Labnics

Density Meter

NDSM-100

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1. Introduction

Density Meter NDSM-100 is a plug-in type densitometer with a high-performance micro-controller integrated circuit providing high accuracy, good stability and strong anti-jamming function. The fluid density is directly proportional to the vibrational frequency obtained by the tuning fork when the sensor is put into the medium. Temperature compensation is provided by the built-in temperature sensor.

2. Features

- The use of industrial-grade high-performance micro-controller integrated circuit, high accuracy, good stability, strong anti-jamming ability
- Wide-format precise power supply with isolation circuit design, impact resistance, and anti-jamming
- Monitoring and controlling continuous readings with plug-and-use, maintenance-free techniques
- Sensor signal with photoelectric compartment design
- PLC control system with connection and a 4-20 mA output
- Long rod type is appropriate for use in open and sealed tanks, as well as cans up to 2m in length

3. Specifications

Model	NDSM-100
Density Range	500 to 2500 Kg/ m3
Calibration Range	800 to 1200 Kg/ m3
Accuracy	± 1 Kg/ m3 / ± 2 Kg/ m3
Repeatability	± 0.2 Kg/ m3
Sensitivity Level	0.0001 cm3/g
Temperature Range	(-20 to + 150) ℃
Maximum Working Pressure	10 Mpa
Fluid Viscosity Range	0 to 20000 cP
Temperature Coefficient	Less than 1 Kg/ m3 / ℃
Pressure Effect	Negligible
Built In Temperature Sensor	PT100
Wetting Material	316 L stainless stain Hastelloy
Fork Coating	Standard, PTFE or electropolished
Power Supply	24 VDC
Analog Signal Outage	4 to 20 mA, 0 to 1000Hz, RS232
Output Accuracy	± 0.1 % of reading or ± 0.05 %FS
Output Repeatability	± 0.05 %FS
Protection Level	IP65
Shell Material	Aluminium alloy
Weight	5 Kg

4. Applications

Density Meter is mainly used in petrochemical industry, brewing industry, food industry, pharmaceutical industry and mineral processing.

5. Instrument Introduction

Tuning fork densitometer size structure

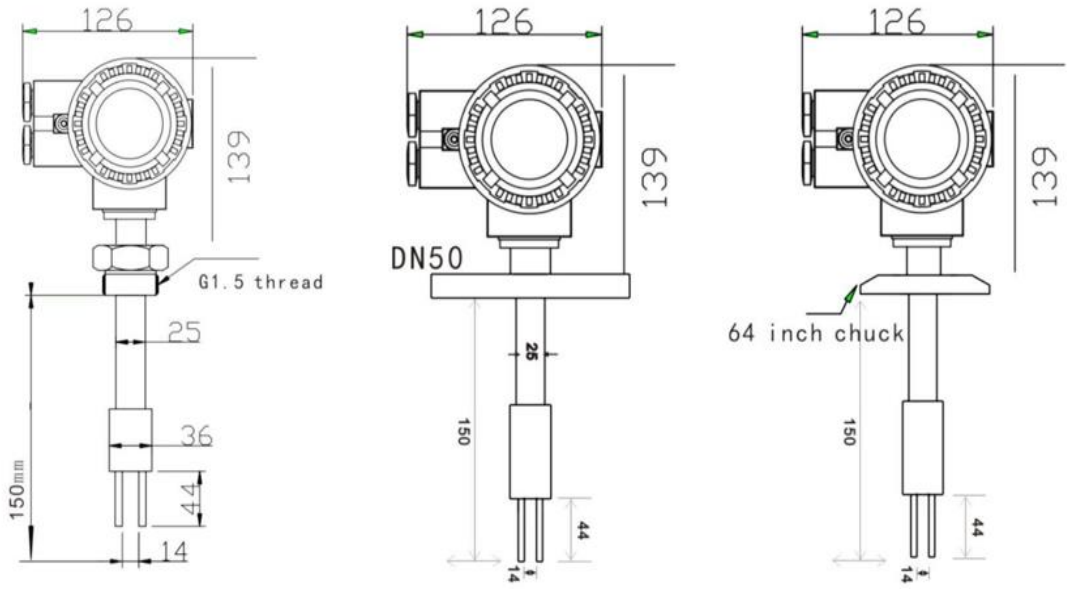


Figure-1

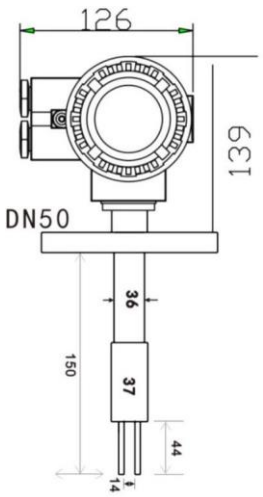


Figure-2 Spraying tetrafluoro Type

6. Installation

Mechanical Installation

Unlike pipe density sensors, the fork portion of a plug-in density meter is not fully enclosed.

6.1 Pipe wall or container

The boundary effect of the wall on the fluid, plus the viscosity effect of the measurement medium itself, these effects will have a certain impact on the measurement calibration of the sensor. To overcome these, according to different environments, we have summarized and set the installation method and pipe diameter in advance, which is convenient for selection under the same conditions.

Installation standard	T-shaped side opening plug-in installation	T-shaped side opening, Recessed installation
Illustrate	The fork body part directly enters the main fluid.	The fork body is retracted into the side opening part of the pipeline to avoid the main fluid and retracted by 25mm.
Flow rate	The flow velocity through the fork is 0-1m/s.	The main flow velocity is 1-5m/s.
Viscosity range	Max 600Cp	Up to 100cP (up to 250cP in individual cases).
Temperature	-50-150℃	-50-150℃
Main pipe size	≥Horizontal pipeline 100mm(4″); ≥Vertical pipeline 150mm (4″)	≥50mm（2″）
Disadvantages	Does not apply to: Unstable flow The diameter of the main pipe is less than DN100	1) Flocculent solutions (such as pulp, etc.) 2) Unstable flow 3) Viscosity gradient solution 4) The diameter of the main pipe is less than DN50 5) When the temperature effect is significant

6.2 Calculation of Flow Velocity

V = Q / (1/4 ×π ×d2) Example: Flow rate 20m3/h Pipe diameter 100mm
V = 20 / 3600 / (1/4 * 3.14 * 0.1 * 0.1) = 0.7 m/s

6.3 Installation and positioning

To ensure that the density meter can measure accurately and display stably, the flow rate of the measured medium should not be greater than 1m/s, and the diameter of the pipeline here the density meter is installed should be greater than or equal to 159mm. When the flow rate is greater than 1 m/s, the diameter-expanding installation is adopted. For every 1m increase in the flow rate, the diameter of the pipeline where the density meter is installed is expanded by 1.5 times. The fluid is in a laminar state when flowing through the fork.
As shown: Horizontal pipe horizontal installation

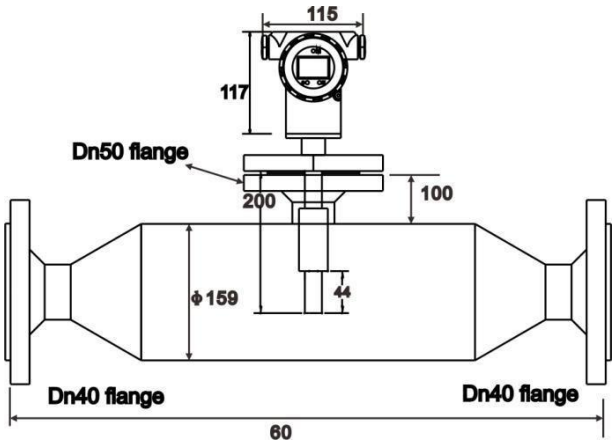


Figure-1

Concentric reducer vertical pipe, inserted directly into the fluid.

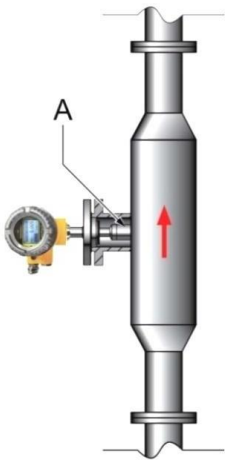


Figure-2

Concentric reducer horizontal pipe, top view of horizontal pipe.

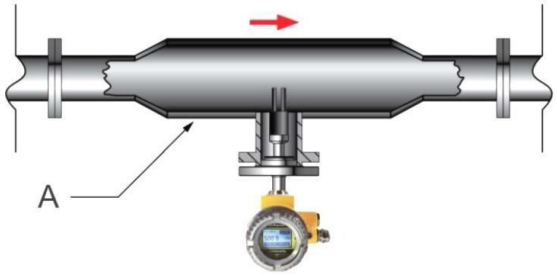


Figure-3

Eccentric Reducer Horizontal Pipe

1) Side view of horizontal pipe (instrument on opposite side).
2) Eccentric Expander/Reducer.
3) The meter is inserted into the fluid in the expander.
4) Internal View of Piping and Instrumentation.

If an eccentric reducer is used, the pipe must maintain a 20" (500 mm) straight upstream run (both sides for bidirectional fluid applications) to avoid jetting effects and combined "jetting" on the tuning fork tines.

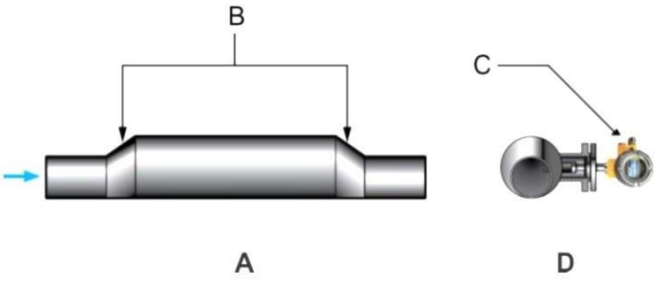


Figure-4

During installation, always position the meter so that the gap between the tines is in a vertical direction, which is convenient for solids to settle and gas to rise.

Figure-5 Free Fluid (Weld Base) Meter Installation

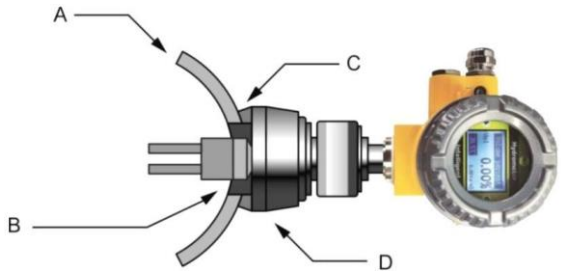


Figure-6

1) 4" pipe for horizontal installation; 6" (152mm) pipe for vertical installation
2) 2.1" (52.5mm) gauge opening in pipe.
3) Welding
4) Free fluid welded base (purchased according to pipe diameter)

6.4 T-pipe installation

Instrument T-Sleeve (Flange Fitting) Installation

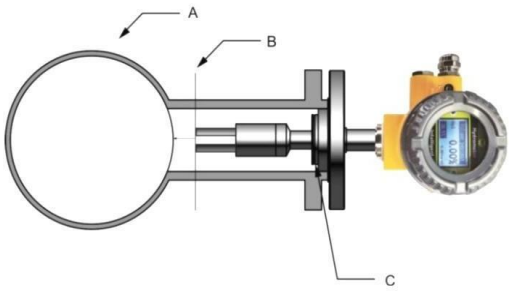


Figure-7

- Horizontal or Vertical Installation for 4" or Larger Diameter Pipe
- The distance of the instrument tuning fork from the main pipe wall is determined by the maximum flow of the process.
- PFA washers and compression springs (not required for self-locking PFA washers). For vertical and horizontal pipes, always install the meter on the side of the pipe. For horizontal pipes, it is prohibited to install meters on top of pipes.

6.5 Pipe Wall Installation

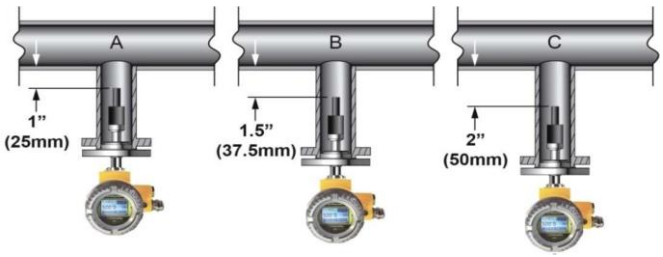


Figure-8

1) Velocity ≤ 10 ft/sec (3 m/sec)
2) 10 < Velocity ≤ 13 ft/sec (4 m/sec)
3) 13 < Velocity ≤ 16 ft/sec (5 m/sec)

6.6 3''T-Sleeve Installation

For slurry measurement applications, install in T-sleeve piping. T-sleeves should be 3 in. (76 mm) (DN80) and installed diagonally to ensure self-draining. Flow rates as low as 1.0 m/s are acceptable, with 3 m/s preferred. Caution should be exercised at flow rates of 5 m/s as there is an increased risk of T-sleeving. Additional cleaning may be required.

Flow	0.5 to 5 m/s (at the pipe wall)
Viscosity	Up to 100cP, or 1000cP (if the insertion distance does not exceed 1 inch (25 mm).
Fork body coating	-58°F to 392°F (-50°C to 200°C) ;- 40°F to 392°F (-40°C to 200°C) (hazardous area).

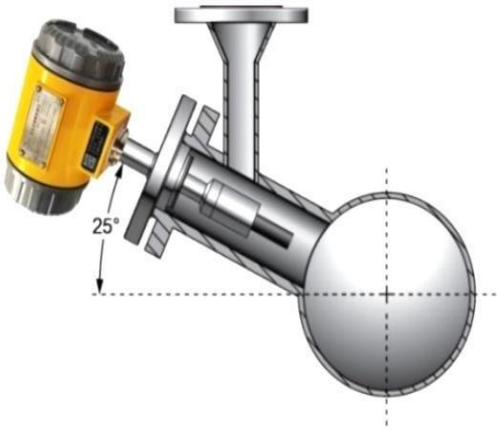


Figure-9 Horizontal Pipe

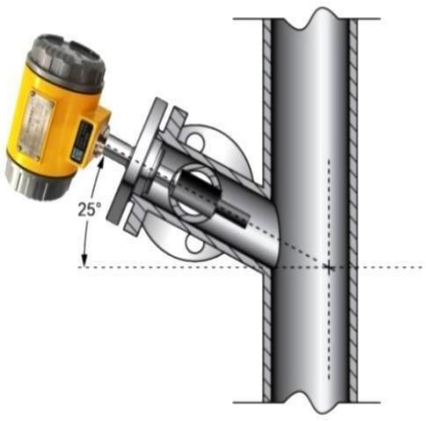


Figure-10 Vertical Pipe

Open Tank Gauge Installation (Long Pole).

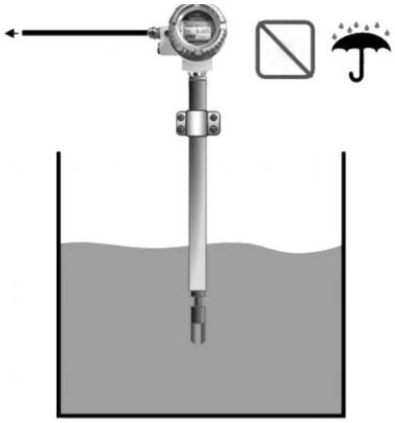


Figure-11

Meter placement (away from tank walls).

Figure-12

Meter placement (distance from objects and spoilers).

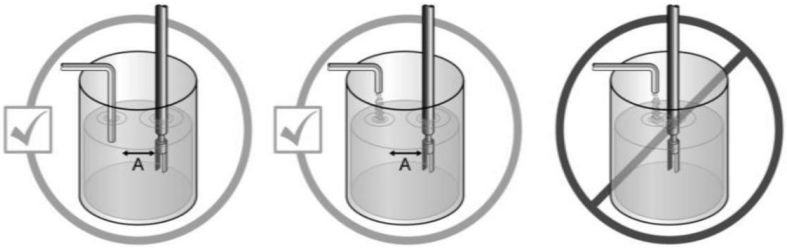


Figure-13

Meter placement (fluid direction through tuning fork gap).

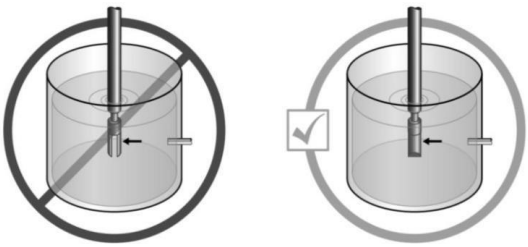


Figure-14

Meter placement (away from sediment).

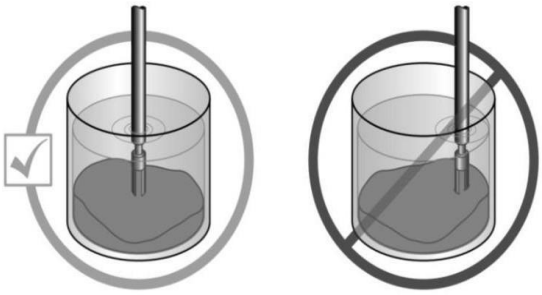


Figure-15

Schematic diagram of horizontal installation of density meter pipeline.

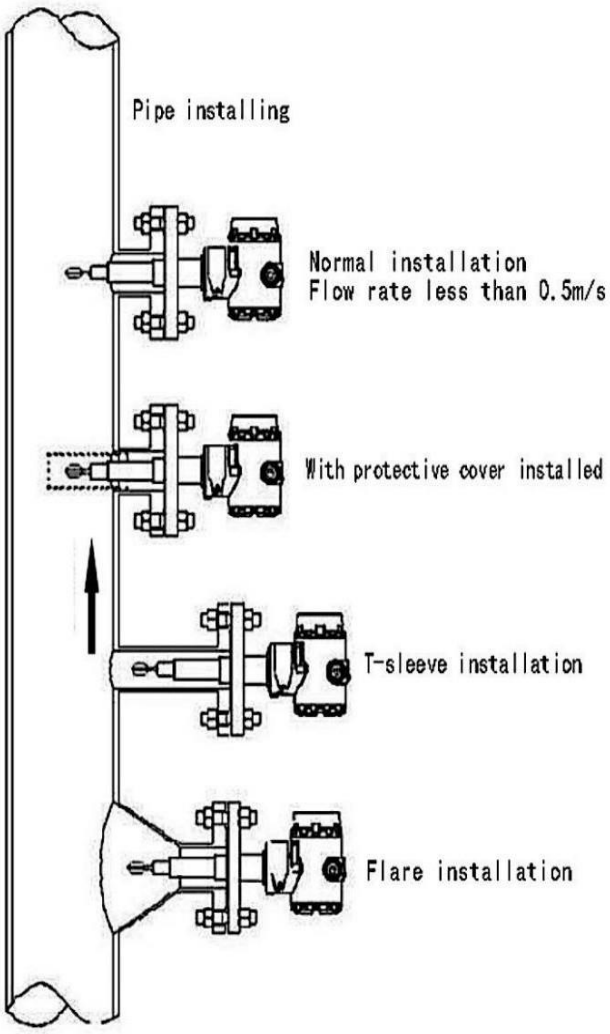


Figure-16

Vertical Pipeline Installation Dimensions

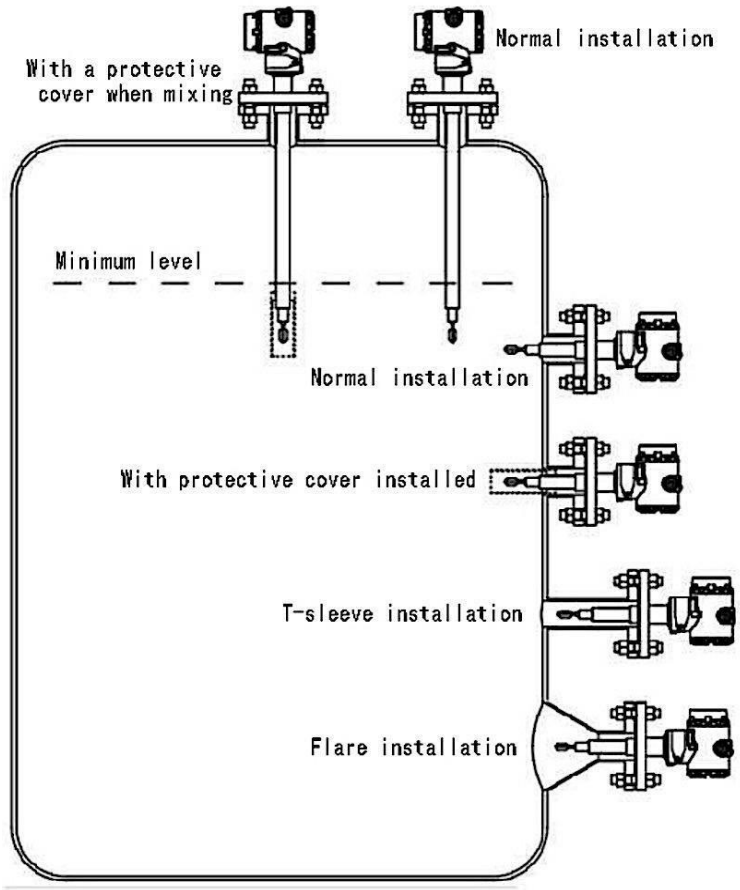


Figure-17

Unreasonable installation diagram

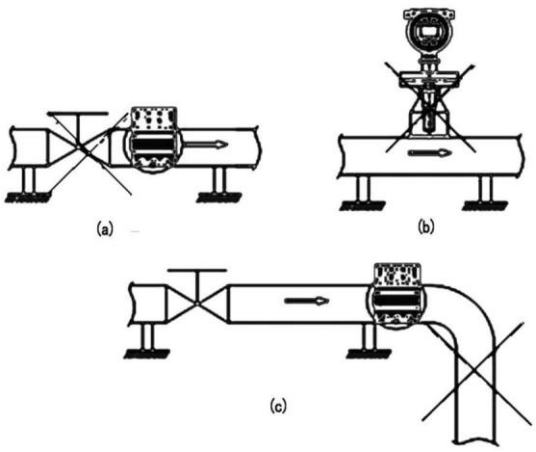


Figure-18 Schematic diagram of unreasonable installation of horizontal pipeline

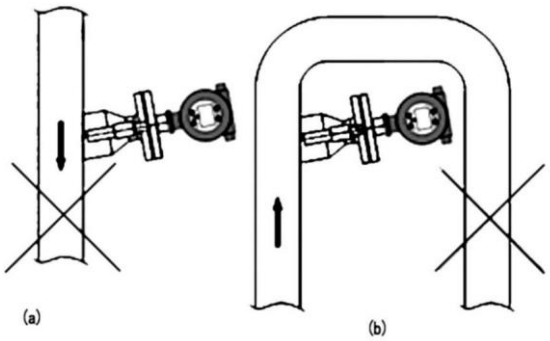


Figure-19 Schematic diagram of unreasonable installation of vertical pipelines

7. Operations

7.1 Calibrate and Run

Before calibrating the meter make sure it has been installed.
Through the keys on the instrument panel, you can adjust the zero point, span, setting unit, zero-point shift, span shift, damping, output characteristics, and change the display output.

7.1.1 Button function description

BK -- set back when the operation is completed, save and exit
↑--Modify ↔--shift OK--confirm

7.1.2 Parameter Setting

Parameters such as range, composition, damping time, unit, installation pipeline, etc. can be modified through parameter setting.
After pressing the **OK** key, the menu interface appears, the arrow ► points to "parameter setting", press ↔ to move ► point to other settings, select "parameter setting" and press "**OK**" to enter the parameter setting interface "range upper limit", press again **OK** An underline appears below the upper limit value, indicating that this digit can be modified, press ↑ to modify the value of the current digit, continue to press ↔ to shift to the digit that needs to be modified, and press ↑ to modify, after the modification is completed, press the "**OK**" key again, the underline disappears to modify At this point, continue to press ↔ to display in sequence → lower limit of range → component A → component B → damping time → unit → installation pipeline → interface, use the same operation method to set the above parameters, press “BK” to exit the current interface and go to the setting interface 10 Number (The interface number will appear in the upper right corner of the display.

7.1.3 Display Settings

The display content of the main variable and the effect of the screen display can be changed by setting
After pressing the **OK** key, the menu interface appears, the arrow ► points to "parameter settings", press ↔ move ► to point to "display settings", then press "**OK**" to enter the display settings interface", press OK again to appear ► point to the display content option, Press ↔ Move ► to point to the desired display content and then press **OK** to complete the setting. If you do not need to save the settings, press "**BK**" to exit the previous level before pressing **BK** and continue to press ↔ Display → Contrast → Backlight → Language → Use the same operation Method to set the above parameters, press “BK” to exit the current interface and go to the setting interface 10 number.

7.1.4 Output Settings

Through the output setting, the corresponding mode of the output signal can be matched. This product supports two output modes: 4-20mA and RS485 (MODBUS protocol). You can choose one of the parameters of density, temperature and percentage to output the current signal.

RS485 can output all signals.

After pressing the OK key, the menu interface appears, the arrow ► points to "parameter setting", press ↔ move ► to point to "output setting", then press "OK" to enter the output setting interface", press OK again to appear ► point to the setting content option, Press ↔ Move ► to point to the desired setting content and then press OK to complete the setting. If you do not need to save the setting, press "**BK**" to exit the previous level before pressing OK, and continue to press ↔ to display the content in sequence→2(4-20mA)→RS485/BPS→Address 1-254→Relay→Set the above parameters with the same operation method, press "BK" to exit the current interface and go to the setting interface No. 10.

The above 2(4-20mA) and relay are optional configurations, this function is not a general configuration

7.2 Description of RS485MODBUS communication protocol.

1) **Function Code 03**

   Use the 03-function code of the MODBUS communication protocol to read the value of the sensor or display (1 value). The command format of the master is slave address, function code, start address, number of bytes, and CRC code. The command format of the slave response is slave address, function code, data area, and CRC code. The data in the data area is binary code, two bytes, high order first, CRC code is two bytes, low order first.

2) **Information frame format: (slave address is 01, both are binary data)**

   Host sends: Station number (1B) Function code (1B) Start address (2B) Number of read points (2B) CRC (2B)

   T1~T4 01 03 00 0X 00 0X XX XX T1~T4

   Among them, T1~T4 means that 3~5 rest periods should be reserved at the beginning and end of each frame:

   Station number (address): One byte "01" Function code: one byte "03"

   Start address: Two bytes: optional 0000~0004 0000, returns the current density value, 0001, returns the current temperature value, FF9BH=-101=-10.1℃.

   0002, returns the current concentration value,

   The unit is kg/cm^3.

   The unit is °C. When the temperature is lower than 0 °C, the temperature data is uploaded in the form of complement code.

   The unit is % (10000/100 100.00%).

   Number of read points: Two bytes: 0001 or 0002 ~0005 is optional CRC: Validation code. two bytes.

   The slave responds:

   Station number (1B) Function code (1B) Number of bytes read (1B) Data (2B) CRC (2B) T1~T4 01 03 02 XX XX XX XX T1~T4

   Among them: T1~T4 means that 4 stationary periods should be reserved at the beginning and end of each frame (you can customize the editing).

   Station number (address): One byte "01" Function code: one byte "03"

   Data: Two bytes; the high byte is first, forming 16-bit binary data; CRC: verification code, two bytes.

7.3 Calculation rules of CRC code

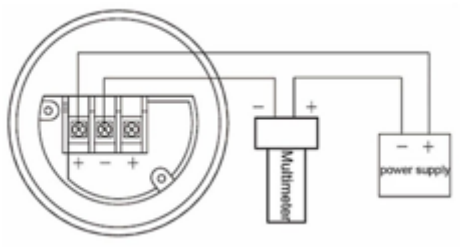
- Reserved 16-bit registers are hexadecimal FFFF (that is, all 1s). This register is called the CRC **register.**
- The first 8-bit data is XORed with the 16-bit CRC register, and the result is placed in the CRC register.
- Check whether the lowest bit is 0; if it is 0, put the register. The content is shifted one bit to the right (toward the lower bits), and the upper bits are filled with 0.
- If it is 1, shift the contents of the register one bit to the right (toward the lower bit), fill the upper bit with 0, and then CRC register with the polynomial A001 (1010 0000 0000 0001) XOR,
- Repeat step 3 until the right shift is performed 8 times, so that the entire 8-bit data has been processed.
- Repeat steps 2 to 4 to process the next 8-bit data.
- The final CRC register is the CRC code. When the CRC result is put into the information frame, the high bits are exchanged, and the low bits are first.

7.4 Example of Communication Protocol

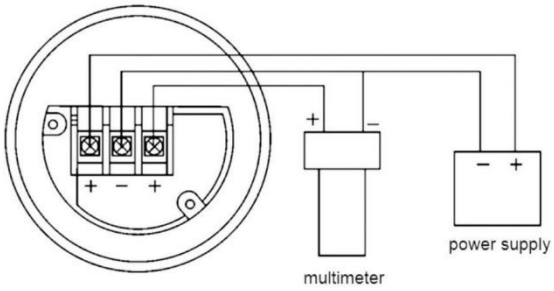
Station No	Function code	Initial address	Number of bytes	Verification code	Significance
01	03	0000	0002	C40B	Read density in kg/m3
01	03	0002	0001	25CA	Read temperature, unit ℃
01	03	0003	0001	740A	Read alcohol concentration in %
01	03	0008	0002	45C9	Read range upper limit Unit kg/m3
01	03	000A	0002	E409	Read the lower limit of the range Unit kg/m3
01	03	000C	0002	0408	Read component A Unit kg/m3
01	03	000E	0002	A5C8	Read component B Unit kg/m3
01	03	0010	0001	85CF	Read damping time Second

01	03	0011	0001	D40F	Reading Units 1-g/L 2-g/ml 3-kg/m3 4-g/cm3
Station No	Function code	Initial address	Number of bytes	Verification code	Significance

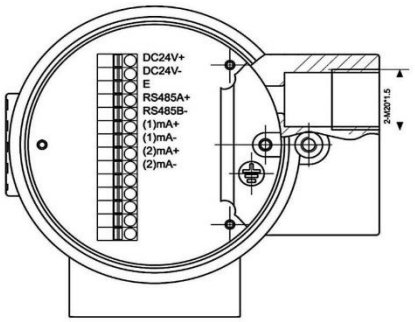
8. Circuit Diagram



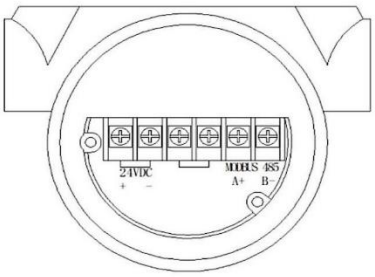
Two Wire System DC24V, 4-20mA



Three-wire system, DC24V, 4-20Ma



Four-wire, two-way 4-20mA



RS485