

USER GUIDE SINGLE ION

HALF-CELL ELECTRODES

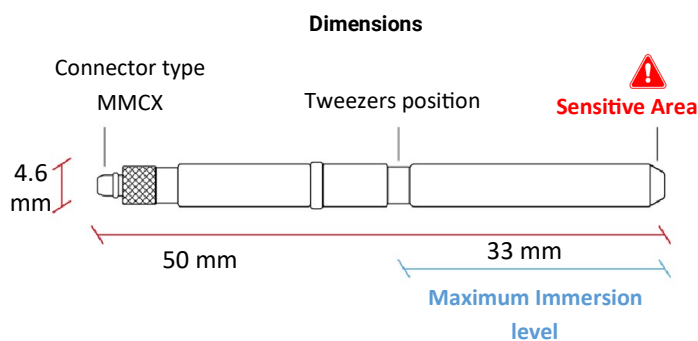
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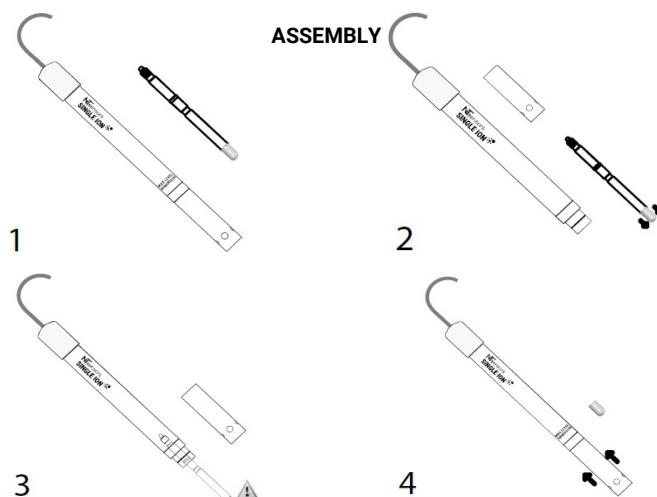
Carrer de la Font, 48
43480 Vila-seca, Spain



All-solid-state
Ion Selective Electrodes
based on carbon nanotubes



ASSEMBLY

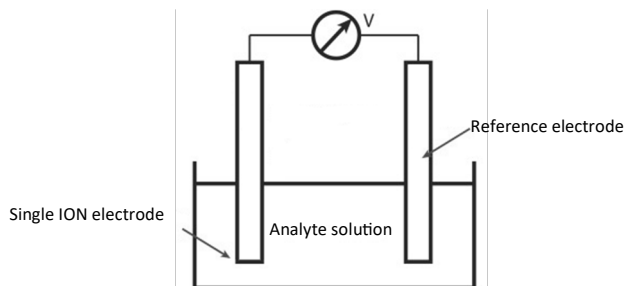


Technical Specifications

Order Code	Electrode	ION	Slope (mV/dec)	Linear Range (mg/L)	pH range	Interferences & Selectivity
MD018	Ammonium	NH_4^+	54 ± 5	0,1 - 9000	4 - 8,5	$\text{K}^+ = 10^{-0.8}$ $\text{Na}^+ = 10^{-2.9}$ $\text{Ca}^{2+} = 10^{-4.8}$ $\text{Mg}^{2+} = 10^{-5.5}$
MD080*	Bromide	Br^-	-54 ± 5	1 - 8000	1 - 12	$\text{Cl}^- = 10^{-2.7}$ $\text{OH}^- = 10^{-4.5}$ Ag^+ , S^{2-} , CN^- affects accuracy. I^- must be negligible in comparison to Br^-
MD040	Calcium	Ca^{2+}	24 ± 5	0,4 - 4000	3,4 - 8	$\text{H}^+ = 10^{-2.9}$ $\text{Na}^+ = 10^{-3.7}$ $\text{K}^+ = 10^{-3.7}$ $\text{Mg}^{2+} = 10^{-4.7}$
MD035*	Chloride	Cl^-	-54 ± 5	1,3 - 35000	2 - 12	I^- damages the membrane; Ag^+ , S^{2-} affects accuracy. Br^- and CN^- must be negligible compared to Cl^-
MD019*	Fluoride	F^-	-54 ± 5	1 - 19000	4 - 8	OH^- affects measurements. Keep pH < 8 and use TISAB due to complexation in real samples.
MD001	pH	H^+	-54 ± 5	--	2 - 9,5	No significant interferences.
MD127*	Iodide	I^-	-54 ± 5	1 - 10000	2 - 12	Cl^- , OH^- , Ag^+ , S^{2-} affects accuracy. CN^- must be negligible compared to I^- .
MD007	Lithium	Li^+	54 ± 5	0,1 - 7000	2 - 12	$\text{K}^+ = 10^{-2.3}$ $\text{Na}^+ = 10^{-2.4}$ $\text{H}^+ = 10^{-3.0}$ $\text{NH}_4^+ = 10^{-3.0}$ $\text{Mg}^{2+} = 10^{-4.3}$ $\text{Ca}^{2+} = 10^{-4.7}$
MD024	Magnesium	Mg^{2+}	24 ± 5	2,4 - 2400	3 - 8,5	$\text{Ca}^{2+} = 10^{-1.9}$ $\text{K}^+ = 10^{-3.3}$
MD062	Nitrate	NO_3^-	-54 ± 5	1 - 30000	3 - 10	$\text{ClO}_4^- = 10^{-3.1}$ $\text{SCN}^- = 10^{-1.7}$ $\text{Br}^- = 10^{-1.0}$ $\text{NO}_2^- = 10^{-1.8}$ $\text{Cl}^- = 10^{-2.2}$ $\text{CH}_3\text{COO}^- = 10^{-3.3}$ $\text{F}^- = 10^{-3.7}$
MD046	Nitrite	NO_2^-	-54 ± 5	1 - 1000	4 - 8	$\text{SCN}^- = 10^{-0.2}$ $\text{I}^- = 10^{-2.2}$ $\text{ClO}_4^- = 10^{-2.4}$ $\text{Br}^- = 10^{-3.3}$
MD099	Perchlorate	ClO_4^-	-54 ± 5	1 - 3000	3 - 9,5	$\text{I}^- = 10^{-1.9}$ $\text{SCN}^- = 10^{-2.6}$ $\text{CH}_3\text{COO}^- = 10^{-3.2}$ $\text{Br}^- = 10^{-3.7}$
MD039	Potassium	K^+	54 ± 5	0,5 - 39000	1 - 9	$\text{NH}_4^+ = 10^{-2.1}$ $\text{Ca}^{2+} = 10^{-3.9}$ $\text{Li}^+ = 10^{-4.3}$ $\text{Na}^+ = 10^{-4.6}$
MD023	Sodium	Na^+	54 ± 5	2,3 - 23000	1 - 9	$\text{Li}^+ = 10^{-3.2}$ $\text{K}^+ = 10^{-2.5}$ $\text{Ca}^{2+} = 10^{-4.0}$

1. Introduction

Single ION belongs to the family of all-solid-state ion-selective electrodes based on carbon nanotubes (CNT-ISE) for detection and quantification of ionic species in a wide range of samples and fields of application: natural water, clinical analysis, industrial process, waste-water, aquaculture, hydroponics, etc.



Single ION is a half cell electrode and always requires a reference electrode to work. The electrode does not contain any internal electrolyte.

2. Required Equipment

The probes are compatible with ION/ISE/pH meters:

- Meter needs minimum input impedance of $1 \cdot 10^{12}$ Ohm.
- It must be able to read electromotive force generated in millivolts (mV).
- Needs a BNC input for the electrode.
- Needs a input for the reference electrode or pH combination electrode.
- The meter's reference input needs to be internally connected to the shell of the ISE's BNC connector.

Other:

- Flasks, pipettes and electrodes holder.
- Deionized water to prepare solutions and rinse the sensors.
- Standard and conditioning solutions of the target ion.

3.3 Measures

To obtain accurate and reliable readings, please follow these guidelines:

- Maintain the same temperature, stirring, and pH conditions as during the calibration process.
- Solid particles, colour, or turbidity do not affect electrode performance.
- If the sample contains solid particles, ensure to rinse the electrodes properly with deionized water after each use.
- Consider potential ionic interferences when using direct calibration. Use complementary electrodes to identify interfering ions or the standard addition technique.

3.3.1 Standard addition method

The standard addition technique is used to quantify the concentration of an ion species in a sample, especially when dealing with complex sample matrices or unknown interferences.

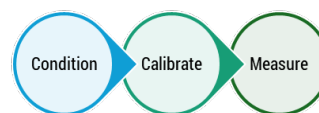
- Measure the initial potential (mV) E_p in the sample.
- Add a known amount of the target ion (standard solution). The addition should cause a potential change of at least 10 to 30 mV.
- Measure the new potential (mV) E_{ps} in the sample after the standard solution is added.

The concentration of the target ion in the sample can be calculated as follows:

- C_p : Target ion concentration in the sample (mol/L).
- C_s : Concentration of the standard solution (mol/L).
- V_p : Volume of the sample (mL).
- V_s : Volume of the added standard solution (mL).
- E_p : Potential reading of the sample (mV).
- E_{ps} : Potential reading after adding the standard solution (mV).
- S : Theoretical/Experimental Slope of the Electrode (mV/decade).

$$C_p = \frac{C_s \left(\frac{V_s}{V_p + V_s} \right)}{10^{\frac{E_{ps} - E_p}{S} - \left(\frac{V_p}{V_p + V_s} \right)}}$$

3. Operating procedure



3.1 Condition

1. Follow the assembly instructions.
2. Ensure the electrode is not connected to the ion meter during conditioning.
3. Place the electrode in a beaker, ensuring the sensor tip doesn't touch the bottom.
4. Add a 1000 mg/L target ion solution, ensuring the solution does not exceed the maximum immersion depth marked in the cap.
5. For low concentration sample target, condition the electrode in a 10 mg/L solution.
6. For MD001 conditioning solution is $10^{-3}M$ of H^+ (in example, from an acid like HNO_3). Never condition on the pH buffers.
7. Conditioning times are:
 - A. First time or sporadic use: 8 hours (overnight)
 - B. Daily use: 30 minutes

3.2 Calibration

Create a calibration curve by measuring standards in increasing concentrations.

- **Calibration standards:** Use at least two standards with a one order magnitude difference (i.e.: 10–100ppm). For better accuracy, use three standards.
- **Electrode handling:** Rinse with DI water and dry with a tissue paper, avoiding touching the sensing area of the sensor.
- **Working conditions:** Adjust your calibration frequency and the number of standards based on your conditions and accuracy needs.
- **Concentration Range:** Ensure the electrode supports the desired concentration range. Dilute your samples if they are above the higher limit.

4. Maintenance and storage

- When finished, rinse the electrode with DI water, dry drops with tissue paper, avoid contact with sensing area. Place back the rubber cap.
- The electrode must be stored dry.
- Avoid stored electrodes to be exposed to the air.
- Store the electrode unplugged from the meter. The electrode must NOT be connected to the meter when it is not in use.
- Store below 20°C in dry and dark place, avoiding direct sunlight.
- Large term storage: Keep refrigerated between 8 ~ 10 °C

5. Troubleshooting guide

Issue	Possible cause	Solution
Invariable mV	No signal received	Check the connection between the probe and the meter.
No signal	Meter disconnected	Turn on the meter. Check connection between probe and meter.
Unstable measures	Air bubbles	Check for bubbles at the tip of the electrode and shake it a little bit to eliminate.
	Electrode damaged	Replace the electrode
	Reference electrode	Make sure it is connected and it is immersed in the same liquid as the single ION.
	External electrical noise	Turn off or disconnect the equipment that produces electromagnetic interferences (i.e. magnetic stirrer)
Incorrect Slope	Lack of condition	Condition sensor for 8 hours.
	Standard solutions	Check standard solution preparation.
	Reference electrode	Replace the reference electrode.
Out of scale values	Connection	Unplug and plug again the sensor.
	Air bubbles	Check for bubbles at the tip of the electrode and shake it a little bit to eliminate.

6. Warranty

Our electrodes are covered for manufacturing defects. Issues during first use should be reported immediately. The warranty excludes improper use, normal wear and tear, premature aging caused by specific samples, and accidental damage. Warranty is valid for 3 months from purchase date.

7. Disposal

Electrodes should be recycled at designated collection points for electronic equipment, not disposed of as household waste, to help conserve natural resources.