a timely manner to resolve them.

4.1.2 Please follow the following procedure steps for installation.

Unscrew and pull out the detection rod from the welding base according to Figure (I) and (II). Note that the lock nut and the sealing rubber ring cannot be separated from the detection rod and the sealing ring shall be protected.

4.2 Installation - Insertion

4.2.1 The user pipeline should be set horizontally, requiring at least **5 times** DN length of straight pipe before the sensor and at least **3 times** DN length of straight pipe after the sensor. The flow regulating valve should be located beyond **3 times** DN length downstream of the sensor.

The user's pipeline should have no obvious vibration and the inner wall of the pipeline should have no obvious unevenness.

4.2.2 First, a Φ60-62mm hole is opened directly above the pipeline measurement point, and the circular hole is required to have a smooth edge, free of burrs, gas cutting scars, and so on.

4.2.3 Screw the mounting parts off the sensor and weld them securely at the above-mentioned openings. Requirements:

A. As shown in Figure (1), make the lower end of the installation piece flush with the inner surface of the pipeline;

B. Ensure no leakage, do not install at the bottom (easy to have sediment) and top (easy to have bubbles), it is best to install at a 45-degree angle perpendicular to the pipeline.

4.2.4 Loosen the four locking screws on the lock nut to ensure that the detection rod and the detection head are not separated and check the sealing ring for later installation. (Note: Users must not open the connection between the detection head and the detection rod!)

4.2.5 For ball valves, tighten the ball valve, seal, and locking mechanism together.

4.2.6 Insert the detection rod slowly from above, tighten the lock nut slightly, and press the insertion rod down to 1/8 to record the size. The installation is complete.

4.3 Installation - Removal

4.3.1 First loosen the four set screws on the side of the lock nut, and then back out the lock nut by 1-4 threads to loosen the sealing ring and facilitate the removal of the insertion rod.

4.3.2 Lift the handle to remove the insertion rod by about 250mm and close the ball valve to remove the rod. (If the ball valve is not included, the rod can be removed only when there is no pressure in the pipeline.)

5 Adjustment

5.1 Insertion depth

5.1.1 When the selection electrode is inserted at the average flow velocity point, insert the handle detection rod into the END scale line of the pipeline according to the average flow velocity point at the distance of H1=0.125D from the pipe wall (D: inner diameter of the pipeline) under the turbulent flow condition of the pipeline. (At this time, the measurement electrode is located at the 0.125 inner diameter of the pipeline.)

5.1.2 After confirming the insertion depth is correct, rotate the detection rod so that the fluid direction arrow on the detection rod is aligned with the fluid direction and parallel to the center line of the pipeline. At this point, the connection line between the two electrodes will be perpendicular to the center line of the pipeline, meaning that the connection line between the electrodes is perpendicular to the fluid stream.

5.13 After adjustment, first tighten the lock nut and then tighten the four lock screws. Their function is to ensure that the insertion rod is not pushed out by the pressure inside the tube, and to ensure that the insertion rod does not vibrate and shift position.

Note: When tightening the first two screws (corresponding), do not apply any force if you have contacted the insertion rod. Only tighten the third and fourth screws as much as possible, and then tighten all four locking screws separately!

5.1.4 When the selection electrode is inserted into the center of the pipeline (here is the maximum flow rate!), the depth of depression H=0.5D. Other work is the same as the above

6 Before operation

6.1 About composition

Composition: The inserted electromagnetic flowmeter must be combined with an electromagnetic flow conversion display to form an electromagnetic flowmeter to achieve and complete the flow measurement task.

When ordering the SSK521 type insertion electromagnetic flowmeter from our company, users should also order the electromagnetic flow converter together.

The SSK521 insertion electromagnetic flowmeter, like the pipeline electromagnetic flowmeter, requires a straight pipe section with an upstream length greater than **10 times** DN length and a downstream length of 5 **times** DN length, as well as a suitable location to ensure that the measured liquid fills the pipeline. Please refer to technical regulations such as straight pipe sections and installation locations for electromagnetic flowmeters.

6.2 About upper flow limit

Since the insertion electromagnetic flowmeter can only be calibrated for flow accuracy in a fixed water flow pipeline (our company is in a pipeline with an inner diameter of DN=400mm) when it is shipped from the factory, and the user's pipeline may not be the same, there is a problem with how to determine the upper flow limit. Therefore, users are requested to first understand the following table, which compares several common pipeline inner diameters, average flow rates (m/s), and volumetric flow rates (m^3/h).

DN (mm)	0.5 (m/s)	1.0 (m/s)	1.5 (m/s)	2.0 (m/s)	2.5 (m/s)	3.0 (m/s)
300	127.2	254.4	381.6	508.8	636.0	763.2
350	173.1	346.2	519.3	692.4	865.5	1038.6
400	226.1	452.2	678.3	904.4	1130.5	1356.6
450	286.2	572.3	858.3	1144.6	1430.8	2574.9
500	353.3	706.5	1059.8	1413.2	1766.5	2119.8
600	508.7	1017.0	1526.0	2034.0	2544.0	3052.0
700	682.4	1385.0	2047.0	2730.0	3412.0	4094.0
800	904.3	1808.0	2713.0	3617.0	4522.0	5126.0
900	1145.0	2290.0	3435.0	4580.0	5725.0	6870.0
1000	1413.0	2826.0	4239.0	5652.0	7065.0	8478.0
1200	2034.0	4068.0	6102.0	8136.0	10170.0	
1400	2770.0	5540.0	8310.0	11080.0	13850.0	

6.3 About parameters correction before use

When the user places the electrode of the insertion electromagnetic flowmeter at the average flow velocity of the pipeline, the user can correctly set the flow rate, flow velocity, and other parameters based on the above table, the company's factory calibration sheet, the inner diameter size of the pipeline being measured, and the functions and usage instructions of the electromagnetic flow converter. After that, the insertion electromagnetic flowmeter can be put into use. (Generally, the parameters of the flowmeter have been set according to the parameters provided by the user before the flowmeter leaves the factory.)

6.4 About Maximum flow velocity and average flow velocity

When the user places the electrode of the insertion electromagnetic flowmeter at the centerline of the pipeline, the electrode detects the maximum flow velocity V_{max} of the pipeline. Therefore, the maximum flow velocity must be converted to the average flow velocity V_{cp}. Under turbulent flow conditions in a circular pipeline, the relationship between the two is as follows:

$V_{cp}=K_1V_{max}$ -- (4)

Where, $K_1<1$ is a coefficient related to the fluid Reynolds number R_{eD}, and its value is:

$K_1=\frac{2n^2}{(n+1)(2n-1)}$ -- (5)

and $n=1.66\lg R_{eD}$

$R_{eD}=354\times\frac{Q_m}{u\cdot D}$ -- (6)

Where: Q_m- mass flow rate of the measured liquid (kg/h)

μ- dynamic viscosity of the liquid being measured (mPa.s)

D-inner diameter of the pipe (mm)

As can be seen from equation (4), when the user places the electrodes of the insertion electromagnetic flowmeter at the centerline of the pipeline, without correction, the flow rate (i.e., flow) value displayed by the electromagnetic flow conversion display is 1/K1 times greater than the correct average flow rate (i.e., flow) value. User must understand and correctly correct this when setting parameters.

The correction method is to reduce the instrument factor by K1 times. (If it has been corrected before leaving the factory as mentioned above)

It is for this reason that it is desirable for users to place the electrodes of the insertion electromagnetic flowmeter at the average flow velocity of the pipeline.

6.5 About the blocking coefficient β

The definition of the blockage coefficient β is: the depth of the detection rod of the insertion electromagnetic flowmeter inserted into the pipeline (i.e. 0.125D or 0.5D) is the ratio of the projected area along the fluid flow direction to the cross-sectional area of the pipeline. That is:

$\beta 0.125D=\frac{4\times47\times0.125D}{\pi D^2}$ -- (electrode at 0.125D, i.e. average flow velocity)

or $\beta 0.5D=\frac{4\times47\times0.5D}{\pi D^2}$ --(electrode at 0.5D, i.e. at the center of the pipeline)

Due to the decrease in flow area and increase in average flow velocity caused by the insertion of this section of rod, it should be corrected based on the value of β during application. According to some data and experimental instructions, when $\beta\leq0.015$, no correction is necessary and there is no discernible impact on measurement accuracy.

When DN300, β0.125D = 0.026; when DN350, β0.125D = 0.021

When DN400, β0.125D = 0.018; when DN450, β0.125D = 0.015

Therefore, in this case, only the correction applied to DN300 and DN350 pipelines should be made. DN400 is a factory-verified pipeline from our company, and the correction has already been made.

After calculation, when DN=600mm, β0.5= 0.049＞0.015, which means that the correction must be made. The correction method is also to correct the instrument coefficient at the factory. To eliminate this

correction and shorten the length of the insertion rod, we recommend placing the electrode at the average flow velocity of the pipeline.
This is another reason why it is recommended that users place the electrodes of the insertion electromagnetic flowmeter at the average flow velocity of the pipeline.

7 Quality Assurance

All products supplied by our company are subject to company guarantees, which means that within 12 months from the date of shipment, if the instrument cannot work properly due to poor manufacturing or substandard components, our company is responsible for free repair or replacement of parts, components, and even the entire machine.

8 Transportation, acceptance, and storage

8.1 Transportation and receiving

The insertion electromagnetic flowmeters and electromagnetic flow conversion displays supplied by the company are all packed in wooden cases for moisture and shock protection, and are shipped by railway or highway.
When receiving the goods, the user should first check whether the packaging box is intact. If any damage is found, the user should negotiate with the carrier and contact our company for claims and handling.

8.2 Acceptance

After receiving the intact instrument packing box, the user should immediately unpack the box for inspection and acceptance. Check whether the instrument and the random documents in the packing box are consistent with the packing list. If there is any problem, contact our company within 15 working days.

8.3 Storage

After the user has inspected the goods and documents, the original packaging state should be restored. Instruments that are not temporarily installed or after maintenance should be stored indoors with the following conditions: rain and moisture protection; low mechanical vibration; temperature range: -20~+60℃, relative humidity not exceeding 80%.

9 Ordering Instructions

When ordering the insertion electromagnetic flowmeter from our company, users should be clear about:
1. Internal diameter size or pipe specification: external diameter × wall thickness
2. Pipe material (if it is cast iron or non-metal, additional design and installation parts should be provided)
3. Pressure and temperature in the pipeline
4. Name and cleanliness of the fluid being tested, and its corrosivity
5. On-site protection requirements (IP65) or (IP68)
6. The length of the separately ordered cable for the split type (IP68)

10 Electrical connections

To ensure the safe operation of the instrument, the following precautions must be strictly observed!

- Only soft cables can be used in the two M20×1.5 cable sleeves. Tighten the cable sleeve nuts to ensure good sealing.
- Two different cables are used for power and signal output, and they cannot be installed in the same steel pipe.

- Prevent rainwater from entering the conduit, which can cause the insulation strength of the wire to decrease due to moisture.

There should be no condensation or frost inside the terminal box, as this will reduce the insulation strength of the excitation coil.

All output and power cords are provided by the user according to the actual situation, but please note that the load current requirements must be met.

10.1 Power supply

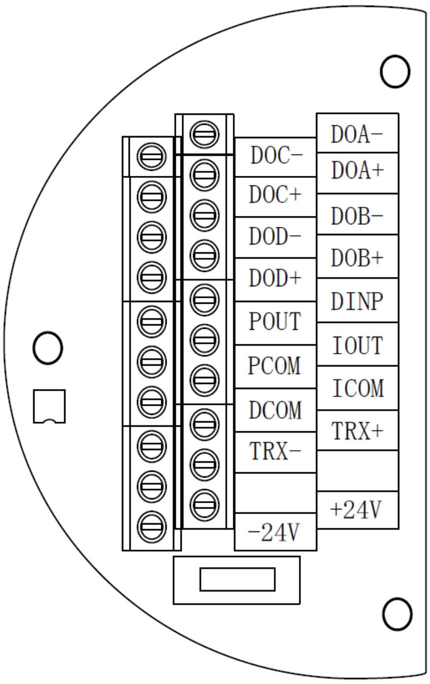
- It is forbidden to install the instrument under the power-on state.
- It is necessary to comply with relevant national regulations.
- Before energizing, carefully check the parameters (power supply and frequency) on the nameplate.

There are two power supplies for the SSK521 insertion electromagnetic flowmeter: an AC high-frequency switching power supply with a voltage range of 85VAC to 250VAC, and a DC 24V switching power supply with a voltage range of 16VDC to 36VDC. Users can choose the required power supply when ordering. The wiring details are shown in Figure (4) Wiring Terminal Diagram.

10.2 Integrated instrument wiring:

- Unscrew the side cover of the converter housing. Thread the power cable and signal cable through the two cables glands into the instrument junction box.
- Connect the wires according to the wiring method shown in Figure 12.
- After wiring, re-cover the side cover of the junction box and tighten the screws to ensure sealing.

10.3 Instrument terminal wiring diagram:



DOC-	Alarm Output C-
DOC+	Alarm Output C+
DOD-	Alarm Output D-
DOD+	Alarm Output D+
POUT	Freq./Pulse Output +
PCOM	Freq./Pulse Output -
DCOM	Empty
TRX-	Communication -
24V-	Power Input
DOA-	Alarm Output A-
DOA+	Alarm Output A+
DOB-	Alarm Output B-
DOB+	Alarm Output B+
DINP	Empty
IOUT	Current Output +
ICOM	Current Output -
TRX+	Communication +
24V+	Power Input

Figure (4) Wiring Terminal Diagram. Symbols and Description of Connectors in Circinal Pane

10.4 Grounding

Contact area of copper Connector PE on Converter Cabinet for grounding should be larger than 1.6mm^2. Contact resistance should be less than 10Ω.

11. Operation and calibration

After connecting the SSK521 insertion electromagnetic flowmeter converter and sensor to the liquid pipeline (whether for calibration or use), the following steps should be taken first:

- Connect the pipes before and after the sensor with copper wire firmly.
- Ground the sensor well.

When adjusting the zero point of the instrument, ensure that the liquid is filled in the pipeline and is in a static state.

- Ensure stable generation of the sensor electrode oxide film (48 hours of continuous contact between the electrode and the fluid is sufficient). After the instrument is powered on, it automatically enters the measurement state. In the automatic measurement state, the instrument automatically completes various measurement functions and displays the corresponding measurement data. In the parameter setting state, the user uses the three panel keys (see Figure 5) to complete the instrument parameter settings.

11.1 Key functions

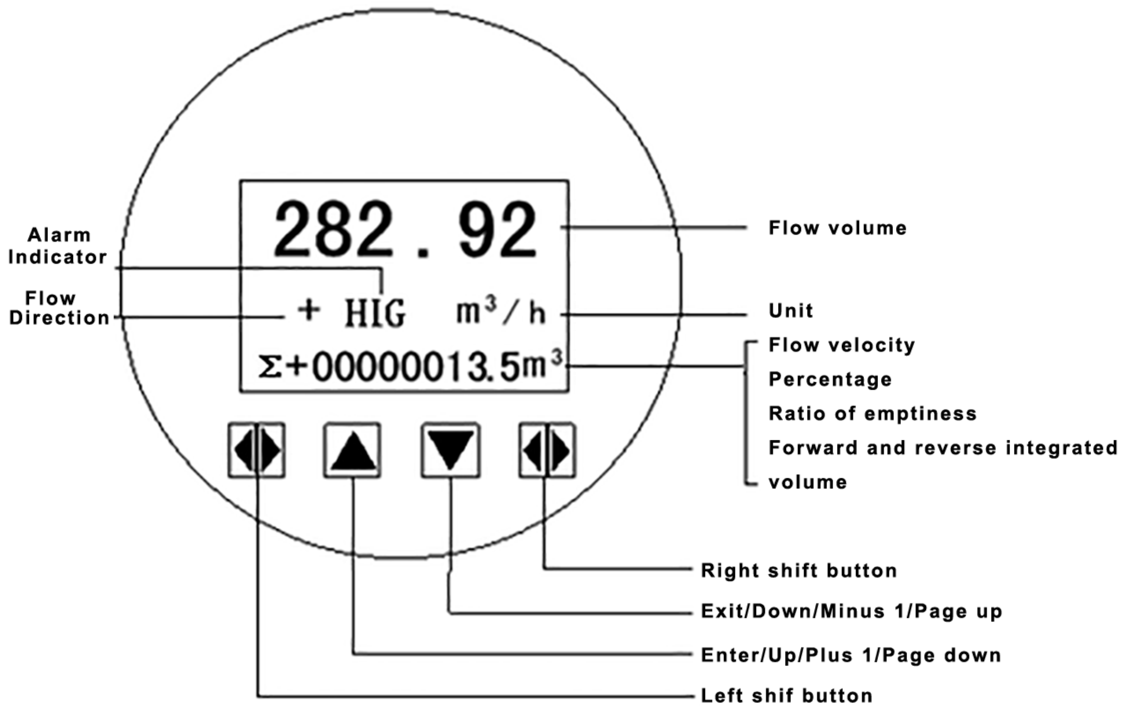


Figure (5) Keys on the panel and big LCD display

Note: When the instrument is powered on, it automatically enters the measurement state. In the automatic measurement state, the instrument automatically completes various measurement functions and displays the corresponding measurement data. To set or modify the instrument parameters, the instrument must be brought from the measurement state to the parameter setting state. In the parameter setting state, the user uses the panel keys to complete the instrument parameter settings.

11.2 Key Function and Remote Controller Function

11.2.1 Key functions in automatic measurement state

Down key: Selecting displayed data on lower line in turn.

Right shift key: Press the right shift key to enter the password screen. After entering the password, you can enter the parameter setting state.

11.2.2 Function keys for parameters setting

Down key: decrement the number by 1 at the cursor and turn the page forward;

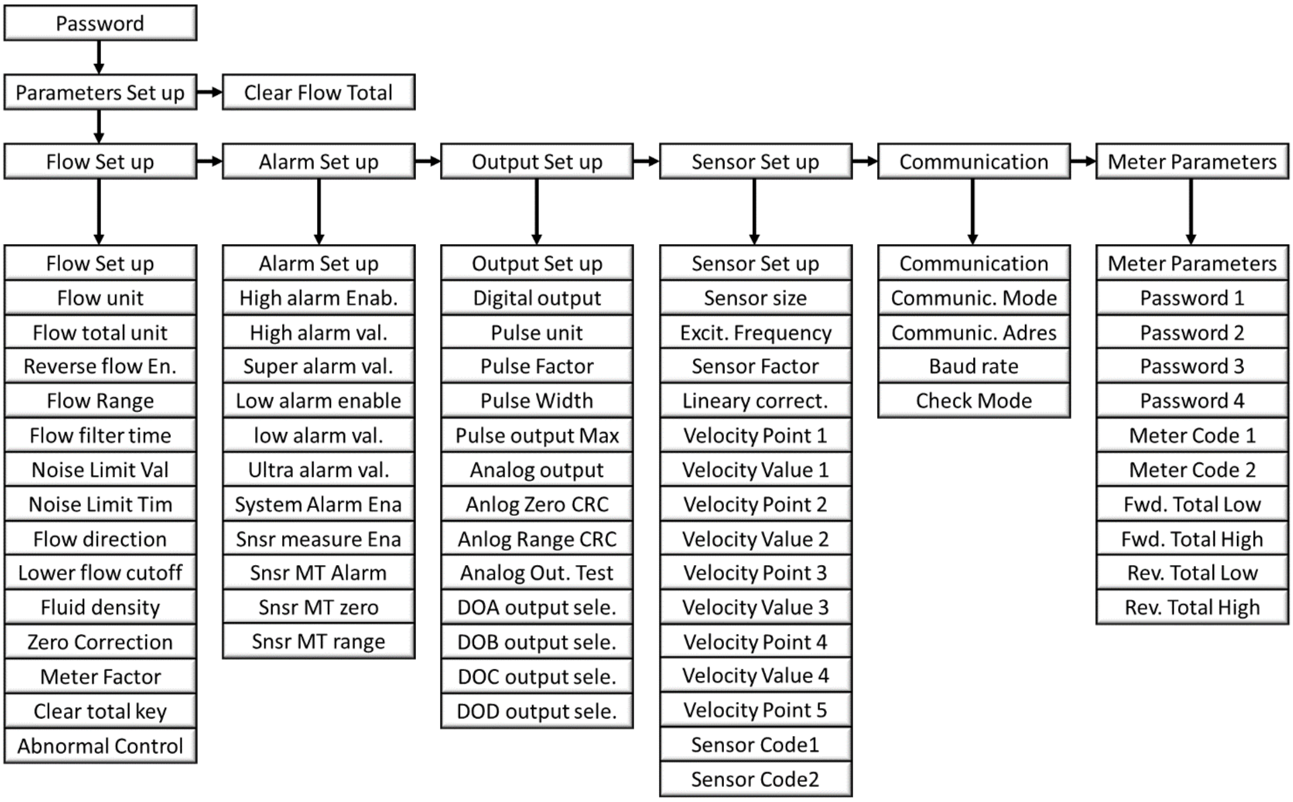
Up key: add 1 to the cursor number and turn the page;

Press the right shift key to move the cursor clockwise, and press the left shift key to move the cursor counterclockwise;

When the cursor is moved below the up key, press the up key to enter the submenu.

When the cursor is moved below the down key, press the key to return to the previous menu.

11.2.3 Setting parameters



11.2.3.1 Setting Parameters in Menu

Setting Parameters in Menu

No.	Parameters	Setting Type	Content	Password Level
Flow Set up				
1	Flow unit	Select	L/h、L/m、L/s、m^3/h、m^3/m、m^3/s UK/h、UK/m、UK/s、US/h、US/m、US/s	2
2	Flow total unit	Select	0.001m^3 ~ 1m^3、0.001L ~ 1L 0.001UKG ~ 1UKG3 、0.001USG ~ 1USG	2
3	Reverse flow En.	Select	Enable, Disable	2
4	Flow Range	Input	0 ~ 99999	2
5	Flow filter time	Select	1 ~ 60S	2
6	Noise Limit Val	Input	0% ~ 30%	3
7	Noise Limit Tim	Input	0s ~ 20s	3
8	Flow direction	Select	Forward, Reverse	2
9	Lower flow cutoff	Input	Set by Flow	2
11	Fluid density	Input	0 ~ 19.999T/m^3	2
10	Zero Correction	Input	0 ~ ±9999	2
12	Meter Factor	Input	0.0000 ~ 5.9999	5

13	Clear total key	Modifiable	0 ~ 99999	2
14	Abnormal Control	Input	5 ~ 70s	2
Alarm Set up				
1	High alarm Enab.	Select	Enable, Disable	2
2	High alarm val.	Input	Set by Flow	2
3	Super alarm val.	Input	Set by Flow	2
4	Low alarm enable	Select	Enable, Disable	2
5	low alarm val.	Input	Set by Flow	2
6	Ultra alarm val.	Input	Set by Flow	2
7	System Alarm Ena	Select	Enable, Disable	2
8	Snsr measure Ena	Select	Enable, Disable	2
9	Snsr MT Alarm	Input	0 ~ 59999	2
10	Snsr MT zero	Input	0 ~ 59999	5
11	Snsr MT range	Input	0 ~ 5.9999	5
Output Set up				
1	Digital output	Select	Frequency/pulse	2
2	Pulse unit	Select	m^3 、L、UKG、USG	2
3	Pulse Factor	Input	00.001 ~ 59.999	2
4	Pulse Width	Select	1 ~ 9999ms	2
5	Pulse output Max	Input	1 ~ 5000 Hz	2
6	Analog output	Select	4-20mA	2
7	Anlog Zero CRC	Input	0.0000 ~ 1.9999	5
8	Anlog Range CRC	Input	0.0000 ~ 3.9999	5
9	Analog Out. Test	Input	0.00 ~ 99.99	2
10	DOA output sele.	Select	Nomal open disable output, Nomal open Upper Limit ALM, Nomal open Super Limit ALM, Nomal open lower Limit ALM,Nomal open Ultra Limit ALM, Nomal open Sensor MT alarm, Nomal open System MT alarm, Nomal open cutoff alarm, Nomal open Reverse flow, Nomal close disable output, Nomal close Upper Limit ALM, Nomal close Super Limit ALM, Nomal close lower Limit ALM,Nomal close Ultra Limit ALM, Nomal close Sensor MT alarm, Nomal close System MT alarm, Nomal close cutoff alarm, Nomal close Reverse flow	2
11	DOB output sele.	Select	Nomal open disable output, Nomal open Upper Limit ALM, Nomal open Super Limit ALM, Nomal open lower Limit ALM,Nomal open Ultra Limit ALM, Nomal open Sensor MT alarm, Nomal open System MT alarm, Nomal open cutoff alarm, Nomal open Reverse flow, Nomal close disable output, Nomal close Upper Limit ALM, Nomal close Super Limit ALM, Nomal close lower Limit ALM,Nomal close Ultra Limit ALM, Nomal close Sensor MT alarm, Nomal close System MT alarm, Nomal close cutoff alarm, Nomal close Reverse flow	2

12	DOC output sele.	Select	Nomal open disable output, Nomal open Upper Limit ALM, Nomal open Super Limit ALM, Nomal open lower Limit ALM,Nomal open Ultra Limit ALM, Nomal open Sensor MT alarm, Nomal open System MT alarm, Nomal open cutoff alarm, Nomal open Reverse flow, Nomal close disable output, Nomal close Upper Limit ALM, Nomal close Super Limit ALM, Nomal close lower Limit ALM,Nomal close Ultra Limit ALM, Nomal close Sensor MT alarm, Nomal close System MT alarm, Nomal close cutoff alarm, Nomal close Reverse flow	2
13	DOD output sele.	Select	Nomal open disable output, Nomal open Upper Limit ALM, Nomal open Super Limit ALM, Nomal open lower Limit ALM,Nomal open Ultra Limit ALM, Nomal open Sensor MT alarm, Nomal open System MT alarm, Nomal open cutoff alarm, Nomal open Reverse flow, Nomal close disable output, Nomal close Upper Limit ALM, Nomal close Super Limit ALM, Nomal close lower Limit ALM,Nomal close Ultra Limit ALM, Nomal close Sensor MT alarm, Nomal close System MT alarm, Nomal close cutoff alarm, Nomal close Reverse flow	2
Sensor Set up				
1	Sensor size	Select	3 ~ 3000	2
2	Excit. Frequency	Select	3.125Hz ~ 12.5Hz	4
3	Sensor Factor	Input	0.0000 ~ 5.9999	4
4	Lineary correct.	Select	Enable, Disable	2
5	Velocity Point 1	User set	Set by Flow	4
6	Velocity Value 1	User set	Set by Flow	4
7	Velocity Point 2	User set	Set by Flow	4
8	Velocity Value 2	User set	Set by Flow	4
9	Velocity Point 3	User set	Set by Flow	4
10	Velocity Value 3	User set	Set by Flow	4
11	Velocity Point 4	User set	Set by Flow	4
12	Velocity Value 4	User set	Set by Flow	4
13	Velocity Point 5	User set	Set by Flow	4
14	Sensor code1	User set	Factory date (Year, Month)（0-99999）	4
15	Sensor code2	User set	Product code（0-99999）	4
Communication				
1	Com type	Select	MODBUS、HART、PROFIBUS	2
2	Com Adres	Input	0 ~ 250	2
3	Com Speed	Select	300 ~ 38400	2
4	Cali Type	Select	8-bit no check, 8-bit odd check, 8-bit even check	2
Meter Parameters				
1	Password 1	Modifiable	0 ~ 59999	5
2	Password 2	Modifiable	0 ~ 59999	5
3	Password 3	Modifiable	0 ~ 59999	5

4	Password 4	Modifiable	0 ~ 59999	5
5	Meter code1	Factory	Factory date (Year, Month)（0-99999）	5
6	Meter code2	Factory	Factory date (Year, Month)（0-99999）	5
7	Fwd. Total Low	Modifiable	0 ~ 99999	5
8	Fwd. Total High	Modifiable	0 ~ 9999	5
9	Rev. Total Low	Modifiable	0 ~ 99999	5
10	Rev. Total High	Modifiable	0 ~ 9999	5

11.2.3.2 Alarm mode introduction

When the "Upper limit alarm enable" setting is enabled, the high limit alarm, Super limit alarm, and function are enabled. When the setting is disabled, the upper limit alarm, super limit alarm, and function do not work. When the "Lower limit alarm allowed" setting is enabled, the lower limit alarm, Ultra limit alarm, and function are enabled. When the setting is disabled, the lower limit alarm, Ultra limit alarm, and function do not work.

There are 18 parameters in the DA output selection, DB output selection, DC output selection, and DD output selection: output of inhibition normally open, upper limit alarm output normally open, upper limit alarm normally open, lower limit alarm output normally open, lower limit alarm output normally open, air traffic control alarm output normally open, excitation alarm output normally open, signal removal alarm normally open, reverse alarm output normally open, output of inhibition normally closed, upper limit alarm output normally closed, upper limit alarm normally closed, lower limit alarm output normally closed, lower limit alarm output normally closed, air traffic control alarm output normally closed, excitation alarm output normally closed, signal removal alarm normally closed, reverse alarm output normally closed. Users can select the corresponding alarms for each output alarm point according to their needs.

11.2.4 Instrument parameter description

Instrument parameters determine the operating state, calculation method, output mode, and status of the instrument. Proper selection and setting of instrument parameters can enable the instrument to operate in the optimal state and achieve high measurement display accuracy and measurement output accuracy.

The instrument parameter setting function has four levels of passwords. Levels 1-3 are user passwords, and level 4 is the manufacturer password. Regardless of which level of password is used, users can view the instrument parameters. However, if users want to change the instrument parameters, they must use different levels of passwords. It is recommended that the user's higher-level personnel possess the level 4 password; the level 1-3 passwords are determined by the user.

Level 1 password (factory default value 00521): Users can only read parameters;

Level 2 password (factory default value 03210): the user can change the parameters from 1 to 24;

Level 3 password (factory default value 06108): the user can change the parameters from 1 to 25;

Level 4 password (factory default fixed value): the user can change the parameters from 1 to 29;

11.2.4.1 Language

The SSK521 Insertion electromagnetic flowmeter converter has both Chinese and English languages, and users can choose their own operation.

1.2.4.2 Comm Addres

It means this instrument’s address when communicates with many, and has 01~99, holding the 0.

11.2.4.3 Baud Rate

600, 1200, 2400, 4800, 9600, 19200, baud rate.

11.2.4.4 Sensor Size

SSK521 converters can be equipped with some deferent sensors that have deferent diameter of measuring pipes. The pipes in deferent diameters from 3mm to 3000mm can be chosen in relative table.

11.2.4.5 Flow unit

The flow unit can choose form the parameters (L/s, L/m, L/h, m^3/s, m^3/m, m^3/h), and the user can choose the proper unit according to the technological requirement and using habit.

11.2.4.6 Flow Range

Flow range means upper limit value, and lower limit value is set “0” automatically. So, it makes the range, and makes the relation of percent display, frequency output and current output with flow:

percent display = (flow measure / measure range) * 100 %;

frequency output = (flow measure / measure range) * frequency full;

current output = (flow measure / measure range) * current full + base point;

pulse output will not affect.

11.2.4.7 Flow filter time

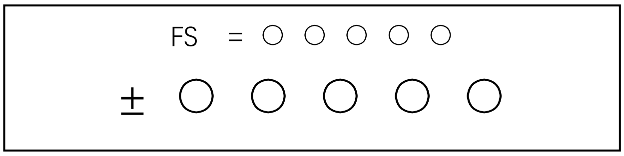
It means time of filter measure value. The long one can enhance the stability of flow display and output digital, and fits for gross add up of pulse flow; the short one means fast respond rate, and fits for production control. It is set by select.

11.2.4.8 Flow Direction

If users think the direct and design are differ, just change the direct parameter is OK, but not change exciting or signal.

11.2.4.9 Zero Correction

Make sure the sensor is full of flow, and the flow is stillness. Flow zero is shown as velocity of flow, mm/s.



Converter’s zero-flow correction displays like this:

Upper small words: FS means measure value of zero;

Lower large words: correction value of zero.

When FS is not “0”, make FS = 0.

Note: if change the value on next line and FS increases, please change the “+, -” to correct FS to zero.

Flow zero is the compound value of the sensor, and should be recorded in sensor list and band. The unit will be mm/s, and the sign will be opposite with correction value.

11.2.4.10 Lower flow cutoff

Lower flow cutoff is set in percentage of Upper Limit Range of flow, and users can delete all Negligible Small Signals of flow volume, velocity, and percentage out of displaying and outputting them. Sometimes user can delete output of current output signal and frequency (pulse) output signal only to have flow, velocity and percentage being displayed.

11.2.4.11 Flow total unit

Converter display is counter with 9 bits, and the max is 999999999.

Integrator units are L, m^3, UKG and USG (liter, cubic meter, imperial gallon, US gallon).

Flow integrator value: 0.001L, 0.010L,0.100L,1.000L

0.001m^3, 0.010m^3,0.100m^3, 1.000m^3;

0.001UKG, 0.010UKG,0.100UKG,1.000UKG
0.001USG, 0.010USG,0.100USG,1.000USG

11.2.4.12 Reverse flow En.

When "Reverse flow En. " is "enable", as long as the fluid is flowing, the converter will output pulses and currents according to the flow rate value, while accumulating the total amount. When "Reverse flow En. " is "disable", if the fluid flows in the reverse direction, the converter will output a "0" pulse and a "0" current signal (4mA or 20mA).

11.2.4.13 Analog output

Output current types can be chosen by users as 1~10mA or 4~20mA practically.

11.2.4.14 Digital output

Two kinds of Digital Outputs are can be chosen: Frequency Output and Pulse Output. Because the frequency output and pulse output use the same output point on the wiring, users cannot choose both frequency output and pulse output simultaneously, but can only choose one of them.

Frequency output mode: The frequency output is a continuous square wave, and the frequency value corresponds to the percentage of flow. The frequency output mode is generally used for control applications, as it reflects the percentage flow. If the user is using it for metering applications, the pulse output mode should be selected.

Frequency output value = (measured flow value/meter range) * frequency full-range value.

Pulse output mode: The pulse output is a rectangular wave pulse train, where each pulse represents a flow equivalent passing through the pipeline. The pulse Factor is selected by the "Pulse Factor" parameter below. Pulse output is different from frequency output in that it accumulates enough pulse factor to output a pulse, so the pulse output is not very uniform. Generally, counter instruments (such as totalizers) should be used for measuring pulse output, rather than frequency meters.

11.2.4.15 Pulse Factor

Equivalent pulse Unit is referred to one pulse for value of flow. The range of pulse factor can be chosen:

Pulse Equivalent	Flow	Pulse Equivalent	Flow
1	0.001 L/cp	9	0.001 USG/cp
2	0.01 L/cp	10	0.01 USG/cp
3	0.1 L/cp	11	0.1 USG/cp
4	1.0 L/cp	12	1.0 USG/cp
5	0.001 m3/cp	13	0.001 UKG/cp
6	0.01 m3/cp	14	0.01 UKG/cp
7	0.1 m3/cp	15	0.1 UKG/cp
8	1.0 m3/cp	16	1.0 UKG/cp

11.2.4.16 Pulse width

The width time of the pulse output can be selected between 4~400ms, and it will automatically convert to a square wave at high frequencies:

Max = 020p/s

40ms

11.2.4.17 Freque output Max

Frequency output range is as the upper limit of flow measure, just the percent flow 100%. Frequency output upper limit can be selected between 1～5000Hz.

11.2.4.18 Snsr measure Ena

SSK521 insertion electromagnetic flowmeter has a dead pipe detection function and does not require additional electrodes. If the user chooses to allow dead pipe alarms, when the fluid in the pipeline falls below the measuring electrode, the instrument can detect a dead pipe condition. After detecting the dead pipe condition, the analog output and digital output of the instrument are set to signal zero, and the instrument flow display is set to zero.

11.2.4.19 Snsr MT Alarm

The flowmeter measures the fluid resistivity value in the sensor in real time to determine whether the pipeline is in a full state. Therefore, the empty measurement value is a continuous value. Although different fluids have different resistivity values, if the fluid is in a full state, the resistivity value is stable. SSK521 flowmeter calculates the empty measurement value based on the relative resistivity, defining the resistivity value of the fluid in a full state as 100%. That is, when the fluid is full, the empty measurement value is calibrated to 100% using the "empty alarm threshold". When the fluid level in the pipeline is lower than the measuring electrode, the electrode comes into contact with the air, and the relative resistivity increases. When it is higher than the empty alarm threshold, the instrument will display an empty alarm signal. According to the actual usage statistics, when the fluid level in the pipeline is fully below the entire measuring electrode (the electrode is not in contact with the fluid) after calibrating the empty measurement value to 100% when the fluid is full, the empty measurement value will reach more than 1000%. Therefore, the empty alarm value is set at around 900%, which can accurately report the empty state. When the fluid level in the pipeline drops from a full state to an empty state, there will be a fluid wall phenomenon, which causes the empty measurement value of the instrument to not immediately reach the maximum with the fluid level, but there is a transition time, which corresponds to the residence time of the wall-hanging fluid. Therefore, in practical use, if you want the instrument to respond faster to the empty alarm, you can set the empty alarm threshold value a little smaller, such as around 500%.

11.2.4.20 Snsr MT range

Snsr MT range is used for measuring relative conductivity. When the sensor is filled with test liquid, the correction factor makes the conductivity ratio a certain value. For example, if the test liquid is water, its conductivity is about 100μS/cm, which can be corrected to 100%. When the conductivity of the measured liquid is 5μS/cm, the relative conductivity ratio is approximately 2000%. If the conductivity ratio of the test liquid water is corrected to 10%, the relative conductivity ratio of the measured liquid with a conductivity of 5μS/cm is approximately 200%.

11.2.4.21 High alarm Enab.

Users can choose “Enable” or “Disable”.

11.2.4.22 High alarm val.

The parameter of high limit alarm is percentage of flow range and can be set in the way of setting one numerical value between 0%~199.9%. When the value of flow percentage is larger than the value of setting value, the converter outputs the alarm signal.

11.2.4.23 Low alarm enable

The same as high limit alarm.

11.2.4.24 Sensor Code

It is referred to the produced date of sensor and the serial number of product that can keep the sensors coefficient right and accurate.

11.2.4.25 Sensor Factor

“Sensor Factor” is printed on the Label of the sensor when it is made in factory. The “sensor Factor” has to be set into Sensor Factor Parameter when it runs with converter.

11.2.4.26 Excit. Frequency

The converter of SSK521 provides three excitation frequency options: 1/10 power frequency (mode 1), 1/16 power frequency (mode 2), and 1/25 power frequency (mode 3). The excitation system inductance of small-caliber sensors is small, and users should choose 1/10 power frequency. The excitation system inductance of large-caliber sensors is large, and users can only choose 1/16 power frequency or 1/25 power frequency. During use, first select excitation mode 1, and if the instrument flow rate zero point is too high, then select mode 2 or 3 in turn.

Note: Demarcate on which exciting type, working on it only.

1.2.4.27 Instrument calculation factor

This coefficient is used to match open channel measurement submersible electromagnetic flowmeters. For example, if a working sensor is equipped with two parallel pipes of the same diameter, the instrument calculation coefficient is 3.0000.

11.2.4.28 Fwd. Total Low / High

Positive total volume high byte and low byte can change forthcoming and reverse total value, and be used to maintenance and instead.

User use 5-byte code to enter, and can modify the positive accumulating volume (∑+). Usually, it is unsuitable to exceed the maximum the counter set (999999999).

11.2.4.29 Rev. Total Low / High

User use 5-byte code to enter, and can modify the negative accumulating volume (∑-). Usually, it is unsuitable to exceed the minimum the counter set (999999999).

11.2.4.30 Time Year, month, day, hour, minute, second (with clock function).

The user needs to enter the password of the manufacturer to modify the time, including year, month, day, hour, minute, and second.

11.2.4.31 Password 1~4

Users can use 5 grades of passwords to correct these passwords.

11.2.4.32 Anlog Zero CRC

When the converters are made in the factory, output current has been calibrated to zero scale, that is, accurate 0mA or 4mA output.

11.2.4.33 Anlog Range CRC

When the converters is made in the factory, output current have been calibrated to full scale, that is, accurate 10mA or 20mA output.

11.2.4.34 Meter Factor

This fact is the special one of sensor-made-factory and the factory use this fact to unite SSK521 insertion electromagnetic flowmeters converters to make sure all the instruments can interchange by 0.1%.

11.2.4.35 MeterCode 1 and 2

Converter code records the date of manufacturing and serial number of converters.

11.2.4.36 Clearing the total amount

Press the "Enter Key" to display the "Parameter Settings" function, then press the "Enter Key" to turn to the "Total Zero Reset" page, press the total reset password "00002", and press the "Enter Key". When "00002" automatically changes to "00000", the reset function of the instrument is complete, and the total amount inside the instrument is 0.

12. Alarm information

The printed circuit board of the SSK521 insertion electromagnetic flowmeter converter uses surface-mount technology, which is not repairable for the user. Therefore, the user cannot open the converter housing. This instrument has self-diagnostic capabilities. In addition to power and hardware circuit failures, the instrument can correctly provide alarm information for common application failures. These messages are indicated by " ⍰ " on the left side of the display. In the measurement state, the instrument automatically displays the following fault content:

FQH - Flow Capacity Alarm;

FQL - Flow limit alarm;

FGP - Fluid empty tube alarm;

SYS - system excitation alarm.

13. Troubleshooting

13.1 No display on the instrument

- Check whether the power supply is connected;
- Check whether the power fuse is intact;
- Check whether the power supply voltage meets the requirements.

13.2 Excitation alarm

- Check whether the excitation wires EX1 and EX2 are open-circuited;
- Check whether the total resistance of the sensor excitation coil is less than 150Ω;
- If the first two items are normal, the converter has a fault.

13.3 Sensor empty alarm

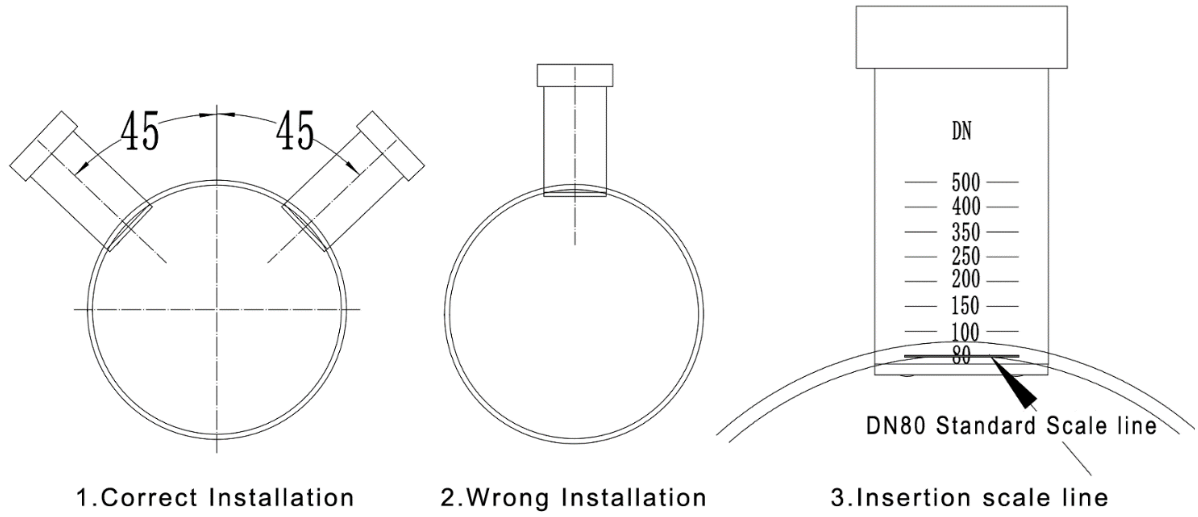
- Check whether the measured fluid is filled in the sensor measuring tube;
- Short-circuit the converter signal input terminals SIG1, SIG2, and SKIGND with a wire, and if the "empty tube" prompt is cancelled, it indicates that the converter is normal, and there may be an error in the conductivity of the fluid being measured, or in the empty tube threshold and empty tube range settings;
- Check whether the signal connection is correct;
- Check whether the sensor electrode is normal;
- Make the flow rate zero, and observe that the conductivity ratio should be less than 100%;
- In the case of traffic, the resistance of terminals SIG1 and SIG2 to SIGGND should be less than 50kΩ (measured with water as the medium. It is best to use a pointer multimeter to measure and observe the charging and discharging process during the measurement).
- Use a multimeter to measure the DC voltage between DS1 and DS2, which should be less than 1V, otherwise it indicates that the sensor electrodes are contaminated and should be cleaned.

13.4 Inaccurate measured flow

- Check whether the measured fluid is filled in the sensor measuring tube;
- Check whether the signal line connection is normal;
- Check whether the sensor coefficient and sensor zero point are set according to the sensor label or factory calibration sheet.

14 Appendix

Installation Instructions



As shown in the figure above, the installation process of inserting the electromagnetic flowmeter sensor on the pipe is very important.

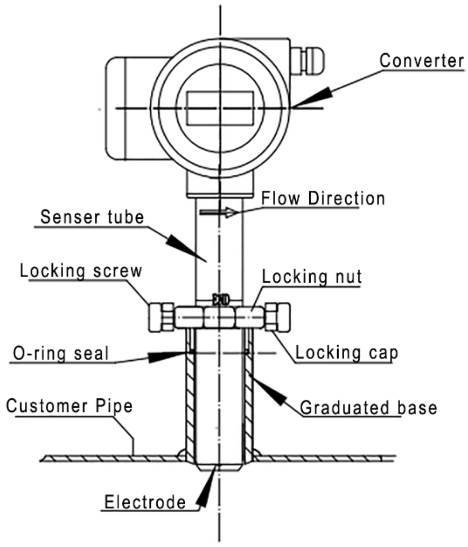
1. Install the sensor at a 45-degree angle to the center line of the pipe, as shown in Figure 1.
2. Choose the correct installation location, as shown in Figure 2. Do not install the sensor on the top of the pipeline, as the pipeline is not full of liquid, which can cause inaccurate measurement.
3. The depth of insertion of the sensor into the pipeline is very important for accurate measurement. After theoretical calculations and practical experience, it is determined that the optimal position for the sensor to measure the electrode position is 10-15% of the measurement pipe. In order to ensure the accuracy of the insertion depth position for field installation, this product comes with a graduated mounting base when it leaves the factory, as shown in Figure 3. During installation, just weld the corresponding pipe inner diameter according to the scale mark on the diagram to ensure the correct position. If the sensor is installed on a DN80 pipe, the DN80 scale mark and the pipe inner wall should be aligned when welding the base. Note that it is not allowed to insert too deep, as the sensor will cause resistance to the fluid flow, resulting in measurement errors and unstable instantaneous flow values. It is also not allowed to be too shallow, as the sensor will be blocked by the pipe wall outside the pipe wall, resulting in errors.
4. The process of inserting the sensor into the mounting base is also important. The sensor is engraved with a fluid direction arrow on the upper part of the sensor tube when it leaves the factory. See the sensor installation diagram. During installation, the arrow points towards the front of the fluid and is aligned with the center line of the pipe. The converter display is perpendicular to the pipe axis. In addition, the sensor tube is engraved with an END line to ensure that the sensor can be inserted into the base at the optimal position. Therefore, the END line should be aligned with the upper side of the locking

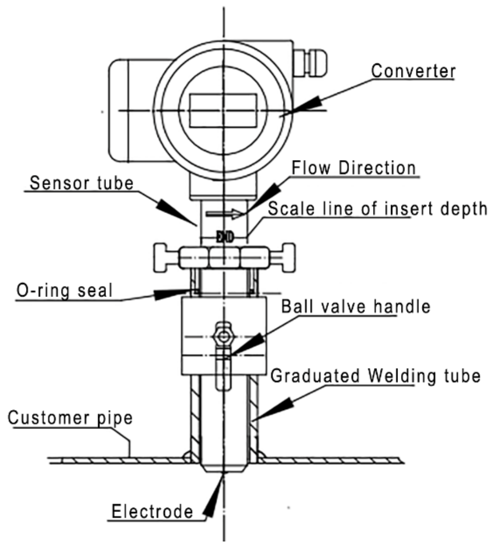
nut of the base. The idea is to insert it to this line position and stop, and then it will not be visible anymore.

5. Sensor installation

   To ensure that the sensor does not move or leak in the base, it is necessary to insert the lock nut into the sensor tube before inserting the sensor, then put on the O-ring seal, and then insert the tube into the mounting base.

   For ball valves, it is necessary to fully open the ball valve, properly tighten the lock nut, insert the tube to the end line position, and tighten the nut to lock it. Before locking, ensure that the fluid direction is consistent with the center line of the pipe, and the converter display and pipe axis are perpendicular. Then tighten the jackscrew on the lock nut and lock the cap. When opening the fluid, pay attention to observe until there is no liquid leakage. If there is any leakage, tighten the lock nut again to ensure that the O-ring seal is fully functional.





Installation Diagram