Hardness analyzer

硬度计分析仪

使用说明书（Manual）

红器自控（江苏）有限公司

前言

尊敬的用户您好，非常感谢您选择本公司仪器！在使用本产品前，请详细阅读本说明书，并保存以供参考。请遵守本说明书操作规程及注意事项。由于不遵守操作规程及注意事项，所引起的任何故障和损失均不在厂家的保修范围内，厂家亦不承担任何相关责任。

请妥善保管好所有文件。如有疑问，请联系我公司售后服务部门或地区客服中心。在收到仪器时，请小心打开包装，检查仪器及配件是否因运送而损坏，如有发现损坏，请联系我公司售后服务部门或地区客服中心，并保留包装物，以便寄回处理。当仪器发生故障，请勿自行修理，请联系我公司售后服务部门或地区客服中心。

安全注意事项

1. 为了安全使用本产品，操作者请务必遵守以下安全事项：

2. 操作前，请熟读使用说明书并对产品有深入了解。

3. 客户选购产品时，需对产品的使用用途有所了解，本公司不保证该产品适用于用户的某一特殊需求。

4. 为本产品安装防雷装置，或者其他保护电路时，需要借助其他外部设备来实现。

5. 本产品不适应于直接关系到人身安全的系统，如核动力设备、使用放射能的设备、铁路系统、航空、航天、医疗等。如果使用，用户有责任使用额外保护设备或系统确保人身安全。

6. 接通电源时，请确保与产品所要求的电压一致，否则或造成本产品不可逆的损坏。

为了防止触电、静电、干扰等，请务必良好的接地。

7. 室外安装时，务必做好防雷工程施工，共用接地网进行等电位接地、屏蔽、合理布线、适当使用浪涌保护器等。

8. 检查故障时，应切断电源，以免发生事故

9. 请定期检查接地保护状况，若您认为接地保护等措施不够完善，请勿运行

目录

一、 产品简介

在线硬度计分析仪主要用于检测液体中硬度值的精密仪表，利用原电池原理，相比上一代硬度计分析仪，采用最新的集成电路方案，24 位 ADC 的超高分辨率，实现硬度值的精准测量。

广泛应用于自来水、污水、环保、石油、化工、电力、食品、制药、化学实验室、养殖等行业。

二、 产品特点

■LCD 中/英文界面显示，中/英文菜单，操作更简单方便。

■采用更高精度的 ADC 信号采集和抗干扰电路，精度更高，更稳定。

■光电隔离 4-20mA 电流输出(可选)

■RS-485 通讯接口(可选)

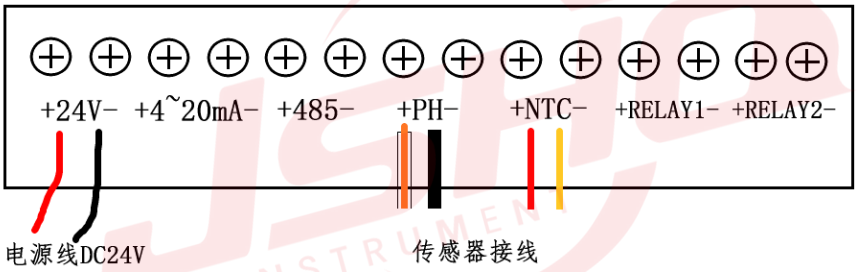
■双继电器上下限报警输出(可选)

■传感器自带温度补偿，可修正温度对硬度值的影响

■支持定制特殊功能需求

三、 电气连接

注意：提高工作人员和仪表的安全性，仪表采用 DC24V 供电（如果需要 AC220V，请使用厂家标配的 220V 转 24V 适配器）。

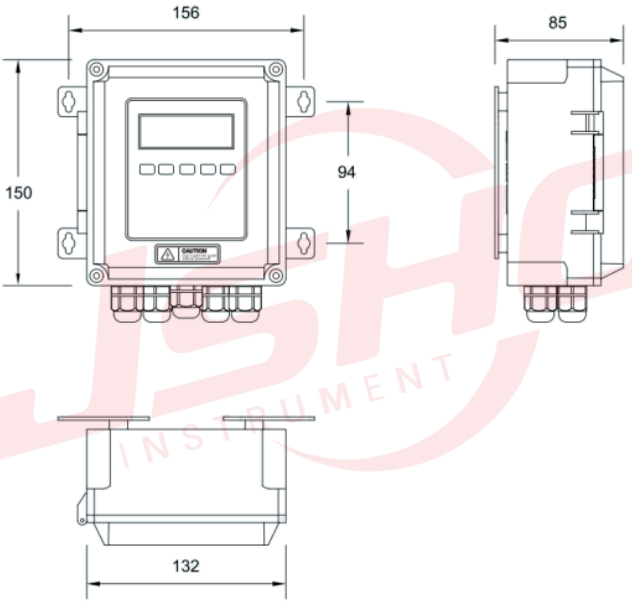


注意：信号线中的透明的铜线接 PH+，黑色线（ref）接 PH-，温度线为随机颜色，温度线没有正负极，接在+NTC-上，（如果是 5根线，绿色线不需要接）

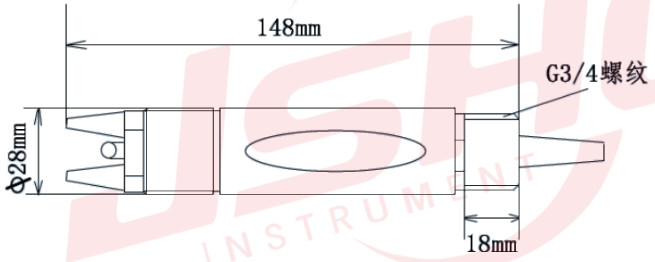
+24-	电源供电，DC24V
+4~20mA-	4-20mA 模拟信号输出
+485-	485 数字信号输出
+PH-	传感器信号线
+NTC-	外部温度传感器线

四、 安装

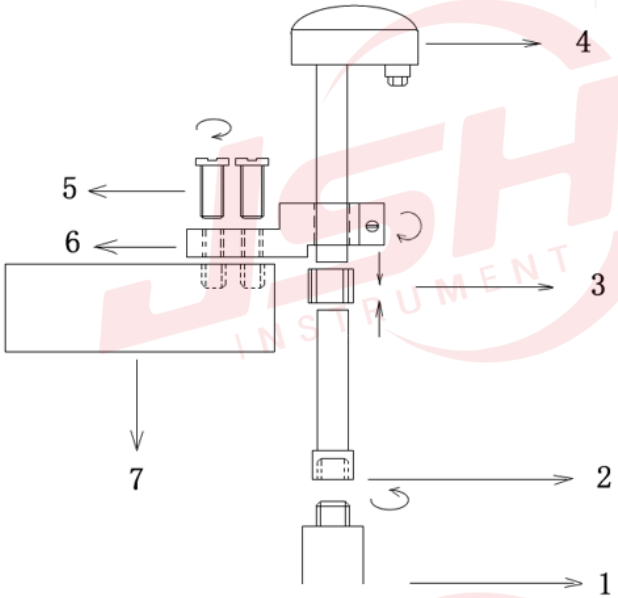
1. 主机尺寸图



2. 传感器尺寸



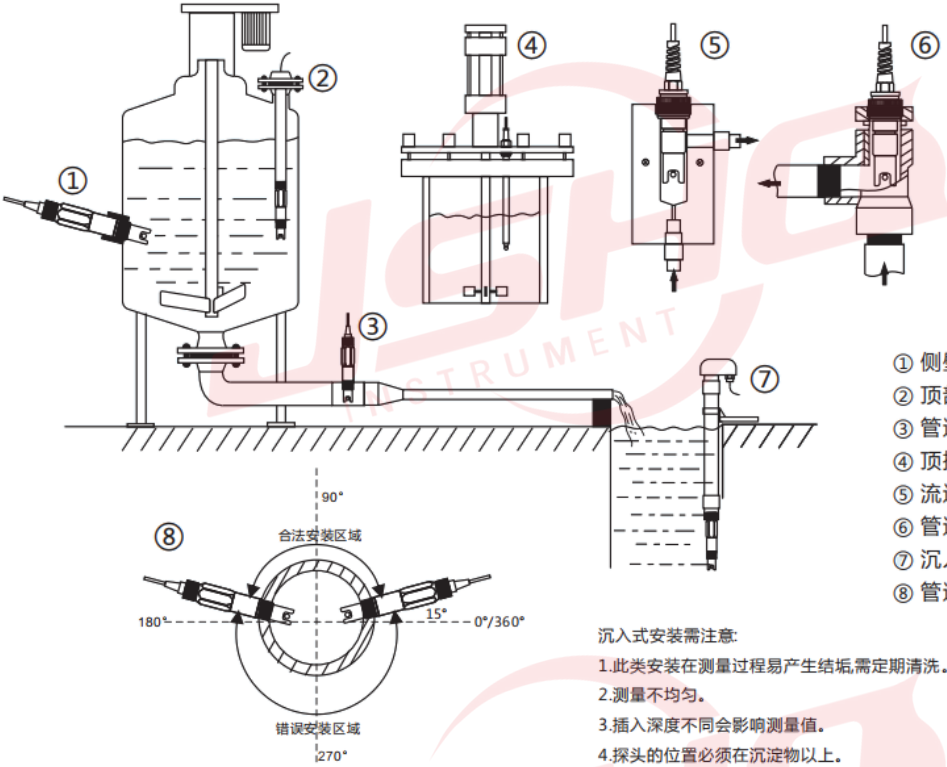
3. 传感器支架式安装图



1	传感器
2	支架杆
3	快速接头
4	防水帽
5	M4螺丝
6	固定架
7	被固定平面板

注：传感器末端螺纹为 G3/4 螺纹

4. 传感器其他类型安装



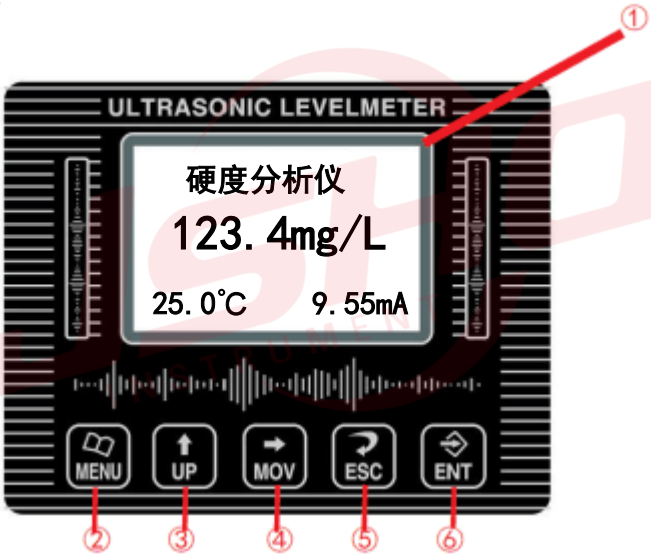
① 侧壁安装
② 顶部法兰式安装
③ 管道安装
④ 顶插式安装
⑤ 流通池安装
⑥ 管道安装
⑦ 沉入式安装
⑧ 管道安装角度

沉入式安装需注意:

1.此类安装在测量过程易产生结垢,需定期清洗。
2.测量不均匀。
3.插入深度不同会影响测量值。
4.探头的位置必须在沉淀物以上。

五、显示窗口简介

1.工作界面



测量模式显示界面说明：

名称	说明
1 显示屏	显示测量的硬度值、温度、输出电流。
2 MENU 键	菜单键：进入菜单选项
3 UP 键	增加键： 用于调整参数 0-9 循环和菜单选项调整
4 MOV 键	移位键：切换测量界面中空间距离和液位，设置模式下用以参数移位
5 MSC 键	返回键：退出/返回上一级菜单，当前 设置不保持；
6 ENT 键	确认键 ：设置当前参数确认保存

六、 菜单设置

同时按 MENU 键，进入到密码界面。输入正确用户密码(3000)后，进入设置模式菜单；按 INC 键(或 MOV 键)依次显示各个菜单，按 OK 键，可进入对应菜单，进入二级菜单后，通过 MOV 键移动光标，按 INC 键设置数值，按 OK 键保存设置参数。注意：INC 键(可 0-9 循环增加)，修改参数后需要按 OK 键才能保存，否则视为无效。

设置密码说明：

进入菜单	3000
语言选择	输入 0005（英文） 输入 0006（中文）

菜单 Menu	说明
标定	分别对硬度值 1.0、硬度值 100、硬度值 10000 进行标定
电流设置	设置分别 4mA、20mA 对应的硬度计值
继电器 1	设置第一路继电器的报警模式和报警对应的硬度计值
继电器 2	设置第二路继电器的报警模式和报警对应的硬度计值
通讯地址设置	设置 485 通讯地址的 ID
温度设置	调整温度
阻尼设置	用于调整采样间隔周期与计算的平均值个数（最大为 19）
电流标定	微调 4mA 和 20mA 电流使其满足更高精度要求

七、 仪表标定

首先配置三种标定液：1mg/L 的氯化钙溶液，100mg/L 的氯化钙溶液，10000mg/L 的氯化钙溶液。
电极标定方法如下：
1. 按”MENU”键，进入到密码界面。输入正确用户密码(3000)后，进入设置模式菜单,选择第一项菜“标定”，按“ENT”键确认进入，可以看到“标准液一”“标准液二”“标准液三”三个选项。
2. 将硬度计电极放入去离子水中，浸泡 5 分钟，取出后，重新再用新的去离子水浸泡 5 分钟，选择“标准液一”菜单进入，会在仪表上出现一串数据，（这串数字是用于检测电极性能的，用户不必理会）将电极完全浸入到 1mg/L 标准液中，保持静止 20 秒钟左右，按“ENT”确认保存。
3. 以此类推，将剩余两项进行标定。

八、通信

仪表提供串行异步半双工 RS485 通信，采用 MODBUS-RTU 规约，测量数据均可由 485 读出，每个仪表可设 定其通信地址，通信连接应使用带有铜网的屏蔽双绞线，线径不小于 0.5mm2。布线时应使通信线远离强电电缆 或其他强电场环境，推荐采用 T 型网络的连接方式，不建议采用星形或其他的连接方式。

MODBUS_RTU 通信规约：即在一根通信线上采用主从应答方式的通信连接方式。首先，主机寻址到一台唯 一地址的从机设备，然后，从机设备发出的应答信号以相反的方向传输给主机，实现在 一根单独的通信线上信号沿着相反的两个方向传输所有的通讯数据流。

MODBUS 协议只允许在主机（PC，PLC 等）和终端设备（硬度计/ORP 计）之间通讯，而不允许独立的终端设备

（硬度计/ORP 计）之间的数据交换。

主机查询：　　查询消息帧包括设备地址、功能代码、数据信息码、校准码。

地址码：　　表明要选中的从机设备地址；

功能代码：　　表明被选中的从设备要执行何种功能；

数据段：　　包含了从设备要执行功能的任何附加信息；

校验码：　　用来检验一帧信息的正确性，采用 CRC16 的校准规则。

从机响应：　　如果从设备产生一正常的回应，在回应消

息中有从机地址码、功能代码、数据信息码和 CRC16 校验码。

数据信息码则包括了从设备收集的数据，如参数测量值。

表 14 Modbus 通信协议

字节	发送（PC 端）	示例	回应	示例
0	地址（ID）	0x01	地址（ID）	0x01
1	功能码	0x03	功能码	0x03
2	数据首地址	0x00	长度	0x02
3		0x00	硬度计高位	0x00
4	数据长度	0x00	硬度计低位	0xC0
5		0x01	CRC 校验（L）	0xB8
6	CRC 校验（L）	0x84	CRC 校验（H）	0x14
7	CRC 校验（H）	0x0A		
8				
9				
10			注意：硬度计值=返回值*0.1	

例如：PC 主机发送：01 03 00 00 00 01 84 0A

仪表返回值： 01 03 02 00 C0 B8 14

返回值解析信息分别为：硬度计值：19.2

九、硬度计电极保养

特别注意：

1.禁止电极引线加长或者剪短，加长或者剪短引线会导致电极无法测试，严重会导致电极报废！

2.电极严禁测试含氟物质（氢氟酸或者其他含弗溶液），会导致电极玻璃球泡被腐蚀；

一、 硬度计电极的正常使用寿命：

电极的使用寿命从出厂开始计时，不管是否使用，最长使用寿命只有 1 年，如果使用与 管理方法不到位，使用寿命会成倍地缩短。更换电极请联系公司购买准确电极。

二、 硬度计电极的正确使用方法：

1、 电极在使用过程中因经常泡在测试液体中，若长时间干露在空气中，使用前，将电极前端浸在去离子水 10 分钟后，浸在稀释的硬度计溶液中 2 小时以上。

2、 电极暂时不用时，应将电极采用正确的清洗方法进行清洗后套上保护套，放在阴凉处保存

3、电极禁止使用在高温或干燥的环境中，高温或干燥的环境容易使电极的表面结垢，从而电极遭到破坏。

4、 电极禁止使用或保存在接近冰点的环境中，冰点环境容易使电极发生冷爆。低于 15℃的环境温度下使用硬度计灵敏度和准确度降低属于正常现象。

5、 电极禁止使用和保管在有剧烈震动的环境。否则，电极可能遭到破坏。

6、 电极一般视情况半个月至一个月（最理想的是每天进行清洗或者隔天进行清洗）由仪表电工专业人员进行一次清洗和保养，具体的时间间隔视现场测试环境的恶劣程度决定，环境越

恶劣，清洗保养需要越频繁(如含重金属或者有机物的溶液，需要更加频繁的清洗保养。)

7、 电极应处于能真实反映液体硬度计值的高度，一般处于被测液体下面 200∽300mm 左右为适宜（前端玻璃球泡需要完全浸没在被测液体中）。

技术规格

电源：	□AC220V □ DC24V
分辨率：	0.1 硬度值
测量精度：	1-2%标定精度
重复性:	<=1%
刷新时间：	=1s(可调)
输出信号：	□4～20mA □485 □继电器
电流精度：	0.02mA
地点：	室内/室外
环境温度：	10～30℃

Preface

Thank you for choosing our instrument! Before using this product, please read this manual carefully and keep it for reference. Please follow the operating procedures and precautions of this manual. Due to non-compliance with the operating procedures and precautions, any failures and losses caused are not covered by the manufacturer’s warranty, and the manufacturer does not assume any related responsibilities.

Please keep all documents well. If you have any questions, please contact our after-sales service department or regional customer service center. When you receive the instrument, please carefully open the package and check whether the instrument and accessories are damaged due to shipping. If you find any damage, please contact our after-sales service department or regional customer service center, and save the packaging for return processing. When the instrument breaks down, please do not repair it yourself, please contact our after-sales service department or regional customer service center

Precautions

1.In order to use this product safely, the operator must observe the following safety items：

2.Before operation, please read the instruction manual and have a thorough understanding of the product.

3.Customers need to understand the use of the product before purchasing. The company does not guarantee that the product is suitable for a particular requirement of customer.

4. When installing lightning protection devices or other protection circuits for this product, you need to use other external equipment to achieve.

5. This product is not suitable for systems directly related to personal safety, such as nuclear power equipment, equipment that uses radioactive energy, railway systems, aviation, aerospace, medical, etc. If used, the user is responsible for using additional protective equipment or systems to ensure personal safety.

6. When turning on the power, please ensure that the voltage is consistent with the product's required voltage, otherwise it may cause irreversible damage to the product.

To prevent electric shock, static electricity, interference, etc., be sure to ground well.

7.When installing outdoors, be sure to do a good job of lightning protection construction, share the grounding network for equipotential grounding, shielding, reasonable wiring, and appropriate use of surge protectors.

8. When checking for faults, please cut off the power supply to avoid accidents.

9. Please check the grounding protection status regularly. If you think the grounding protection measures are not perfect, please do not run.

Content

I、Product profile

The online industrial Hardness tester is mainly used as a precision instrument for detecting the Hardness value of liquids, using the principle of primary batteries,compared with the previous generation of industrial hardness analyzer, it adopts the latest integrated circuit solution and the ultra-high resolution of 24-bit ADC to achieve accurate hardness measurement.

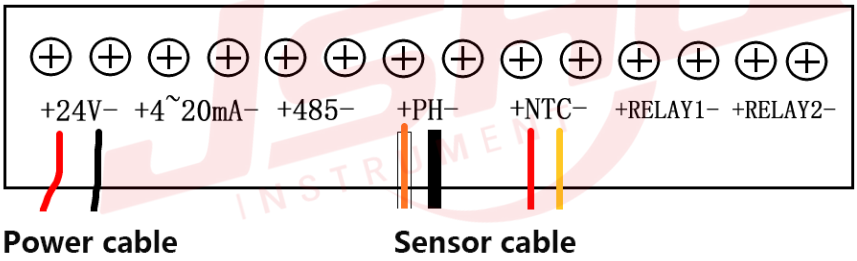
It is widely used in tap water, sewage, environmental protection, petroleum, chemical, electric power, food, pharmaceutical, chemical laboratory, breeding and other industries.

II、Features

- LCD Chinese/English interface display, English/Chinese menu, simpler and more convenient operation.
- Adopting higher precision ADC signal acquisition and anti-interference circuit, higher precision and more stable.
- Photoelectric isolation 4-20mA current output (optional).
- RS-485 communication interface (optional).
- Double relay upper and lower limit alarm output (optional).
- The sensor comes with temperature compensation, which can correct the influence of temperature on hardness value.
- Support customized special function requirements

III、Electrical connection

Attention: In order to ensure the safety of the staff and the instrument, the instrument adopts DC24V power supply (if AC220V is required, please use the factory standard 220V to 24V adapter), Direct AC220V power supply has been cancelled.

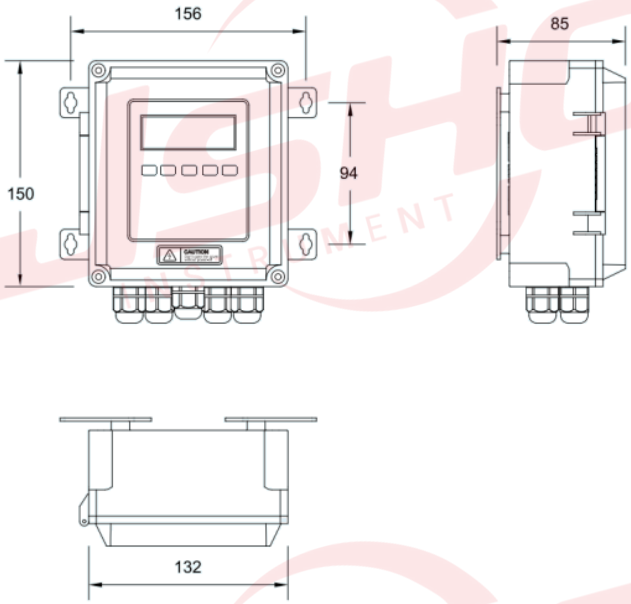


Attention: The transparent copper signal wire is connected to PH+, the black wire (ref) is connected to PH-, and the temperature wire is of random color. The color of the temperature wire is random, and has no positive and negative poles, Be connected to +NTC- (if there are 5 wires, the green wire does not need to be connected)

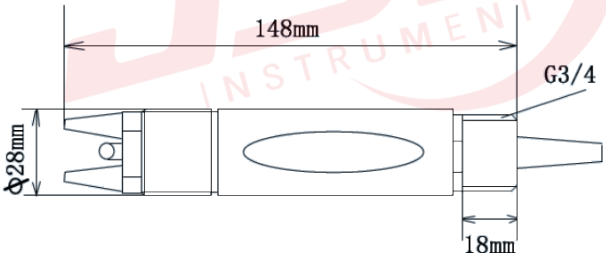
+24-	Power supply，DC24V
+4~20mA-	4-20mA analog signal output
+485-	485 digital signal output
+PH-	Sensor signal cable
+NTC-	External temperature sensor cable

IV、Installation

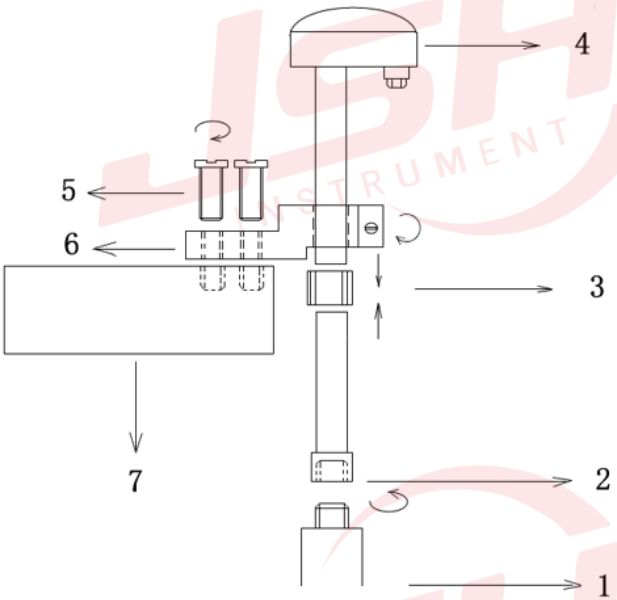
1. Diagram of host size



2. Sensor size



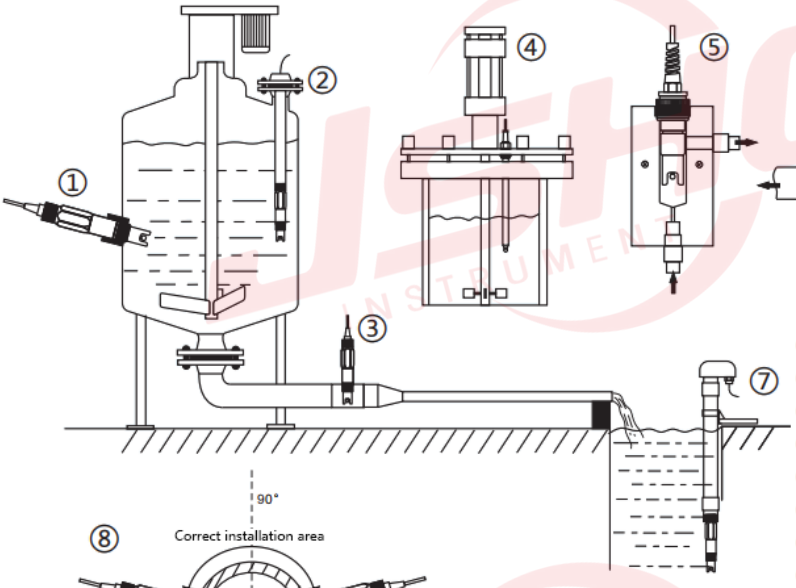
3. Sensor bracket installation diagram



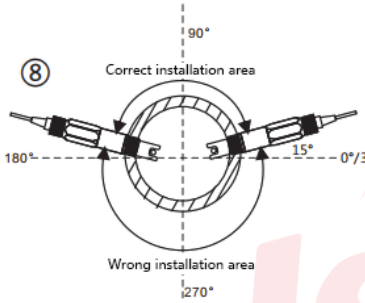
1	Sensor
2	Bracket pole
3	Quick Connector
4	Waterproof cap
5	M4 Screw
6	Fixed frame
7	Fixed flat panel

Attention: The end thread of the sensor is G3/4

4.Other types of sensor installation



① Side wall installation
② Top flange installation
③ Pipeline installation
④ Top plug-in installation
⑤ Circulation trough installation
⑥ Pipeline installation
⑦ Submerged installation
⑧ Pipeline installation angle

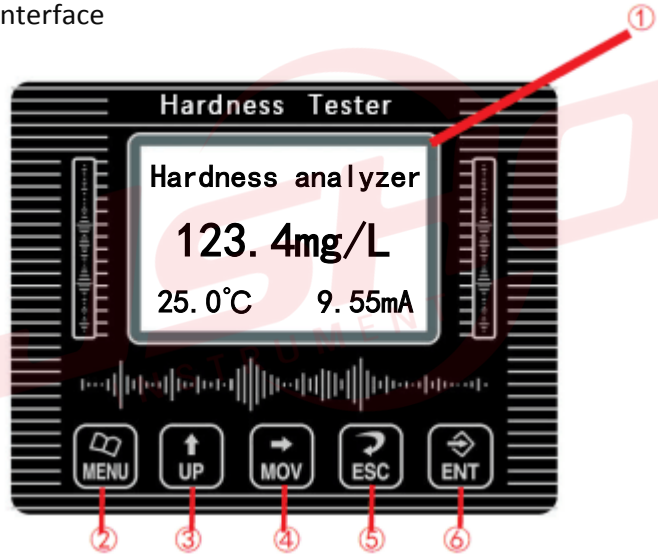


Submerged installation attentions :

1.Scaling is easy to occurTduring the measurement with this type of installation , and needs to be cleaned regularly.
2.Uneven measurement.
3.Different insertion depths will affect the measured value.
4.The position of the probe must be above the sediment.

V、Display introduction

1.working interface



Measurement mode display interface description:

	Explanation
1 Screen	Display the measured hardness value, temperature.
2 MENU button	Enter menu option
3 UP button	Increase button: used to adjust parameters 0-9 cycle and menu option adjustment
4 MOV button	Shift button: switch the space distance and liquid level in the measurement interface, and use to shift the parameters in the setting mode
5 MSC button	Back button: Exit/return to the previous menu, the current setting is not maintained;
6 ENT button	Confirm button: set the current parameters to confirm and save

VI、Menu setting

Press the MENU button to enter the password interface and entering the correct user password (3000) to the setting mode; press the INC button (or MOV) to display each menu in turn, press OK to enter the corresponding menu, after entering the secondary menu, move the cursor through the MOV button, and press INC to set the value, then press OK to save the set parameter. Note: INC key (0-9 cycle increase), after modifying the parameter, you need to press the OK key to save, otherwise it will be regarded as invalid.

Password setting instructions:

Press Menu button	Enter 3000
language selection	Enter 0005（Choose English） Enter 0006（Choose Chinese）

Menu	Description
Calibration	Calibrate hardness value 1.0 , 100 , 10000 respectively
Current	Set the hardness values corresponding to 4mA and 20mA respectively
Relay1	Set the alarm mode of the first relay and the hardness value corresponding to the alarm.
Relay2	Set the alarm mode of the second relay and the hardness value corresponding to the alarm.
Modbus ID	Set the ID of the 485 communication address.
Temp Set	Adjust temperature.
Damping	Used to adjust the sampling interval period and the number of calculated average values (the maximum is 19).

Current calibration	Fine-tune 4mA and 20mA current to meet higher precision requirements.

VII、Calibration

First, configure three kinds of calibration solution:1mg/L calcium chloride solution, 100mg/L calcium chloride solution, 10000mg/L calcium chloride solution.

The electrode calibration method is as follows:

1.Press the "MENU" button to enter the password interface. After entering the correct user password (3000), enter the setting mode menu, select the first menu "calibration", press the "ENT" key to confirm the entry, you can see "First", "Second", and "Third" "Three options.

2. Put the hardness analyzer electrode into deionized water and soak for 5 minutes. After taking it out, soak it in new deionized water for 5 minutes. Select and enter the "First" , a string of data will appear on the meter, (This series of numbers is used to test the performance of the electrode, the user does not need to pay attention to it) .Immerse the electrode completely in the 1mg/L standard solution, keep it still for about 20 seconds, and press "ENT" to confirm the storage.

3. By analogy, calibrate the remaining two items.

VIII、Communication

The instrument provides serial asynchronous half-duplex RS485 communication, adopts MODBUS-RTU protocol, and the measurement data can be read out by 485. Each instrument can set its communication address. The communication connection should use shielded twisted pair wire with copper mesh, the wire diameter should not less than 0.5mm^2. When wiring, keep the communication line away from strong electric cables or other strong electric field environments， recommended to use T-type network connection mode, not to use star or other connection mode.

MODBUS_RTU communication protocol: that is, the communication connection mode using master-slave response mode on a communication line. First, the host computer addresses a slave device with a unique address, and then the response signal from the slave device is transmitted to the host in the opposite direction.Realize that the signal transmits all communication data streams on a single communication line in two opposite directions.

The MODBUS protocol only allows communication between the host (PC, PLC, etc.) and terminal equipment (Hardness analyzer/ORP meter), but does not allow data exchange between independent terminal equipment（Hardness analyzer/ORP meter）.

Host Query: The query message frame includes device address, function code, data information code, and calibration code.。

Address code: Indicate the address of the selected slave device ;

Function code: Indicate what kind of function the selected slave device should perform；

Data segment: Contains any additional information about the function to be performed by the slave device；

Check code: Used to check the correctness of a frame of information, using CRC16 calibration rules.

Slave response: If the slave generates a normal response, there are slave address code, function code, data information code and CRC16 check code in the response message.

The data information code includes the data collected from the slave device, such as measurement values parameter .

Table 14 Modbus communication protocol

byte	Issue (PC side)	Example	Response	Example
0	Address（ID）	0x01	Address（ID）	0x01
1	Function code	0x03	Function code	0x03
2	Data first address	0x00	Data length	0x02
3		0x00	high bit of hardness	0x00
4	Data length	0x00	Low bit of hardness	0xC0
5		0x01	Low bit of CRC check	0xB8
6	Low bit of CRC check	0x84	High bit of CRC check	0x14
7	High bit of CRC check	0x0A		
8				

9				
10			Attention: hardness value=return value*0.1	

For example PC Host issue：01 03 00 00 00 01 84 0A

Meter Return value： 01 03 02 00 C0 B8 14

The return value analysis information is：

Hardness value：19.2

IX、Hardness analyzer electrode maintenance

Pay attention:

1. It is forbidden to lengthen or shorten the electrode lead. Lengthening or shortening the lead will cause the electrode to fail to measure, and seriously cause the electrode to be scrapped!

2. It is strictly forbidden to test fluorine-containing substances (hydrofluoric acid or other solutions containing fluorine), which will cause the electrode glass bulb to be corroded.

i、Normal service life of hardness analyzer electrode:

The service life of the electrode is timed from the factory. Regardless of whether it is used or not, the longest service life is only 1 year. If the use and management methods are not comprehensive, the service life will be shortened exponentially. To replace the electrode, please contact the company to purchase an accurate

electrode.：

ii、The correct use of hardness analyzer electrode:

1、 The electrode should be soaked in the test liquid frequently during use. If it is exposed to the air for a long time, soak the tip of the electrode in deionized water for 10 minutes and then immerse it in the diluted hardness solution for more than 2 hours before use.

2、 When the electrode is temporarily not in use, the electrode should be cleaned with a correct cleaning method and then put on a protective cover and stored in a cool place.

3、It is forbidden to use the electrode in a high temperature or dry environment. The high temperature or dry environment is likely to cause fouling on the surface of the electrode, which will damage the electrode.

4、The electrode is not allowed to be used or stored in an environment close to the freezing point. The freezing point environment is likely to cause the electrode to cold explode. It is normal that the sensitivity and accuracy of the hardness analyzer will decrease when the temperature is lower than 15℃.

5、 It is forbidden to use and store the electrode in an environment with severe vibration. Otherwise, the electrode may be damaged.

6、 Electrodes are generally cleaned and maintained by professionals from half a month to a month depending on the situation (the ideal is to clean every day or the next day). The specific time interval depends on the harshness of the on-site test

environment. The worse the environment, The more frequent cleaning and maintenance are required (such as solutions containing heavy metals or organic substances, more frequent cleaning and maintenance are required).

7、 The electrode should be at a height that can truly reflect the hardness value of the liquid, generally about 200∽300mm below the measured liquid is appropriate (the front glass bulb needs to be completely immersed in the measured liquid).

Technical Specifications

Power supply: □AC220V □ DC24V

Resolution: 0.1 hardness value

Accuracy: 1-2% calibration accuracy

Repeatability: <=±1%

Refresh time: =1s(Adjustable)

Output signal: □4～20mA □485 □relay

Current accuracy: 0.02mA

Location: Indoor/Outdoor

Ambient temperature: 0～30℃