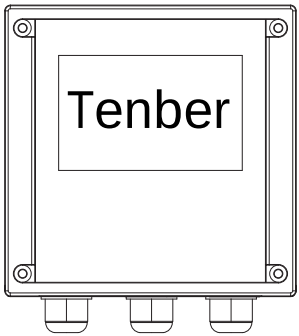
ION-8301 Ion Controller Operating Manual



144 Series

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Safe Operation

Please read the following instructions for safe operation carefully before use:

1. Before use, please observe whether the appearance of the instrument is damaged due to transportation and extrusion; 2. The instrument must be operated by trained professional technicians; 3. The operating manual must be read thoroughly before use to avoid incorrect wiring that may cause safety issues and damage to the instrument; 4. After all wiring is completed, it must be carefully checked before powering on and confirming that the connected equipment is correct; 5. Please install the instrument away from high temperature, high humidity and corrosive environments, and away from direct sunlight; 6. Avoid using a power supply that generates surge interference. If there is surge interference, please separate the instrument power supply from the power supply of other interfering equipment.

Intended Use

The instrument is used for industrial ion and temperature measurement, such as wastewater, environmental monitoring, etc., and can be connected to a variety of ion selective electrodes. The instrument can be installed on the panel, wall, or pipeline. The instrument provides 2 current outputs, with a maximum load of 500 ohm. The instrument provides 3 control relays, and the maximum withstand voltage and current of the relay is 5A/250VAC or 5A/30VDC.

Package Contents and Warranty

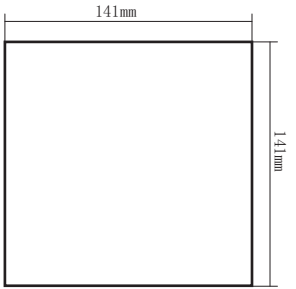
144 series: product packaging, including 1 instrument, 1 instruction manual, and 4 sets of brackets (screws, fixing blocks, fixing rods)

Specifications

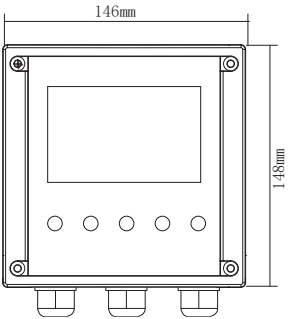
Function	ION
Measurement range	0.00-20.00 / 0.0-200.0 / 0.0-2000.0 / 0-20000
Resolution	0.01 ppm / 0.1 ppm / 1 ppm
Accuracy	+/-0.01 ppm / +/-0.1 ppm / +/-1 ppm
Voltage input range	0.0-1000.0 mV
Temperature compensation	Pt1000 / NTC10K
Temperature measurement range	-10.0 to +130.0 deg C
Temperature compensation range	-10.0 to +130.0 deg C
Temperature resolution	0.1 deg C
Temperature accuracy	+/-0.2 deg C
Operating temperature	0 to +70 deg C
Storage temperature	-20 to +70 deg C
Input impedance	>10^12 ohm
Display	Large backlit color LCD
Ion current output 1	Isolated 4-20 mA; max. load 500 ohm
Temperature current output 2	Isolated 4-20 mA; max. load 500 ohm
Current output accuracy	+/-0.05 mA
RS485	Modbus RTU standard protocol
Communication rate	9600 / 19200 / 38400
Relay contact rating	5 A / 250 VAC; 5 A / 30 VDC
Cleaning settings	ON: 1-1000 s; OFF: 0.1-1000.0 h
Multifunction relay	Cleaning / periodic alarm / error alarm
Relay delay	0-120 s
Data logging	500,000 records
Language	Simplified Chinese
USB port (optional)	Record download and software update (USB drives up to 32 GB)
Protection rating	IP65
Power supply	90-260 VAC; power consumption <5 W
Installation	Panel / wall / pipe mounting
Instrument weight	144 Series: 0.85 kg

Instrument
Installation

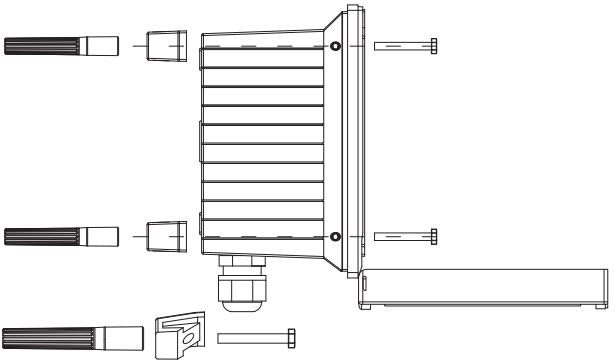
144 series: The instrument can be installed in panel type, pipe type or wall-mounted type. Panel installation: Open a 141mmx141mm square hole on the distribution box panel, place the instrument from the front of the distribution box panel, insert the screws from the back cover, and lock the fixing block and rod from the rear of the distribution box panel.



144 Series Opening Dimensions

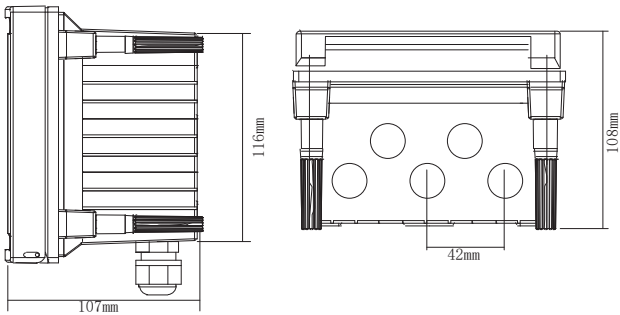


Panel Dimensions

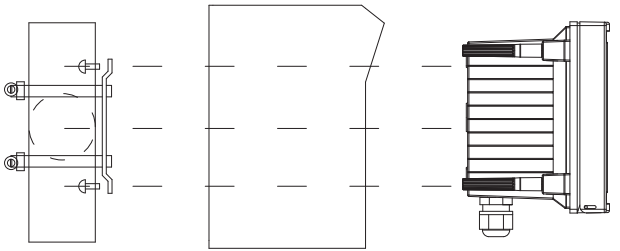


144 Series Bracket Installation Diagram

Terminal Labels



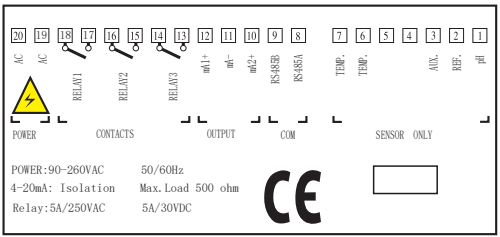
144 Series Dimensional Drawing



144 series wall mounting and pipeline installation

Terminal Labels

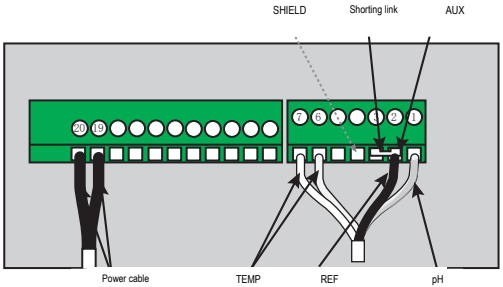
144 Series



Note: 1. Strip the pH electrode wire and remove the black conductive rubber inside the outer sheath. x O

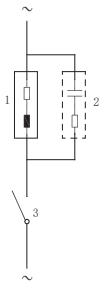
2. The two-wire electrode (2,3 must be connected to a short-circuit piece) and the three-wire electrode (including the ground pin) have different connection methods, please see the wiring label.

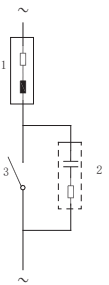
144 series electrode wiring diagram



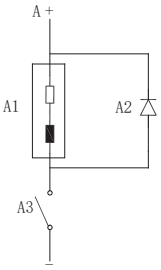
Relay Contact Protection Diagram

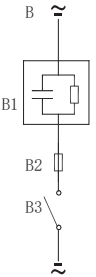
Relay contacts receiving electrical sparks will affect the service life, especially in inductive and capacitive loads. In order to suppress sparks and arcs, an RC circuit should be used to extend the relay life.

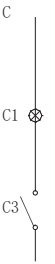




AC protection for inductive loads 1. Load 2. RC spark elimination, for 220VAC, R=10 ohms 1 watt, C=0.1630V 3. Relay contacts

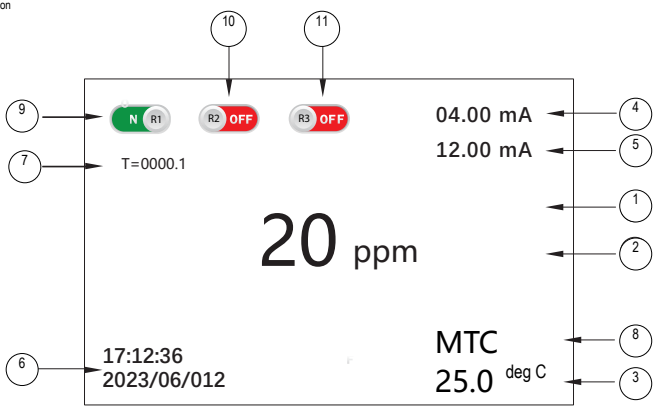






A DC protection, A1: Inductive load A2: 1N4007, A3: Relay contact B AC and DC protection, B1: Capacitive load, B2: 0.8 ohm/1 watt (DC 24V), B3: Relay contact C Resistive load, C1: Light bulb, C3: Relay contact

Display
Description



1. Main display 2. Unit 3. Temperature and unit 4. First current 5. Second current 6. Measurement mode, date and time 7. Countdown: cycle time/cleaning time, when relay 3 has a delay, Delay will be displayed 8. Temperature compensation 9. Relay 1 status indication 10. Relay 2 status indication 11. Relay 3 status indication

Note: If the ion measurement value exceeds the range, 99.99/99999 will be displayed.
If the temperature exceeds the positive and negative range, it will display -99.9/999.9

Key Description

SET CAL UP DOWN ENTER

Key	Measurement	Settings	Calibration	Record
SET	Enter password	Exit	Exit	Exit
CAL	Enter calibration	Move digit	Move digit	Move digit
UP	View records	Increase value	Increase value	Increase value
DOWN	None	Decrease value	Decrease value	Decrease value
ENTER	Backlight on/off	Confirm	Confirm	Confirm

Hold Mode

Hold mode is a safety mode used during calibration, settings, record viewing and relay cleaning. In hold mode, all relays are open (inactive), the output current follows the selected fixed-current or last-current setting, and the displayed measurement remains unchanged.

Entering any of these four modes activates hold mode. After returning to measurement mode, hold mode remains active for about 10 seconds. The instrument also remains in hold mode for about 10 seconds after power-up.

Output current in hold mode: Fixed Current or Last Current.
Fixed Current: set any value from 4.00 to 20.00 mA.
Last Current: holds the last measured output current.
Relays in hold mode: all open (inactive).

Settings

Press SET, use UP/DOWN and SHIFT to enter password 0001, then press ENTER. Press SET to exit. If no key is pressed for 10 minutes, the instrument returns to measurement mode.

Password
0000

Password
0001

Main Screen

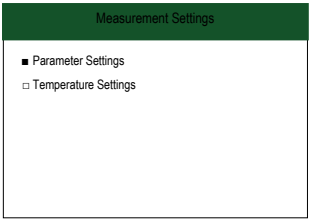
Select a function with UP/DOWN and press ENTER.

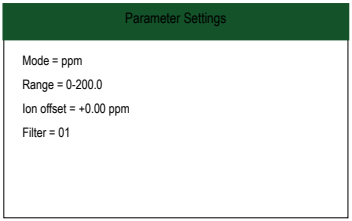
Settings 1/2
Measurement Settings
Output Settings
Relay Settings
Data Logging Settings
Output Test
Calibration
General Settings

General Settings
Date and Time
Language
Backlight
Version
Restore Factory Settings

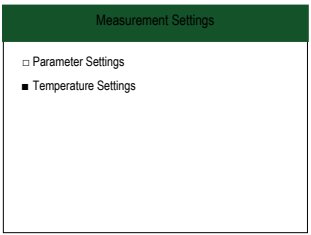
Notes: If a value is outside its allowed range, Error appears at the top of the display. Press ENTER to save each value. Press SET at any time to exit. After 10 minutes without a key press, the instrument returns to measurement mode.

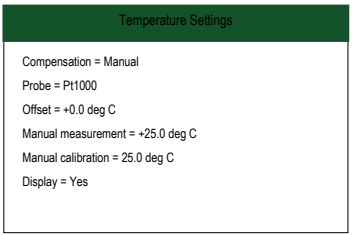
Measurement Settings





1. Select ppm or mg/L. 2. Select the measurement range. 3. Enter ion offset: +/-1.00, +/-10.0, +/-100.0 or +/-1000 according to the selected range. 4. Filter range: 0-10. Increase the filter value if readings are unstable; a higher value slows the response.





Select automatic or manual compensation and the matching Pt1000 or NTC10K probe. Automatic temperature offset range: +/-5.0 deg C. In manual mode, the measurement and calibration temperatures use the entered values. When Automatic is selected, connect the correct temperature probe; otherwise the temperature output will be incorrect.

Output Settings

Current Output Settings

- ■ Current Output A
- □ Current Output B
- □ Communication

Current Output A - Ion

Mode = Ion

Output = 4-20 mA

4.00 mA = 00000 ppm

20.00 mA = 20000 ppm

Offset = +0.00 mA

Filter time = 01 s

Hold mode = Fixed Current

Fixed value = 04.00 mA

Current Output A - Temperature

Mode = Temperature

Output = 4-20 mA

4.00 mA = +000.0 deg C

20.00 mA = +100.0 deg C

Offset = +0.00 mA

Filter time = 01 s

Hold mode = Fixed Current

Fixed value = 04.00 mA

1. Set the ion value corresponding to 4.00 mA. 2. Set the value corresponding to 20.00 mA. Minimum span: 1.0 / 10.0 / 10.0 / 100 ppm depending on range. 3. Current offset range: +/-1.00 mA. 4. Filter time: 0-120 s; a larger value produces a smoother but slower output. 5. Hold mode: Fixed Current or Last Current. Output limits after offset: 3.50-22.00 mA.

Output Settings

Current Output Settings

- ■ Current Output B
- □ Current Output A
- □ Communication

Current Output B - Ion

Mode = Ion

Output = 4-20 mA

4.00 mA = 00000 ppm

20.00 mA = 20000 ppm

Offset = +0.00 mA

Filter time = 01 s

Hold mode = Fixed Current

Fixed value = 04.00 mA

Current Output B - Temperature

Mode = Temperature

Output = 4-20 mA

4.00 mA = +000.0 deg C

20.00 mA = +100.0 deg C

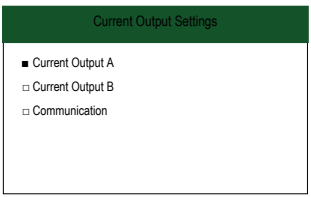
Offset = +0.00 mA

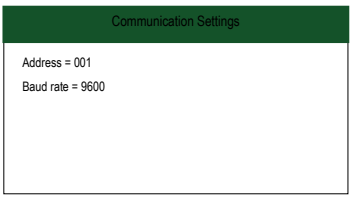
Filter time = 01 s

Hold mode = Fixed Current

Fixed value = 04.00 mA

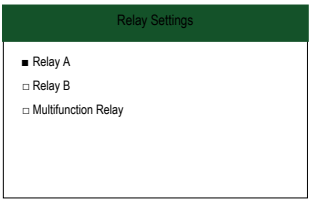
1. Set the ion value corresponding to 4.00 mA. 2. Set the value corresponding to 20.00 mA. Minimum span: 1.0 / 10.0 / 10.0 / 100 ppm depending on range. 3. Current offset range: +/-1.00 mA. 4. Filter time: 0-120 s; a larger value produces a smoother but slower output. 5. Hold mode: Fixed Current or Last Current. Output limits after offset: 3.50-22.00 mA.

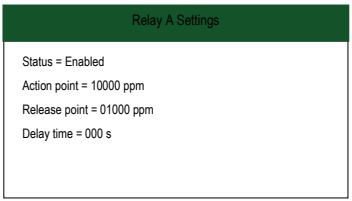




1. Select communication address: 1-255.
2. Select the baud rate with UP/DOWN.

Relay Settings





1. Status: select Enabled or Disabled. If disabled, the relay does not operate.
2. Action point: ion value at which the relay operates.
3. Release point: ion value at which the relay releases.
4. Delay time: 0-120 s before relay action after the action point is reached.

Example: to run a pump at 100 ppm and stop it at 10 ppm, set Action point to 100 ppm and Release point to 10 ppm.

Relay Settings

□ Relay A

■ Relay B

□ Multifunction Relay

Relay B Settings

Status = Enabled

Action point = 01000 mg/L

Release point = 10000 mg/L

Delay time = 000 s

1. Status: select Enabled or Disabled. If disabled, the relay does not operate.
2. Action point: ion value at which the relay operates.
3. Release point: ion value at which the relay releases.
4. Delay time: 0-120 s before relay action.
Example: to run a pump at 10 ppm and stop it at 100 ppm, set Action point to 10 ppm and Release point to 100 ppm.

Relay Settings

□ Relay A

□ Relay B

■ Multifunction Relay

Relay 3 Settings

Status = Disabled

Cycle time = 0001.0 h

Cleaning time = 0010 s

Delay time = 000 s

Function = Error Alarm

1. Status: select Enabled or Disabled. 2. Cycle time: interval for cleaning or periodic alarm. 3. Cleaning time: relay-on time after the cycle expires. 4. Delay time: 0-120 s. 5. Function: Cleaning, Periodic Alarm or Error Alarm.

Cleaning: the relay closes for the cleaning time, then a new cycle starts.
Periodic Alarm: the relay closes when the cycle expires and remains active until Periodic Alarm is selected again.
Error Alarm: any measurement error closes the relay until the error is resolved; no delay is applied.

Data Logging Settings

Data Logging Settings

■ Settings
□ View Logged Data
□ Download Records

Logging Parameters

Status = Off
Display mode = Record
Storage interval = 01 min
Clear records = No

Data Logging Settings

□ Settings
■ View Logged Data
□ Download Records

Enter Starting Record

000000
Press ENTER to view

Data Logging Settings

□ Settings
□ View Logged Data
■ Download Records

Download Records

Insert a USB drive
Press ENTER to download

Use UP/DOWN to select a function and ENTER to confirm. Logging interval: 1-60 min. Records can be displayed as a list or graph. Insert a USB drive to download records. Downloading 500,000 records takes about 10 minutes; 50,000 records takes about 1 minute.

Notes: When data logging is enabled, records are stored at the selected interval. Record display shows 5 entries per page; graph display shows 150 entries per page. Clearing all records takes about 10 seconds.

Ion mode record display: 5 entries per page

Record 0010300
24-01-14 00100 ppm 025.0 deg C
21:20:49
24-01-14 00100 ppm 025.0 deg C
21:20:49
...

Ion mode graph display: 150 entries per page

Graph 0010300
20000
10000
00000
2023-07-14 05:20:49

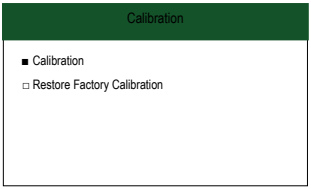
Output Test

Output Test
Current output A = 04.00 mA
Current output B = 04.00 mA
Relay A = Release
Relay B = Release
Multifunction relay = Release

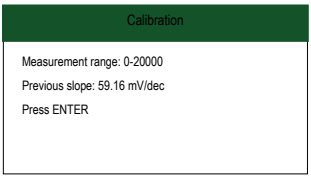
1. Current output A test: 4.00-20.00 mA.
2. Current output B test: 4.00-20.00 mA.
3. Relay A test: select with UP/DOWN.
4. Relay B test: select with UP/DOWN.

Use this function to verify current outputs and relay operation.

Calibration (Ion)

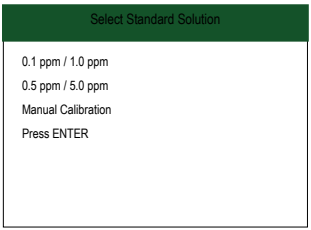


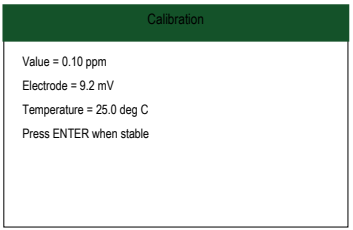
Select a function with UP/DOWN and press ENTER.
1. Calibration: enter calibration parameters.
2. Restore Factory Calibration: restore factory calibration values.



The values shown during calibration depend on the selected measurement range. The previous calibration slope is displayed.

Calibration (range 0-20.00)





Calibration

Calibration
Value = 0.10
Electrode = 9.2 mV
Temperature = 25.0 deg C
Press ENTER when stable

Calibration
Value = 0.10
Electrode = 98.8 mV
Temperature = 25.0 deg C
Slope = 56.00 mV/dec

1. Use UP/DOWN to select the standard-solution value, then press ENTER to start calibration. The available values depend on the selected range; enter the value manually when required. 2. When the voltage is stable, press ENTER to complete calibration. 3. The right display shows electrode voltage. 4. The final electrode slope is displayed when calibration is complete; press ENTER to return.

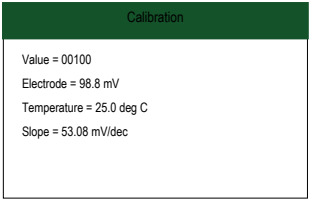
Calibration (range 0-20000)

Calibration
Value = 00010
Electrode = 45.8 mV
Temperature = 25.0 deg C
Enter first point value

Calibration
Value = 00010
Electrode = 45.8 mV
Temperature = 25.0 deg C
Reading stable; press ENTER

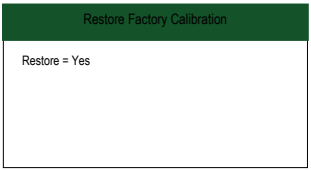
Calibration
Value = 00100
Electrode = 98.8 mV
Temperature = 25.0 deg C
Enter second point value

Calibration
Value = 00100
Electrode = 98.8 mV
Temperature = 25.0 deg C
Reading stable; press ENTER



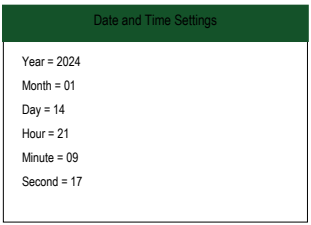
1. Place the electrode in the first standard solution. 2. Enter the first standard value and press ENTER. 3. When the voltage is stable, press ENTER to proceed to the second point. 4. Place the electrode in the second standard solution. 5. Enter the second standard value and press ENTER; press ENTER again when stable. 6. The right side shows electrode voltage. 7. The final slope is displayed after calibration. Limits: first point 0.0-60.0 deg C and +/-900.0 mV; second point 0.0-60.0 deg C and +/-1000.0 mV.

Restore Factory Calibration



Restores calibration values to the factory state. Other parameters changed in Settings are not affected.

General Settings - Date and Time



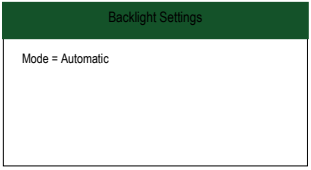
Set the date and time with UP/DOWN. The clock is retained for about two days after power loss.

General Settings - Language



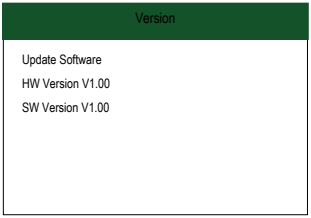
Sets the display language to Simplified Chinese.

General Settings - Backlight



Select automatic backlight-off after 60 seconds or manual backlight operation.

General Settings - Version



Displays the current hardware and software versions. For an update, copy the new software to a USB drive, insert it, and select Update Software. The update takes about 30 seconds.

General Settings - Restore Factory Settings

Restore Factory Settings

Measurement = No

Current outputs = No

Relays = No

Communication = No

Restore all = No

Select individual groups or Restore All with UP/DOWN. Backlight contrast, communication settings and measurement mode are not affected.

Factory Default Values

Parameter	Default	Range / Options
Ion 20 mA value (0-20.00)	20.00 ppm	1.00-20.00
Ion 4 mA value (0-20.00)	0 ppm	0.00-19.00; min span 1.00
Ion 20 mA value (0-200.0)	200.0 ppm	10.0-200.0
Ion 4 mA value (0-200.0)	0 ppm	0.0-190.0; min span 10.0
Ion 20 mA value (0-2000.0)	2000.0 ppm	100.0-2000.0
Ion 4 mA value (0-2000.0)	0 ppm	0-1990.0; min span 10.0
Ion 20 mA value (0-20000)	2000.0 ppm	100-20000
Ion 4 mA value (0-20000)	0 ppm	0-19900; min span 100
Temperature 20 mA value	100.0 deg C	0.0-130.0
Temperature 4 mA value	0.0 deg C	-10.0-120.0; min span 10.0
Current output 1 offset	0.00 mA	+/-1.00
Current output 2 offset	0.00 mA	+/-1.00
Current output 1 filter time	0 s	0-120
Current output 2 filter time	0 s	0-120
Current output 1 fixed value	4.00 mA	4.00-20.00
Current output 2 fixed value	4.00 mA	4.00-20.00
Current output 1 hold mode	Last	Fixed / Last
Current output 2 hold mode	Last	Fixed / Last
Relay 1 action (20.00)	10.00 ppm	0-20.00
Relay 1 release (20.00)	1.00 ppm	0-20.00; min gap 0.01
Relay 1 action (200.0)	100.0 ppm	0-200.0
Relay 1 release (200.0)	10.0 ppm	0-200.0; min gap 0.1

Factory Default Values (continued)

Parameter	Default	Range / Options
Relay 1 action (2000.0)	1000.0 ppm	0-2000.0
Relay 1 release (2000.0)	100.0 ppm	0-2000.0; min gap 0.1
Relay 1 action (20000)	10000 ppm	0-20000
Relay 1 release (20000)	1000 ppm	0-20000; min gap 1
Relay 1 delay	0 s	0-120
Relay 2 action (20.00)	1.00 ppm	0-20.00
Relay 2 release (20.00)	10.00 ppm	0-20.00; min gap 0.01
Relay 2 action (200.0)	10.0 ppm	0-200.0
Relay 2 release (200.0)	100.0 ppm	0-200.0; min gap 0.1
Relay 2 action (20000)	1000 ppm	0-20000
Relay 2 release (20000)	10000 ppm	0-20000; min gap 1
Relay 3 cycle time	1.0 h	0.1-1000.0
Relay 3 cleaning time	10 s	1-1000
Relay 3 delay	0 s	0-120
Relay 3 function	Error Alarm	Cleaning / Periodic / Error
Storage interval	1 min	1-60
Communication ID	1	1-255
Baud rate	9600	9600 / 19200 / 38400
Ion offset	0 ppm	+/-1.00 / 10.0 / 100.0 / 1000
Temperature offset	0.0 deg C	+/-5.0
Manual measurement temp.	25.0 deg C	-10.0-130.0
Manual calibration temp.	25.0 deg C	0.0-60.0
Temperature coefficient	0.00240	0.00001-1.00000
Filter	1	0-10
Temperature compensation	Manual	Automatic / Manual
Temperature probe	Pt1000	Pt1000 / NTC10K
Record display mode	Record	Record / Graph

Password

Press SET. 8243: user electrode calibration. 8888: function settings. If no key is pressed for 10 minutes, the instrument exits automatically and saves all changed parameters.

Error Codes

Error 01 Memory error
Error 02 Measured value above maximum
Error 03 Measured value below minimum
Error 04 Temperature above maximum
Error 05 Temperature below minimum
Error 06 Current output 1 above 20.5 mA; upper limit 22.00 mA
Error 07 Current output 1 below 3.8 mA; lower limit 3.5 mA
Error 08 Current output 2 above 20.5 mA; upper limit 22.00 mA
Error 09 Current output 2 below 3.8 mA; lower limit 3.5 mA
Error 10 Data logger fault
Error 11 ADC fault
Error 12 Factory data missing

RS485 Communication

The instrument uses the standard Modbus RTU protocol. Measurement values are floating-point numbers; other data are signed two-byte parameters (-32767 to 32767) represented in hexadecimal, with the most significant bit used as the sign bit.

Master request frame:

Instrument ID	Function	Start address	Quantity	CRC16
1 byte	1 byte	2 bytes	2 bytes	2 bytes
0x01	0x03	0x0001	0x0001	0xD5CA

Example: read the first data item; refer to the register table below.

Slave response frame:

Instrument ID	Function	Byte count	Data	CRC16
1 byte	1 byte	1 byte	N bytes	2 bytes
0x01	0x03	0x02	0x02 0xBC	0xB895

Exception response 01: unsupported function code
Exception response 02: invalid address
Exception response 03: invalid data quantity

Baud rate: 9600 (fixed) Data bits: 8 Parity: None Stop bits: 1
Function 03: Read holding registers Function 04: Read input registers

Function 04 - Read Measurement Values

Dec	Hex	Register	Format
00	0x00	Model	Fixed M
01	0x01	Model	Fixed 7
02	0x02/0x03	Ion measurement	Floating point
04	0x04/0x05		
06	0x06	Temperature	X0.1
07	0x07	Current output 1	X0.01
08	0x08	Current output 2	X0.01
09	0x09	Unit	X1
10	0x0A		
11	0x0B	Error code	X1
12	0x0C	Status	X1

Function 03 - Read Setting Values

Dec	Hex	Register	Format
00	0x00	ION 20 mA value (20.00)	Float
02	0x02	ION 4 mA value (20.00)	Float
04	0x04	ION 20 mA value (200.0)	Float
06	0x06	ION 4 mA value (200.0)	Float
08	0x08	ION 20 mA value (200.0)	Float
10	0x0A	ION 4 mA value (200.0)	Float
12	0x0C	ION 20 mA value (2000)	Float
14	0x0E	ION 4 mA value (2000)	Float
16	0x10	ION 20 mA value (20.00)	Float
18	0x12	ION 4 mA value (20.00)	Float
20	0x14	ION 20 mA value (200.0)	Float
22	0x16	ION 4 mA value (200.0)	Float
24	0x18	ION 20 mA value (200.0)	Float
26	0x1A	ION 4 mA value (200.0)	Float
28	0x1C	ION 20 mA value (2000)	Float
30	0x1E	ION 4 mA value (2000)	Float
32	0x20	Temperature 20 mA value	X0.1
33	0x21	Temperature 4 mA value	X0.1
34	0x22	Temperature 20 mA value	X0.1
35	0x23	Temperature 4 mA value	X0.1
36	0x24	Current output 1 offset	X0.01
37	0x25	Current output 2 offset	X0.01
38	0x26	Current output 1 filter time	X1
39	0x27	Current output 2 filter time	X1
40	0x28	Current output 1 fixed value	X0.01
41	0x29	Current output 2 fixed value	X0.01
42	0x2A	Current output 1 hold mode	X1: 0 Fixed; 1 Last
43	0x2B	Current output 2 hold mode	X1: 0 Fixed; 1 Last

Function 03 - Read Setting Values (continued)

Dec	Hex	Register	Format
44	0x2C	Relay 1 delay	X1
45	0x2D	Relay 2 delay	X1
46	0x2E	Relay 1 action (20.00)	Float
48	0x30	Relay 1 release (20.00)	Float
50	0x32	Relay 1 action (200.0)	Float
52	0x34	Relay 1 release (200.0)	Float
54	0x36	Relay 1 action (2000.0)	Float
56	0x38	Relay 1 release (2000.0)	Float
58	0x3A	Relay 1 action (20000)	Float
60	0x3C	Relay 1 release (20000)	Float
62	0x3E	Relay 2 action (20.00)	Float
64	0x40	Relay 2 release (20.00)	Float
66	0x42	Relay 2 action (200.0)	Float
68	0x44	Relay 2 release (200.0)	Float
70	0x46	Relay 2 action (2000.0)	Float
72	0x48	Relay 2 release (2000.0)	Float
74	0x4A	Relay 2 action (20000)	Float
76	0x4C	Relay 2 release (20000)	Float
78	0x4E	Relay 3 cycle time	X0.1
79	0x4F	Relay 3 cleaning time	X1
80	0x50	Relay 3 delay	X1
81	0x51	Relay 3 function	X1: 0 Clean; 1 Periodic; 2 Error
82	0x52	Logging interval	X1
83	0x53	ION offset (20.00)	Float
85	0x55	ION offset (200.0)	Float
87	0x57	ION offset (2000.0)	Float
89	0x59	ION offset (20000)	Float
91	0x5B	Temperature offset	X0.1
92	0x5C	Manual measurement temp.	X0.1
93	0x5D	Manual calibration temp.	X0.1
94	0x5E	Temperature compensation	X1: 0 Auto; 1 Manual
95	0x5F	Probe type	X1: 0 Pt1000; 1 NTC10K
96	0x60	Language	X1: 0 English; 1 Chinese
97	0x61	Filter	X1