DOC022.53.80072

MP Series Portable Meters

USER MANUAL

October 2009, Edition 1

hh/dk

Table of contents

Section 1 Specifications

Specifications are subject to change without notice.

General	
Display	4-digit LCD
Dimensions (L x W x H)	196 x 68 x 64 mm (7.7 x 2.7 x 2.5 in.)
Weight	352 g (12.4 oz)
Case material	VALOX®[1]
COND/RES/TDS cell material	VALOX
COND/TDS electrodes (4)	316 stainless steel
COND/RES/TDS cell cup capacity	5 mL (0.2 oz)
pH /ORP sensor cup capacity	1.2 mL (0.04 oz)
Power	9V alkaline battery
Battery life	>100 hours (5000 readings)
Operating/Storage Temperature	0 to 55 ºC (32 to 132 ºF)
Protection Ratings	IP67/NEMA 6
Warranty	MP Series Meter Warranty: Two years from date of shipment (see Section 9 on page 47)
	pH/ORP Sensor Warranty: Six months from date of shipment (see Section 9 on page 47)
Ranges	
pH (MP-6 and MP-6p models)	0 to 14 pH
ORP (MP-6 and MP-6p models)	±999 mV
Conductivity	0 to 9999 µS/cm 10 to 200 mS/cm in 5 autoranges
TDS	0 to 9999 ppm 10 to 200 ppt in 5 autoranges
Mineral/Salt (MP-6p model only)	0 to 9999 ppm 10 to 200 ppt in 5 autoranges
Resistivity (MP-6 and MP-6p models)	10 KΩ to 30 MΩ
Temperature	0 to 71 ºC (32 to 160 ºF)

Resolution	
pH	±0.01 pH
ORP	±1 mV
Conductivity	0.01 (<100 µS) 0.1 (<1000 µS) 1.0 (<10 mS) 0.01 (<100 mS) 0.1 (<200 mS)
TDS	0.01 (<100 ppm) 0.1 (<1000 ppm) 1.0 (<10 ppt) 0.01 (<100 ppt) 0.1 (<200 ppt)
Mineral/Salt	0.01 (<100 ppm) 0.1 (<1000 ppm) 1.0 (<10 ppt) 0.01 (<100 ppt) 0.1 (<200 ppt)
Resistivity	0.01 (<100 KΩ) 0.1 (<1000 KΩ) 0.1 (>1 MΩ)
Temperature	0.1 ºC/ºF
Accuracy	
pH	±0.01 pH[2]
ORP	±1 mV
Conductivity	±1% of reading
TDS	±1% of reading
Mineral/salt	±1% of reading
Resistivity	±1% of reading
Temperature	±0.1 ºC
Auto temperature compensation	
pH	0 to 71 ºC (32 to 160 ºF)
Conductivity	0 to 71 ºC (32 to 160 ºF)
TDS	0 to 71 ºC (32 to 160 ºF)
Mineral/Salt	0 to 71 ºC (32 to 160 ºF)
Resistivity	0 to 71 ºC (32 to 160 ºF)
Adjustable temperature compensation	
Conductivity	0 to 9.99%/ºC
TDS	0 to 9.99%/ºC
Mineral/Salt	0 to 9.99%/ºC
Resistivity	0 to 9.99%/ºC

COND/TDS ratios pre-programmed	
Conductivity	KCl, NaCl, 442™[3]
TDS	
Mineral/salt	
Adjustable COND/TDS ratio factor	
Conductivity	0.20 to 7.99
TDS	
Mineral/salt	

[1] Trademark of SABIC Innovative Plastics IP BV

[2] ± 0.2 pH in presence of RF fields 3 V/m and >300 MHz.

[3] Trademark of Myron L Company

Section 2 General information

In no event will the manufacturer be liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual. The manufacturer reserves the right to make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the manufacturer's website.

2.1 Safety information

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger, warning and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that specified in this manual.

2.1.1 Use of hazard information

⚠ DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Indicates a situation that is not related to personal injury.

2.1.2 Precautionary labels

Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of life equipment to the Producer for disposal at no charge to the user.
Note: *For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.*

2.2 General product information

The MP-4, MP-6 and MP-6p (see Figure 2 on page 14) handheld meters allow users to test water for pH, ORP, conductivity, resistivity, TDS (Total Dissolved Solids), mineral/salt concentration and temperature.

2.2.1 Overview

The MP Series portable meters measure various parameters in water. Data can be stored and (with the optional MP-Dock) transferred to a printer, PC, or USB storage device.

- **MP-4**—Measures conductivity, resistivity, TDS and temperature
- **MP-6p**—Measures pH, ORP, conductivity, mineral/salt concentration, TDS and temperature. The mineral/salt measurement is a TDS value based on an NaCl profile.
- **MP-6**—Measures pH, ORP, conductivity, resistivity, TDS and temperature

2.2.2 Features common to all models

- 4-digit LCD
- IP67 rating
- Internal electrode sensors for maximum protection
- Time and date-stamped data logging
- Automatic temperature compensation
- Download capability with optional MP-Dock
- User-adjustable conductivity/TDS conversion ratio
- Accuracy of ±1% of reading or better
- Autorange conductivity/TDS/resistivity
- Memory stores 100 readings
- Factory-stored calibrations
- Adjustable auto shut-off

2.2.3 User mode features

- Adjustable conductivity/TDS conversion factor
- Programmable temperature compensation factor

2.3 Conductivity and pH/ORP sensor cups

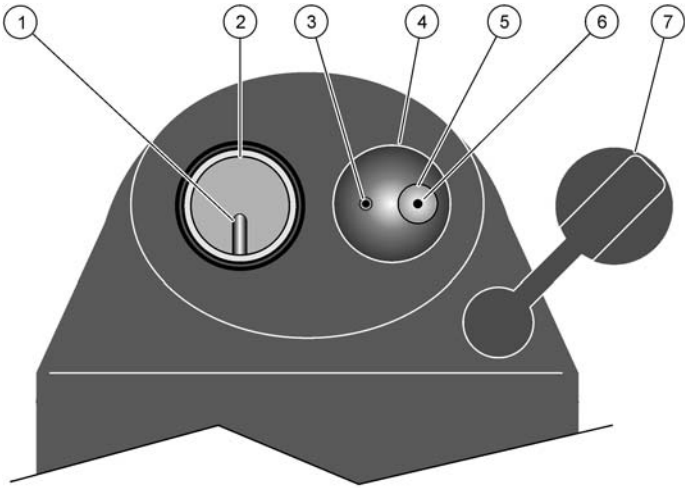


Figure 1 Model MP-6 conductivity and pH/ORP sensor cups

1	Temperature sensor	**5**	pH glass electrode
2	Conductivity cup (built-in electrodes)	**6**	Reference junction under glass pH bulb
3	ORP electrode	**7**	pH/ORP sensor protective cap
4	pH/ORP sensor cup (replaceable sensor)		

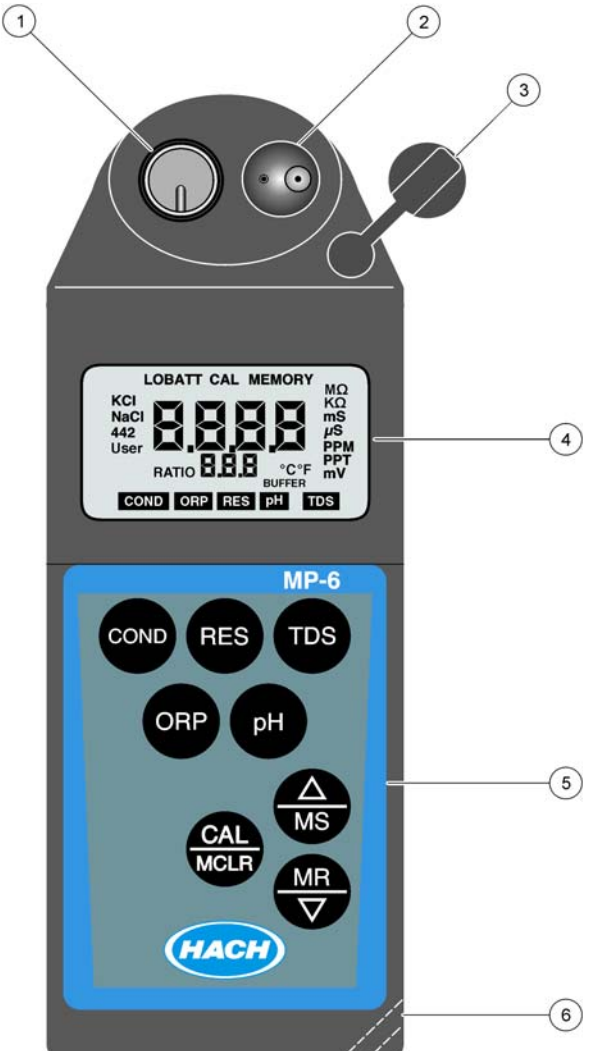


Figure 2 Model MP-6

1	Conductivity cup	**4**	Display
2	pH/ORP sensor cup	**5**	Keypad
3	pH/ORP sensor protective cap	**6**	Wrist strap slot (customer supplied)

Section 3 Operation

3.1 System startup

There is no ON key or OFF key. Press any measurement key to power on the meter. After 15 seconds of inactivity, the meter turns off (60 seconds in CAL mode). Users can adjust the automatic shut off time up to 75 seconds (see section 3.19 on page 26).

3.2 Display description

The meter display shows the temperature, units, parameter, test values, user mode, memory recall, memory store, calibration, date and time (Figure 3).

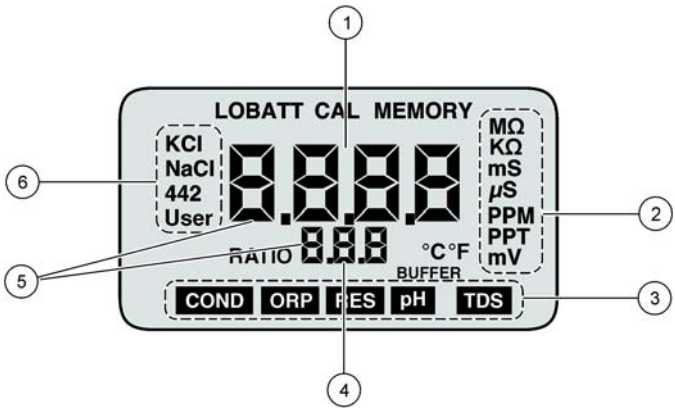


Figure 3 Model MP-6 display

1	Test value—Shows the test value.
2	Units of measurement—Shows the units of measurements.
3	Parameters—Shows the parameters being measured.
4	Multiple value readout—Shows the temperature value readout, user temperature compensation or conductivity/TDS ratio. Memory record location numbers or pH calibration. Also shows same date readout as the time and date indicator.
5	Time and date—Shows the time and date.
6	Selected solution—Shows the solution profile that is selected.

3.3 Keypad description

The MP-6 meter is used as an example for keypad description and function.

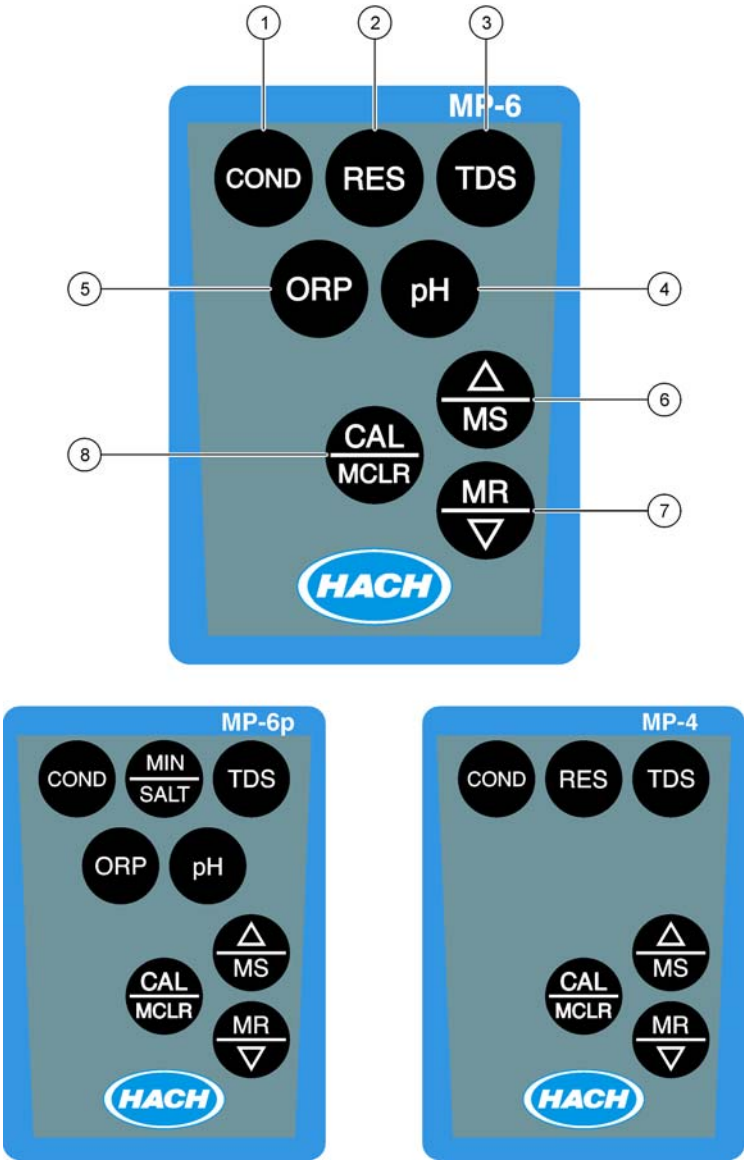


Figure 4 Keypads on MP Series meters

1	**COND**—Turns on the meter, measures conductivity, and exits any function
2	**RES**[1] (MP-4 and MP- 6 only)—Turns on the meter, measures resistivity, and exits any function
3	**TDS**—Turns on the meter, measures TDS, and exits any function
4	**ORP** (MP-6 and MP-6p only)—Turns on the meter, measures pH, and exits any function
5	**UP/MS**—Scrolls up and stores value to memory
6	**MR/DOWN**—Scrolls down and recalls stored memory information
7	**CAL/CMC LR**—Enters the calibration mode, clears the memory, and provides confirmation

[1] The MP-6p meter has a **MIN/SALT** key instead of the **RES** key. The mineral/salt measurement is a TDS value based on an NaCl profile.

3.4 Take a measurement

To take a measurement:

1. Rinse the sensor cup with test solution three times and refill.

   Note: *If testing solutions that are highly concentrated or at extreme temperatures, more rinsing is required.*

2. Push the desired measurement key.

   Note: *To prevent auto shut off, push the measurement key again and as needed.*

3. Observe or record the value displayed, or push **UP/MS** to store the reading.

3.5 Measure conductivity

To measure conductivity:

1. Rinse the conductivity cup three times with the sample to be measured. This conditions the temperature compensation sensor and prepares the cell.
2. Fill the conductivity cup with the solution.
3. Push the **COND** key.
4. Observe or record the value displayed, or push **UP/MS** to store the reading. A display of [----] indicates an over range condition.

Note: *Carefully fill conductivity cup to ensure that the air bubbles do not cling to the cell wall.*

3.6 Measure resistivity (MP-4 and MP-6 models)

Resistivity is measured in low conductivity solutions. In the conductivity cup, the value can drift due to trace contaminants or absorption from atmospheric gasses. Therefore, measuring a flowing sample is recommended.

1. Make sure the pH/ORP sensor protective cap is secure to avoid contamination (MP-6 model).

2. Hold the meter at a 30 degree angle and let the sample flow into the conductivity cup continuously with no aeration.
3. Push the **RES** key.
4. Observe or record the value displayed.

Note: *If reading is lower than 10 kΩ, [- - -] is shown. Measure conductivity for these samples.*

3.7 Measure mineral/salt (MP-6p model only)

To measure mineral/salt:

1. Rinse the conductivity cup three times with the sample to be measured. This conditions the temperature compensation sensor and prepares the cell.
2. Fill the conductivity cup with the solution.
3. Push the **MIN/SALT** key.
4. Observe or record the value displayed, or push **UP/MS** to store the reading.

3.8 Measure TDS

To measure TDS:

1. Rinse the conductivity cup three times with the sample to be measured. This conditions the temperature compensation sensor and prepares the cell.
2. Fill the conductivity cup with the solution.
3. Push the **TDS** key.
4. Observe or record the value displayed, or push **UP/MS** to store the reading.

3.9 Measure ORP/Redox (MP-6 and MP-6p models)

To measure the ORP/Redox:

1. Remove the protective pH/ORP sensor cap. Squeeze the sides and pull up.
2. Rinse the sensor cup three times with the sample to be measured.
3. Shake the meter after each rinse to remove residual liquid.
4. Fill both sensor cups with the sample.
5. Push the **ORP** key.
6. Observe or record the value displayed, or push **UP/MS** to store the reading.

Important Note: *After the test, fill the pH/ORP sensor cup with pH Storage Solution and replace the protective cap. Do not allow the pH/ORP sensor cup to dry out.*

3.10 Measure pH (MP-6 and MP-6p models)

To measure pH:

1. Remove the protective pH/ORP sensor cap. Squeeze the sides and pull up.
2. Rinse the pH/ORP sensor cup three times with the sample to be measured.
3. Shake the meter after each rinse to remove residual liquid.
4. Fill both sensor cups with the sample.

5. Push the **pH** key.
6. Observe or record the value displayed, or push **UP/MS** to store the reading.

Important Note: *After the test, fill the pH/ORP sensor cup with pH Storage Solution and replace the protective cap. Do not allow the pH/ORP sensor cup to dry out.*

3.11 Select a solution

Conductivity, resistivity and TDS (including mineral/salt) require temperature compensation to 25 °C. The solution profile selection determines the temperature compensation of conductivity and calculation of TDS and mineral/salt from compensated conductivity.

There are four solution types:

- KCl
- NaCl
- 442
- User

On the left side of the display is the salt solution characteristic used to model temperature compensation of conductivity and its TDS conversion. By default, KCl is used for conductivity, NaCl is used for resistivity (and mineral/salt), and 442 (natural water characteristic) is used for TDS. The User selection allows a custom value to be entered for the temperature compensation of conductivity and the conversion ratio if measuring TDS.

Check the display to see if the solution profile displayed is the solution type desired for that measurement. To change a solution:

1. Push the **COND** key, the **RES** key, the **MIN/SALT** key or the **TDS** key to select the parameter to change the solution type.
2. Push and hold the **CAL/MCLR** key for three seconds and wait for **SEL** to appear in the display.
3. Push **UP/MS** or **MR/DOWN** to scroll to the desired solution type.
4. Push the **CAL/MCLR** key to accept the new solution.

3.11.1 Temperature compensation

Electrical conductivity indicates solution concentration and ionization of the dissolved material. Because temperature affects ionization, conductivity measurements change with temperature and must be corrected to read at 25 °C.

Temperature compensation uses the characteristics of salt solutions. The selected salt solution is displayed on the left side of the display. By default, the meter uses KCl for conductivity, NaCl for resistivity and 442 for TDS (see Appendix B on page 51).

The User mode customizes the temperature compensation and the conversion ratio if measuring TDS.

Note: *Calibration of each solution type is performed separately and calibration of one solution does not affect the calibration of the other solution types.*

3.12 Change the user-selected temperature compensation factor

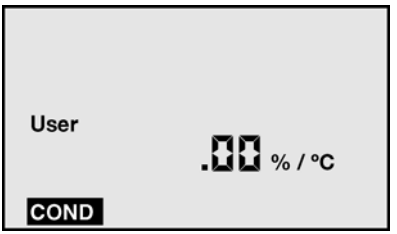
Select the User mode to change the temperature compensation factor. This feature does not apply to pH or ORP. For user mode information, (see section 2.2.3 on page 12).

1. Select the User mode (see section 3.11 on page 19).
2. Push the **CAL/MCLR** key.
3. Push **UP/MS** or **MR/DOWN** to adjust the temperature compensation factor from 0-9.99%/ºC.
4. Push the **CAL/MCLR** key twice to skip calibration adjustment and accept the new temperature compensation (three times if in TDS or MIN/SALT mode).

5. Measure samples with the new temperature compensation factor.

3.12.1 Disable temperature compensation

1. Select the User mode (see section 3.11 on page 19).
2. Push the **CAL/MCLR** key. Hold the **MR/DOWN** key until the temperature compensation shows .00%/ ºC.



3. Push the **CAL/MCLR** key twice (three times for TDS or MIN/SALT).
4. Temperature compensation is now disabled (=0) for measurements in the User mode.

3.13 Change the user-selected conductivity/TDS ratio

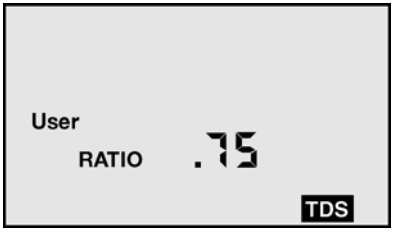
Select the User mode to change a custom conductivity/TDS conversion ratio in the range of 0.20 to 7.99.

To determine the conversion ratio for a custom solution of a known TDS ppm value, measure the solution conductivity at 25 ºC with the MP Series meter and divide the

ppm value by the µS value. For example, a solution of known 75 ppm TDS and measured 100µS conductivity at 25ºC has a conversion ratio of 75/100 or 0.75.

To enter a new conversion ratio:

1. Push the **TDS** key.
2. Select the User mode (see section 3.11 on page 19).



3. Push the **CAL/MCLR** key twice (to skip over temperature compensation adjustment) and the ratio will appear.
4. Push **UP/MS** or **MR/DOWN** until the new conversion ratio is displayed.
5. Push the **CAL/MCLR** key twice (to skip over calibration adjustment) to accept the new conversion ratio.
6. Use the new conductivity/TDS ratio to measure samples.

3.14 Settings

3.14.1 Store a value in the memory

The MP series handheld meters have memory storage for up to 100 readings. Time and date is recorded with each stored reading.

To download this stored data to a computer, see section 3.21 on page 29.

1. Push the **UP/MS** key to record a value.
2. The **MEMORY** icon appears and the temperature display is briefly replaced by a number (1-100) that shows the position of the record. Figure 5 shows a reading of 1806 µS stored in memory record # 4.

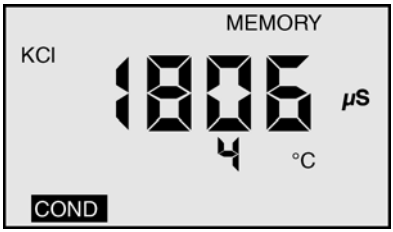


Figure 5

3.14.2 View the memory recall

To view the records in memory:

1. Push any measurement key.
2. Push the **MR/DOWN** key. The **MEMORY** icon appears, and shows the last record stored.
3. Push **UP/MS** or **MR/DOWN** to scroll to the location desired.

   Note: *The temperature display alternates between temperature recorded and location number.*
4. Push the **CAL/MCLR** key to show the time and date stamp.
5. Push any measurement key to leave memory recall.

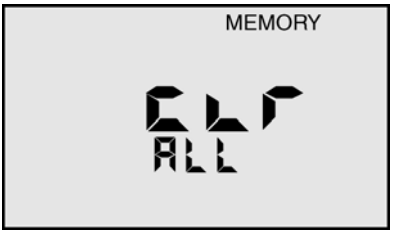
3.14.2.1 Clear a single record

After the user recalls a specific record location, push and hold the **CAL/MCLR** key to clear that memory location. This memory location is used for the next stored memory record unless the user scrolls to another empty memory position before the recall sequence ends.

3.14.3 Clear all records

To clear all records in the memory:

1. Push the **MR/DOWN** key.
2. Scroll down until CLR ALL is displayed.



3. Push the **CAL/MCLR** key. This clears all records.

3.15 Time and date

Change the time and date for travel or for a battery replacement that takes longer than three minutes.

3.15.1 Set the time

Time is displayed in a 24-hour format.

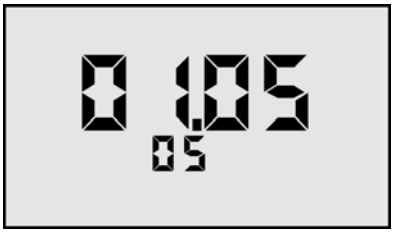
1. Push the any measurement key.
2. Push the **MR/DOWN** key repeatedly until the time is displayed. To quickly scroll through all stored memory records, hold down the **MR/DOWN** key.

3. Push the **CAL/MCLR** key to begin. The **CAL** icon shows the time.

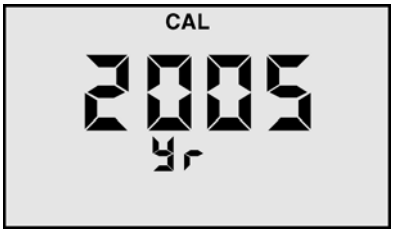
4. Push **UP/MS** or **MR/DOWN** to change the time.
5. Push the **CAL/MCLR** key to accept the new time.

3.15.2 Set the date

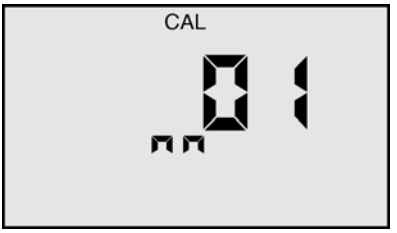
To change the date format, refer to section 3.15.3 on page 24. The default format for the date is US (mo/dy/yr).

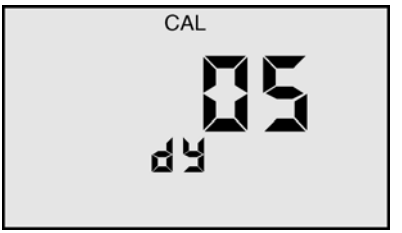


1. Push any measurement key. To quickly scroll through all stored memory records, hold down the **MR/DOWN** key.
2. Push the **MR/DOWN** key repeatedly until the date shows in the display. For example: 01.05/05 (January 5, 2005)
3. Push the **CAL/MCLR** key to begin. The **CAL** icon displays above the year.



4. Push **UP/MS** or **MR/DOWN** to change the year.
5. Push **CAL/MCLR** to accept the new setting for the year.
6. Push **UP/MS** or **MR/DOWN** to change the month.
7. Push **CAL/MCLR** to accept the new setting for the month.



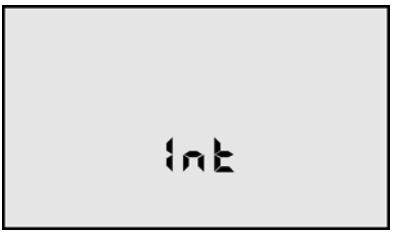


8. Push **UP/MS** or **MR/DOWN** to change the day.
9. Push **CAL/MCLR** to accept the new setting for the day.

3.15.3 Set the date format

To set the date format:

1. Push any measurement key.
2. Push the **MR/DOWN** key repeatedly until US or Int displays. To quickly scroll through all stored memory records, hold down the **MR/DOWN** key.
3. Push **CAL/MCLR** to change the date format. The new format is now displayed.



3.16 Temperature format

To set the temperature format:

1. Push any measurement key.
2. Push the **MR/DOWN** key repeatedly until C or F is displayed. To quickly scroll through all stored memory records, hold down the **MR/DOWN** key.

3. Push the **CAL/MCLR** key to switch units.
4. Push any measurement key to accept the unit preference for all temperature readings.

   Note: *Temperature compensation is always displayed in %/* ºC.

3.17 Return to factory settings

To set all calibrations to factory settings or to erase all records, follow the steps below.

1. Push any measurement key.
2. Push the **MR/DOWN** key repeatedly until FAC SEL is displayed. To quickly scroll through all stored memory records, hold down **MR/DOWN**.

3. Push the **CAL/MCLR** key to accept the factory reset. The meter returns to the measurement mode.

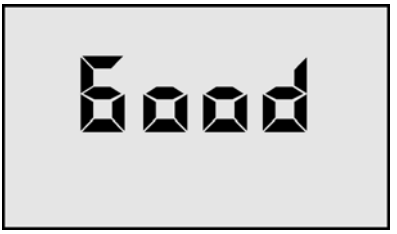
3.18 Cell check

The cell check verifies the cleanliness of the conductivity/TDS/resistivity sensor. If the display shows **.00** when the cell cup is dry, the sensor is probably clean.

In normal use, the conductivity cell may become dirty or coated and require cleaning. To perform a cell check:

1. Push the **COND** key.
2. Push the **MR/DOWN** key repeatedly until the display shows CELL ch. To quickly scroll through all stored memory records, hold down **MR/DOWN**.

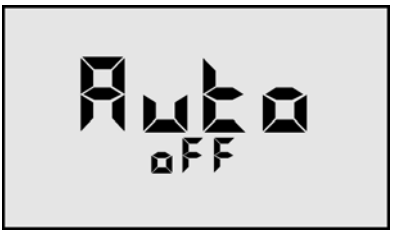
3. Push the **CAL/MCLR** key to test. If the cell is clean, “Good” displays briefly. If cell is dirty, “Cell cLn” displays. To clean the sensors, (see section 5.4 on page 38).



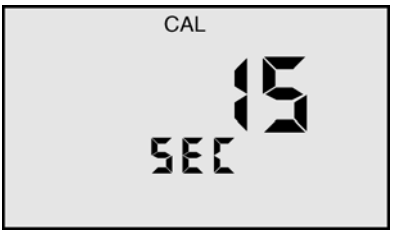
3.19 Auto off

Auto off turns the meter off when there is no activity for a period of time after a key is pushed. The default time is 15 seconds, and 60 seconds in the CAL (calibration) mode. This time may be adjusted up to 75 seconds.

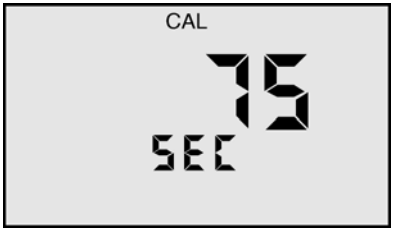
1. Push any measurement key.
2. Push the **MR/DOWN** key repeatedly until the display shows Auto oFF. To quickly scroll through all stored memory records, hold down **MR/DOWN**.



3. Push the **CAL/MCLR** key to begin. The **CAL** icon displays above the 15 SEC display.



4. Push **UP/MS** or **MR/DOWN** to change the time. The maximum time is 75 seconds.



5. Push the **CAL/MCLR** key to accept the new auto shut off time.

3.20 User mode calibration Linc[TM1] function

The **Linc**[TM] function allows for calibration when the meter is in the User mode and the user does not have a user standard solution to calibrate the meter. This ensures more accurate measurements. When the Linc function is used, the User mode is linked to another standard solution. For example: If User and KCl are linked, a KCl standard solution is used to calibrate the instrument.

Note: *When a "Linc" is established for the User mode, the Linc applies to all measurement modes using the User solution selection.*

3.20.1 Calibrate meter for User mode

To calibrate the meter for the User mode:

1. Push the **COND** key, the **MIN/SALT** key, or the **TDS** key.
2. Calibrate the meter using a standard solution (see section 4.4 on page 31).
3. Select the User mode (see section 3.11 on page 19).
4. Set the calibration Linc.

3.20.2 Set User mode calibration Linc

The Linc function sets the calibration offset factor of a standard solution to the User solution mode. The Linc stays intact in future calibrations until it is canceled (see section 3.20.3 on page 28).

Follow the steps below to set the KCl, NaCl or 442 calibration factor to the User solution mode.

1. Push a measurement key to Linc (i.e., **COND**, **RES**, **MIN/SALT** or **TDS**).
2. Select the User mode (see section 3.11 on page 19).

[1]Trademark of Myron L Company

3. Push the **MR/DOWN** key until Linc displays.

4. Push the **CAL/MCLR** key. SEL displays with the **User** icon.

   Note: *Any additional display of KCl, NaCl or 442 icons indicates a Linc between the additional solution and the User solution. If none of the solution selection icons are displayed, nothing is linked to the User mode.*

5. Push **UP/MS** or **MR/DOWN** to select a standard solution to link to the User mode calibration constant.

6. Push the **CAL/MCLR** key to accept the setting. The User mode now uses the calibration offset constant that was created here.

   Note: *To exit without changing the setting, push any measurement key.*

3.20.3 Cancel User mode calibration Linc

To cancel the User mode calibration Linc:

Note: *The MP series meter must be in User linked mode to cancel the "Linc."*

1. Push a (linked) measurement key such as **COND**, **RES**, **MIN/SALT**, or **TDS**. Two solutions are displayed on the left side of the display: User and another, such as KCl.
2. Push the **MR/DOWN** key until Linc displays.
3. Push the **CAL/MCLR** key. SEL, User and the linked solution appear on the display.

4. Push the **MR/DOWN** key until User is the only solution icon that displays.
5. Push the **CAL/MCLR** key. The User mode Linc is now canceled.

3.21 Download stored data

The MP-Dock accessory package (HMPDOCK) allows the user to download stored test data to a PC or spreadsheet. The MP-Dock receives power through the USB port, and requires no external power source. The data is transferred through the Infrared (IR) data port on the bottom of the MP meter (Figure 6) to the MP-Dock, and then to the PC.

The MP Datalink software, which is included with the MP-Dock, operates on Windows 2000 and XP, and Macintosh OS9.2 and OSX-based operating systems.

For the latest instructions on communication port selection and data download, refer to the Hach Company MP-Dock User Manual.

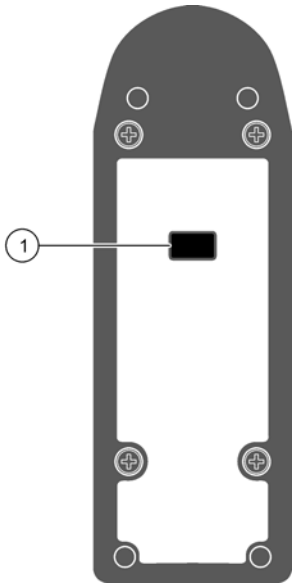


Figure 6 MP meter—bottom view

1	Infrared data port

Section 4 Calibration

4.1 Calibration intervals

The MP Series meters are designed to not require frequent calibration. Calibration is recommended about once per month with conductivity or TDS solutions. Check the calibration with pH solution twice per month. Some applications may require calibration frequencies to differ from these suggested guidelines.

4.2 Calibration limits

The MP Series meters have built in calibration limits. A nominal “FAC” value is an ideal value stored by the factory. Attempts to calibrate too far (±10% or ±1 pH unit) from this value causes the displayed value to be replaced with “FAC”. If the **CAL/MCLR** key is pushed, the value is accepted, and the original default factory calibration for this measurement is shown. The need to calibrate so far out that “FAC” appears indicates a procedural problem, incorrect standard solution, a very dirty cell cup or an aging pH/ORP sensor.

4.3 Calibration records

To minimize calibration efforts, keep records. If the calibration adjustments are minimal, calibration can occur less often. Record the following information:

- Record changes in conductivity in percentages.
- Record changes in pH calibration in pH units.
- Conductivity cell calibration is purposely limited to ±10%. Changes beyond that indicate damage, not drift.
- Calibration changes are limited to ±1 pH unit. Changes beyond that indicate the end of the sensor’s lifetime and replacement is recommended.

4.4 Calibrate the meter

1. Push the measurement key for the parameter to be calibrated.
2. Push **CAL/MCLR**.
3. Measuring continues. The **CAL** icon is on. This indicates that calibration can occur now.
4. Push **UP/MS** or **MR/DOWN** to change the reading to the known value.
5. Calibration for each of the four solution types can be performed in either conductivity, mineral/salt or TDS mode.

   Note: *The number of steps to calibrate depends on what is to be calibrated.*

Parameter	KCl, NaCl or 442	User
COND	Gain only	Temperature compensation, then Gain
RES	Done in conductivity	Done in conductivity or TDS
TDS	Gain only	Temperature compensation, Ratio, then Gain
MIN/SALT	Gain only	Temperature compensation, Ratio, then Gain
pH	7, acid, and/or base	
ORP	Zero set with pH 7 automatically	

6. Push the **CAL/MCLR** key to accept the new calibration value. The meter accepts the value and presents the next value for adjustment. If there are no more adjustments, the meter exits CAL mode.

   Note: *In the CAL mode, the* ***CAL/MCLR*** *key becomes an* ***ACCEPT*** *key. To bypass a calibration step, push the* ***CAL/MCLR*** *key to accept the present value.*

4.5 Exit calibration mode

When the **CAL** icon turns off, calibration is complete. To exit calibration mode when the **CAL** icon is still on, push any measurement key. This cancels any changes not accepted and exits the CAL mode. When CAL mode for pH is exited after the second buffer, the meter enters the same gain for the third buffer.

4.6 Calibrate conductivity, mineral/salt or TDS

To make sure calibration is accurate, follow the items listed below.

1. Clean oily films or organic material from the conductivity cell with foaming cleaner or mild acid.
2. Do not scrub inside the conductivity cell.
3. Rinse the conductivity cup with pure water after taking measurements.
4. Rinse the conductivity cup three times with the standard solution to be used for calibration (KCl, NaCl, or 442).

   Note: *Failure to rinse can cause crystals to form in the cup and contaminate future samples.*

5. Fill the conductivity cup with same standard.
6. Push the **COND** key, the **MIN/SALT** key or the **TDS** key.
7. Push the **CAL/MCLR** key. The **CAL** icon appears on the display.
8. Push the **UP/MS** key or the **MR/DOWN** key to adjust to the standard value, or hold down the key to adjust rapidly.
9. Push the **CAL/MCLR** key once to confirm the new value and end the calibration sequence for this solution type.
10. To calibrate another solution type, change solution type (e.g., KCl, NaCl, or 442) and repeat this procedure.

4.7 Calibrate resistivity

Resistivity is the reciprocal of conductivity. Resistivity is automatically calibrated based on the solution type used during a conductivity calibration.

4.8 Reset factory calibration—conductivity, mineral/salt or TDS

If calibration is suspect or known to be incorrect, and no standard solution is available, it is possible to replace the calibrated value with the original factory value for that solution. This ideal factory (**FAC**) value is the same for all MP Series meters, and it returns to a known state without solution in the cup.

The **FAC** internal electronic calibration is not intended to replace calibration with conductivity standard solutions.

1. Push the **COND** key, the **MIN/SALT** key or the **TDS** key.
2. Push the **CAL/MCLR** key twice in **COND** or three times in **TDS**.

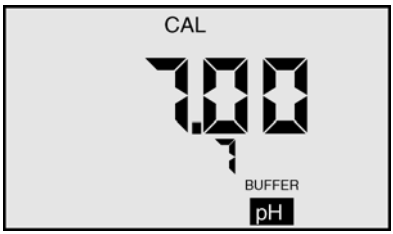
   Note: *In the User mode, push the **CAL/MCLR** key twice in the **COND** mode and three times in the **TDS** mode or the **MIN/SALT** mode. (This bypasses temperature correction and ratio adjustments.)*
3. Push the **UP/MS** key until the **FAC** icon appears.
4. Push the **CAL/MCLR** key to accept the factory calibration setting.
5. If another solution needs to be reset, select another solution type and repeat the procedure.

4.9 pH calibration

Note: *Always zero-out the MP Series meter with a pH 7 buffer solution before calibrating with acid or base buffers such as pH 4 or pH 10 solutions.*

To perform a pH calibration:

1. Rinse the sensor cups three times with a pH 7 buffer solution.
2. Fill both sensor cups with pH 7 buffer solution.
3. Push the **pH** key to verify the pH calibration. If the display shows 7.00, skip the pH zero calibration and proceed to section 4.10 on page 34.



4. Push the **CAL/MCLR** key to enter calibration mode. The **CAL**, **BUFFER** and **7** icons appear. The value displayed is for the uncalibrated sensor.

   Note: *If a wrong buffer is added (outside of pH 6-8),* ***7*** *and* ***BUFFER*** *will flash and the meter does not adjust. The uncalibrated pH value that shows in step 4 assists in determining the accuracy of the pH sensor. If the pH reading is below pH 6 or above pH 8 with pH 7 buffer solution, the sensor cup needs more rinses, or the pH sensor is defective and needs to be replaced.*

5. Push **UP/MS** or **MR/DOWN** until the display reads 7.00.

   Note: *Attempted calibration of > 1 pH point from factory calibration causes the* ***FAC*** *icon to appear. This means that either sensor replacement (see Section 6 on page 41) or a fresh buffer solution is needed. Push the* ***CAL/MCLR*** *key to accept the preset factory value.*

6. Push the **CAL**/**MCLR** key to accept the new value.

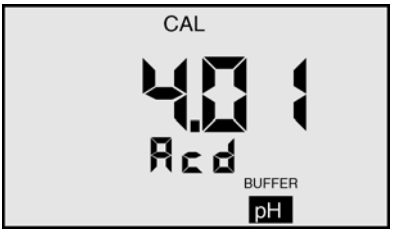
The pH zero calibration is now complete. It is recommended that the user performs the multiple point pH calibration (see section 4.10). If the user does not wish to continue, push any measurement key to exit.

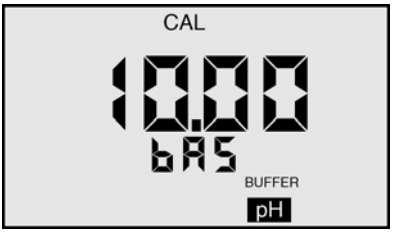
4.10 Set multiple point pH calibrations

Important Note: *Acid or base solution can be used for the second point calibration and then use the other solution for the third point. To verify that a buffer is in the sensor cup, the display shows either the* ***Acd*** *icon or the* ***bAS*** *icon.*

Note: *If the* ***Acd*** *icon or the* ***bAS*** *icon flash, fill the sensor cup with either an acid or base solution to resolve the error.*

1. Push the **CAL**/**MCLR** key twice while in the pH measurement mode to complete the pH zero calibration or verify the pH 7 buffer. The **CAL**, **BUFFER** and **Acd** or **bAS** icons are displayed**.**





2. Rinse the sensor cups three times with acid or base buffer solution.
3. Fill both sensor cups again with the same solution.
4. Push **UP/MS** or **MR/DOWN** until the display agrees with the buffer value.
5. Push the **CAL/MCLR** key to accept the second point of calibration. The display indicates the next type of buffer to be used.

   The two point calibration is complete now. The user can continue with the third point of the calibration or exit the calibration process. Push any measurement

key to exit. If the user exits, the gain value accepted for the buffer is used for both acid and base measurements.

6. Rinse the sensor cup three times with the third buffer solution.
7. Fill the sensor cups again with the same solution.
8. Push **UP/MS** or **MR/DOWN** until the display agrees with the buffer value.
9. Push the **CAL/MCLR** key to accept the third point of calibration. The calibration procedure is now complete.

Note: *Fill the pH/ORP sensor cup with pH storage solution and replace the protective sensor cap when the meter is not in use. Do not allow the cup to dry.*

4.11 ORP calibration

The ORP electrodes rarely give false readings unless there is a problem in the reference electrode. For this reason, and because the calibration solutions for ORP are highly reactive and potentially hazardous, the MP meter has an electronic ORP calibration. This causes the zero point on the reference electrode to be set whenever the pH 7 calibration is done.

4.12 Temperature calibration

Temperature calibration is not necessary in the MP series meters.

Section 5 Maintenance

Practice the following care and maintenance of the MP series handheld meters:

- Rinse with clean water after each use
- Always fill the pH/ORP sensor cup with Hach pH storage solution and replace the protective cap when not in use.
- Avoid solvents
- Avoid drops. Shock damage can damage the meter and void the warranty

5.1 Temperature extremes

Solutions in excess of 71 ºC (160 ºF) should not be placed in the sensor cups. This activity can damage the meter. The pH sensor can fracture if the meter's temperature falls below 0 ºC (32 ºF). Take care not to exceed operating temperatures.

Note: *Do not leave an MP series meter in a vehicle or a storage shed on a hot day. This activity can subject the meter to temperatures in excess of 66 ºC (150 ºF) and void the warranty.*

5.2 Battery replacement

NOTICE

If the meter is not completely dry before you open the meter, damage to the internal electronics of the meter can occur.

Perform the following steps to replace the battery:

1. Dry the meter completely.
2. Remove the four screws from the base of the meter.
3. Open the meter carefully.
4. Take care to detach the battery from the circuit board.
5. Replace the battery with a new 9V alkaline battery.
6. Replace the bottom housing, ensuring that the sealing gasket is installed in the groove of the top half of the case.
7. Replace the screws; tighten evenly and securely. Do not overtighten.

Note: *All data stored in memory and all calibration settings are protected during power loss or battery replacement. Loss of time and date can occur, however, if the battery is removed for more than 3 minutes (180 seconds).*

5.2.1 Maintain the conductivity cup

Rinse the conductivity cup with clean water after taking measurements to prevent buildup on the electrodes. Do not scrub the cup. For oily films, add a few drops of foaming, non-abrasive cleaner or isopropyl alcohol, then rinse.

Note: *When sampling low-conductivity solutions, make sure the pH/ORP sensor cap is well-seated so that solution does not wash from the pH/ORP sensor cup into the conductivity cup.*

5.2.2 Maintain the pH/ORP sensor cup

Keep the pH/ORP sensor cup hydrated with Hach pH Storage Solution. Before replacing the pH/ORP sensor cap, rinse and fill the sensor cup with the storage solution. Never use distilled water to store the sensor cup.

5.3 pH/ORP sensor replacement

Complete installation instructions are included with each replacement sensor. Tools required include a #2 Phillips screwdriver and 1/4-inch wrench.

Note: *When the pH/ORP sensor is replaced, it is also a good time to replace the battery.*

5.4 Clean the sensors

Perform these procedures to clean the various sensors.

5.4.1 Clean the conductivity/resistivity/TDS sensor

Keep the conductivity cell cup (Figure 7) as clean as possible.

Note: *Flush with clean water after use to prevent buildup on electrodes.*

When a dirty sample is left in the cup, a film forms. This film reduces accuracy.

To clean a visible film of oil, dirt or scale that is in the cell cup or on the electrode:

1. Use isopropyl alcohol or a foaming, non-abrasive household cleaner. Hach acid electrode cleaning solution may also be used less frequently.
2. Pour any of these solutions in the cell cup and allow it to soak for no more than five minutes.
3. Use a cotton swab to *gently* clean the electrodes.
4. Rinse out the cleaning solution.

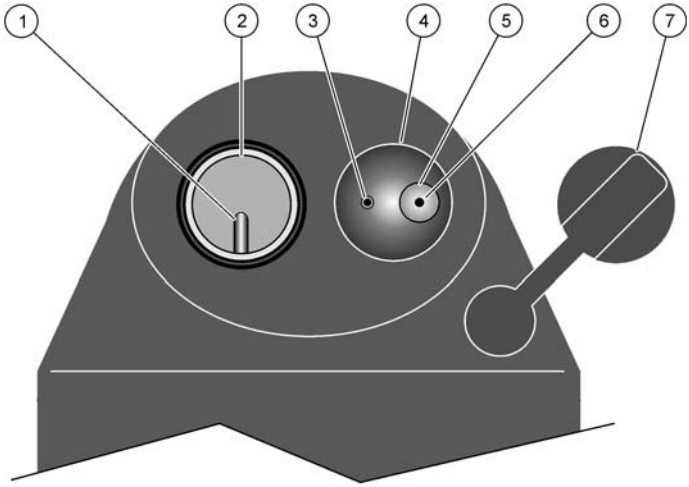


Figure 7 Model MP-6 sensor cups

1	Temperature sensor	**5**	pH glass electrode
2	Conductivity cell (built-in electrodes)	**6**	Reference junction under glass pH bulb
3	ORP electrode	**7**	pH/ORP sensor protective cap
4	pH/ORP sensor (replaceable)		

5.4.2 Clean the pH/ORP sensor

The pH/ORP sensor in the MP series meters is non-refillable and features a porous liquid junction. *It should not be allowed to dry out.* If it does dry out, the sensor can sometimes be restored by following the steps below.

1. Clean the sensor cup with isopropyl alcohol.
2. Rinse well. Do not scrub or wipe the pH/ORP sensor.
3. Follow the hot solution method described below:
   a. Pour a *hot* salt solution ~60 ºC (140 ºF), such as pH storage solution in the sensor cup.
   b. Allow the liquid to cool.
   c. Retest.
4. If the hot solution method does not work, follow the Deionized (DI) water method below:
   a. Pour DI water into the sensor cup.

b. Allow to stand for no more than four hours (more standing time can deplete the reference solution and damage the glass bulb).

c. Retest.

5. If neither of the above methods are successful, the sensor must be replaced.

5.4.2.1 Drifting test results

A film on the pH sensor bulb or the reference can cause drifting. Use isopropyl alcohol to clean the glass bulb.

Note: *The sensor bulb is very thin and delicate. Do not scrub the pH/ORP sensor.*

To clean the sensor:

1. Use isopropyl alcohol or a foaming, non-abrasive household cleaner. Hach acid electrode cleaning solution may also be used less frequently.

2. Pour any of these solutions in the cell cup and allow it to soak for no more than five minutes.

3. Use a cotton swab to *gently* clean the electrodes.

4. Rinse out the cleaning solution.

5. Fill the sensor cup with Hach pH storage solution before the pH/ORP sensor cap is replaced.

5.4.2.2 Solutions that damage the pH/ORP sensor

Samples that contain chlorine, sulfur or ammonia can damage the pH electrode. Rinse the sensor thoroughly with clean water immediately after any measurement of these liquids.

Samples that reduce (add an electron to) silver, such as cyanide will attack the reference electrode.

Leaving alkaline solutions in the pH sensor cup for long periods of time can damage the sensor.

Section 6 Troubleshooting

Symptom	Possible cause	Action
No display even though measurement key is pushed	Battery is weak or not connected.	Check the connections or replace the battery (see section 5.2 on page 37).
Inaccurate pH reading	pH calibration is needed (see section 4.9 on page 33)	Recalibrate the meter.
	Cross-contamination from residual buffers or samples in sensor cup	Rinse the sensor cup.
	Calibration with expired pH buffers	Recalibrate using fresh buffers.
No response to pH changes (MP-6 and MP-6p models)	Sensor bulb is cracked or an electromechanical short is caused by an internal crack.	Replace the pH/ORP sensor (see section 5.3 on page 38).
Meter does not adjust down to pH 7 (MP-6 and MP-6p models)	pH sensor has lost KCl	Clean and restore the sensor (see section 5.4 on page 38) and recalibrate. If there is no improvement, replace the pH/ORP sensor (see section 5.3 on page 38).
pH readings drift or respond slowly to change or FAC displays repeatedly	Temporary condition due to memory of solution in pH sensor cup for long periods	Clean and restore the sensor (see section 5.4 on page 38) and recalibrate. If there is no improvement, replace the pH/ORP sensor (refer to section 5.3 on page 38).
	Bulb dirty or dried out	
	Reference junction clogged or coated	
Unstable conductivity, TDS or resistivity readings	Dirty electrodes	Clean the cell cup and the electrodes (see section 5.4 on page 38). Minimize the test sample exposure to air (see section 3.6 on page 17).
	Test samples that are greater than 1 MΩ	
Meter cannot calibrate Conductivity or TDS	Film or deposits on electrodes	Clean the cell cup and the electrodes (see section 5.4 on page 38).
Resistivity reading is much lower than expected	Contamination from previous samples or from the pH sensor cup	Rinse the sensor cup more thoroughly before measurement. Make sure the pH cap is snugly in place (see section 5.4 on page 38).
	Carbon dioxide in the test sample	

Section 7 Contact Information

HACH Company World Headquarters

P.O. Box 389
Loveland, Colorado
80539-0389 U.S.A.
Tel (800) 227-HACH
(800) 227-4224
(U.S.A. only)
Fax (970) 669-2932
orders@hach.com
www.hach.com

Repair Service in the United States:

HACH Company
Ames Service
100 Dayton Avenue
Ames, Iowa 50010
Tel (800) 227-4224
(U.S.A. only)
Fax (515) 232-3835

Repair Service in Canada:

Hach Sales & Service
Canada Ltd.
1313 Border Street, Unit 34
Winnipeg, Manitoba
R3H 0X4
Tel (800) 665-7635
(Canada only)
Tel (204) 632-5598
Fax (204) 694-5134
canada@hach.com

Repair Service in Latin America, the Caribbean, the Far East, Indian Subcontinent, Africa, Europe, or the Middle East:

Hach Company World
Headquarters,
P.O. Box 389
Loveland, Colorado,
80539-0389 U.S.A.
Tel +001 (970) 669-3050
Fax +001 (970) 669-2932
intl@hach.com

HACH LANGE GMBH

Willstätterstraße 11
D-40549 Düsseldorf
Tel. +49 (0)2 11 52 88-320
Fax +49 (0)2 11 52 88-210
info@hach-lange.de
www.hach-lange.de

HACH LANGE LTD

Pacific Way
Salford
GB-Manchester, M50 1DL
Tel. +44 (0)161 872 14 87
Fax +44 (0)161 848 73 24
info@hach-lange.co.uk
www.hach-lange.co.uk

HACH LANGE LTD

Unit 1, Chestnut Road
Western Industrial Estate
IRL-Dublin 12
Tel. +353(0)1 46 02 5 22
Fax +353(0)1 4 50 93 37
info@hach-lange.ie
www.hach-lange.ie

HACH LANGE GMBH

Hütteldorferstr. 299/Top 6
A-1140 Wien
Tel. +43 (0)1 9 12 16 92
Fax +43 (0)1 9 12 16 92-99
info@hach-lange.at
www.hach-lange.at

DR. BRUNO LANGE AG

Juchstrasse 1
CH-8604 Hegnau
Tel. +41(0)44 9 45 66 10
Fax +41(0)44 9 45 66 76
info@hach-lange.ch
www.hach-lange.ch

HACH LANGE FRANCE S.A.S.

33, Rue du Ballon
F-93165 Noisy Le Grand
Tél. +33 (0)1 48 15 68 70
Fax +33 (0)1 48 15 80 00
info@hach-lange.fr
www.hach-lange.fr

HACH LANGE SA

Motstraat 54
B-2800 Mechelen
Tél. +32 (0)15 42 35 00
Fax +32 (0)15 41 61 20
info@hach-lange.be
www.hach-lange.be

DR. LANGE NEDERLAND B.V.

Laan van Westroijen 2a
NL-4003 AZ Tiel
Tel. +31(0)344 63 11 30
Fax +31(0)344 63 11 50
info@hach-lange.nl
www.hach-lange.nl

HACH LANGE APS

Åkandevej 21
DK-2700 Brønshøj
Tel. +45 36 77 29 11
Fax +45 36 77 49 11
info@hach-lange.dk
www.hach-lange.dk

HACH LANGE AB

Vinthundsvägen 159A
SE-128 62 Sköndal
Tel. +46 (0)8 7 98 05 00
Fax +46 (0)8 7 98 05 30
info@hach-lange.se
www.hach-lange.se

HACH LANGE S.R.L.

Via Riccione, 14
I-20156 Milano
Tel. +39 02 39 23 14-1
Fax +39 02 39 23 14-39
info@hach-lange.it
www.hach-lange.it

Contact Information

HACH LANGE S.L.U.

Edif. Arteaga Centrum
C/Larrauri, 1C- 2ª Pl.
E-48160 Derio/Vizcaya
Tel. +34 94 657 33 88
Fax +34 94 657 33 97
info@hach-lange.es
www.hach-lange.es

HACH LANGE LDA

Av. do Forte nº8
Fracção M
P-2790-072 Carnaxide
Tel. +351 214 253 420
Fax +351 214 253 429
info@hach-lange.pt
www.hach-lange.pt

HACH LANGE SP.ZO.O.

ul. Opolska 143 a
PL-52-013 Wroc³aw
Tel. +48 (0)71 342 10-83
Fax +48 (0)71 342 10-79
info@hach-lange.pl
www.hach-lange.pl

HACH LANGE S.R.O.

Lešanská 2a/1176
CZ-141 00 Praha 4
Tel. +420 272 12 45 45
Fax +420 272 12 45 46
info@hach-lange.cz
www.hach-lange.cz

HACH LANGE KFT.

Hegyalja út 7-13.
H-1016 Budapest
Tel. +36 (06)1 225 7783
Fax +36 (06)1 225 7784
info@hach-lange.hu
www.hach-lange.hu

HACH LANGE S.R.L.

Str. Leonida, nr. 13
Sector 2
RO-020555 Bucuresti
Tel. +40 (0) 21 201 92 43
Fax +40 (0) 21 201 92 43
info@hach-lange.ro
www.hach-lange.ro

HACH LANGE

8, Kr. Sarafov str.
BG-1164 Sofia
Tel. +359 (0)2 963 44 54
Fax +359 (0)2 866 04 47
info@hach-lange.bg
www.hach-lange.bg

HACH LANGE SU ANALÝZ SÝSTEMLERÝ LTD.ÞTÝ.

Hilal Mah. 75. Sokak
Arman Plaza No: 9/A
TR-06550 Çankaya/ANKARA
Tel. +90 (0)312 440 98 98
Fax +90 (0)312 442 11 01
bilgi@hach-lange.com.tr
www.hach-lange.com.tr

HACH LANGE D.O.O.

Fajfarjeva 15
SI-1230 Domžale
Tel. +386 (0)59 051 000
Fax +386 (0)59 051 010
info@hach-lange.si
www.hach-lange.si

ÇÁCH LANGE E.Ð.Å.

Áõëßäïò 27
GR-115 27 ÁèÞíá
Ôçë. +30 210 7777038
Fax +30 210 7777976
info@hach-lange.gr
www.hach-lange.gr

HACH LANGE E.P.E.

27, Avlidos str
GR-115 27 Athens
Tel. +30 210 7777038
Fax +30 210 7777976
info@hach-lange.gr
www.hach-lange.gr

Section 8 Replacement parts and accessories

8.1 Replacement parts

Description	Item No.
pH/ORP sensor	HMPSENS
9V alkaline battery	00024Q

8.2 Accessories

Description	Item No.
MP-Dock (facilitates data download to PC or spreadsheet)	HMPDOCK

8.3 Consumables

Description	Quantity	Item No.
Buffer solution, pH 4.01	50 mL	2283426
Buffer solution, pH 4.01	500 mL	2283449
Buffer solution, pH 4.01	4L	2283456
Buffer solution, pH 4.01	20 L	2283461
Buffer solution, pH 7.00	50 mL	2283526
Buffer solution, pH 7.00	500 mL	2283549
Buffer solution, pH 7.00	4 L	2283556
Buffer solution, pH 7.00	20 L	2283561
Buffer solution, pH 10.01	50 mL	2283626
Buffer solution, pH 10.01	500 mL	2283649
Buffer solution, pH 10.01	4 L	2283656
Buffer solution, pH 10.01	20 L	2283661
pH electrode storage solution, 500 mL	500 mL	2756549
pH electrode storage solution, 50 mL	50 mL	2756526
0.001M KCl Conductivity Standard Solution, 148 µS/cm	500 mL	2974249
0.001M KCl Conductivity Standard Solution, 148 µS/cm	50 mL	2974226
0.01M KCl Conductivity Standard Solution, 1413 µS/cm	500 mL	2974349
0.01M KCl Conductivity Standard Solution, 1413 µS/cm	50 mL	2974326
0.1M KCl Conductivity Standard Solution, 12.88 mS/cm	500 mL	2974449
0.1M KCl Conductivity Standard Solution, 12.88 mS/cm	50 mL	2974426

8.3 Consumables (continued)

Description	Quantity	Item No.
442-30 Natural Water™[1] TDS Standard Solution, 30 ppm	500 mL	2974549
442-30 Natural Water TDS Standard Solution, 30 ppm	50 mL	2974526
442-300 Natural Water TDS Standard Solution, 300 ppm	500 mL	2974649
442-300 Natural Water TDS Standard Solution, 300 ppm	50 mL	2974626
442-1000 Natural Water TDS Standard Solution, 1000 ppm	500 mL	2974749
442-1000 Natural Water TDS Standard Solution, 1000 ppm	50 mL	2974726
442-3000 Natural Water TDS Standard Solution, 3000 ppm	500 mL	2974849
442-3000 Natural Water TDS Standard Solution, 3000 ppm	50 mL	2974826
100 µS/cm NaCl Conductivity Standard Solution	500 mL	2971849
100 µS/cm NaCl Conductivity Standard Solution	50 mL	2971826
1000 µS/cm NaCl Conductivity Standard Solution	500 mL	1440049
1000 µS/cm NaCl Conductivity Standard Solution	50 mL	1440026
10,000 µS/cm NaCl Conductivity Standard Solution	500 mL	2972249
10,000 µS/cm NaCl Conductivity Standard Solution	50 mL	2972226
18.00 mS/cm NaCl Conductivity Standard Solution	500 mL	2307449
18.00 mS/cm NaCl Conductivity Standard Solution	50 mL	2307426

[1] Trademark of Myron L Company

8.4 Recommended cleaning consumables

Description	Quantity	Item No.
Isopropyl alcohol	100 mL	1227642
Isopropyl alcohol prep pads	200/pk	2938200
Cotton swabs	100/pkg	2554300
Acid electrode cleaning solution	50 mL	2975126
Acid electrode cleaning solution	500 mL	2975149

Section 9 Limited Warranty

Hach Company warrants to the original purchaser against any defects that are due to faulty material or workmanship for a period of two years from date of shipment unless otherwise noted in the product manual.

In the event that a defect is discovered during the warranty period, Hach Company agrees that, at its option, it will repair or replace the defective product or refund the purchase price excluding original shipping and handling charges. Any product repaired or replaced under this warranty will be warranted only for the remainder of the original product warranty period.

This warranty does not apply to consumable products such as chemical reagents; or consumable components of a product, such as, but not limited to, lamps and tubing.

Contact Hach Company or your distributor to initiate warranty support. Products may not be returned without authorization from Hach Company.

Warranty Limitations

This warranty does not cover:

- Damage caused by acts of God, natural disaster, labor unrest, acts of war (declared or undeclared), terrorism, civil strife or acts of any governmental jurisdiction
- Damage caused by misuse, neglect, accident or improper application or installation
- Damage caused by any repair or attempted repair not authorized by Hach Company
- Any product not used in accordance with the instructions furnished by Hach Company
- Freight charges to return merchandise to Hach Company
- Freight charges on expedited or express shipment of warranted parts or product
- Travel fees associated with on-site warranty repair

This warranty contains the sole express warranty made by Hach Company in connection with its products. All implied warranties, including without limitation, the warranties of merchantability and fitness for a particular purpose, are expressly disclaimed.

Some states within the United States do not allow the disclaimer of implied warranties and if this is true in your state the above limitation may not apply to you. This warranty gives you specific rights, and you may also have other rights that vary from state to state.

This warranty constitutes the final, complete, and exclusive statement of warranty terms and no person is authorized to make any other warranties or representations on behalf of Hach Company.

Limitation of Remedies

The remedies of repair, replacement or refund of purchase price as stated above are the exclusive remedies for the breach of this warranty. On the basis of strict liability or under any other legal theory, in no event shall Hach Company be liable for any incidental or consequential damages of any kind for breach of warranty or negligence.

Appendix A Temperature compensation

Electrical conductivity indicates solution concentration and ionization of the dissolved material. Because temperature greatly affects ionization, conductivity measurements are temperature dependent, and are normally corrected to read what they would be at 25 ºC.

A.1 Compensation to 25 ºC

The MP series handheld meters includes temperature compensation to 25 ºC. Temperature compensation can be set to KCl, NaCl or 442 solutions or tailored for special measurements or applications.

A.2 Changes in temperature compensation

Most conductivity meters approximate the temperature characteristics of solutions, and assume a constant value, such as, 2%/ºC. In fact, KCl temperature compensation changes with concentration and temperature in a non-linear fashion. Other solutions change even more. The MP series handheld meters use compensations that change with concentration and temperature instead of single average values (Figure 8).

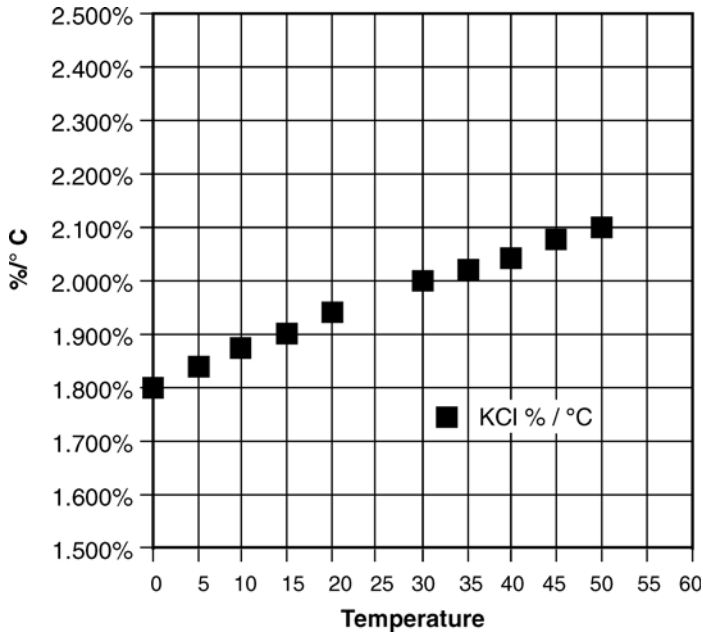


Figure 8

A.3 Graph of comparative error

In the range of 1000 µS, the error of using a KCl temperature compensation on a solution that should be calculated as NaCl or 442 is shown in the chart below (Figure 9).

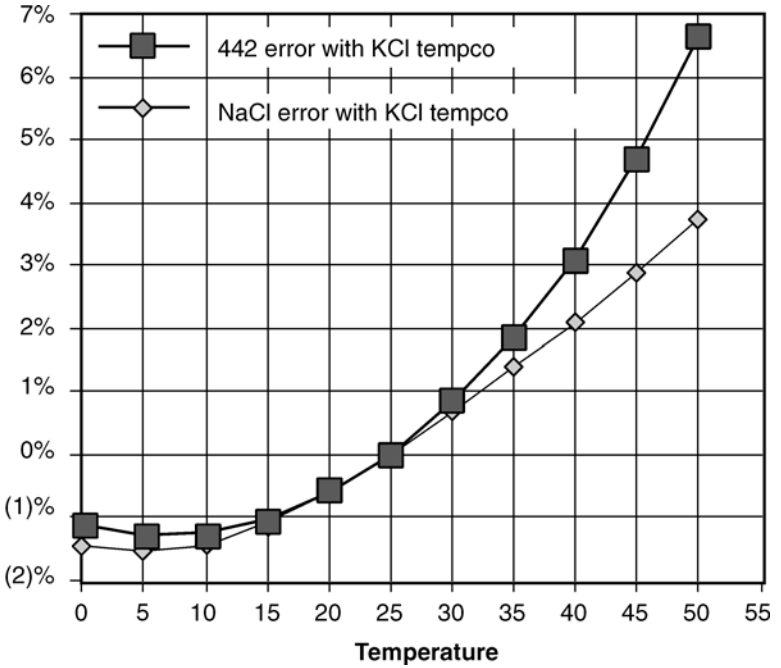


Figure 9

To measure natural water-based solutions to 1%, users must alter the internal temperature compensation to the more suitable, pre-loaded 442 values or stay close to 25 ºC.

A.4 Other solutions

A salt solution like sea water or liquid fertilizer acts like NaCl. The NaCl solution compensation provides the greatest accuracy for these solutions.

Many solutions differ greatly from KCl, NaCl or 442. A sugar solution, a silicate, or a calcium salt at a high or low temperature may require a User value to provide readings close to the true compensated conductivity. This is determined experimentally.

The chosen solution characteristic should closely match the sample being tested to achieve accuracy of ±1%.

Appendix B Conductivity conversion

B.1 How conductivity conversion works

When the effect of temperature is removed, the corrected conductivity depends on the concentration (TDS). Temperature compensation of the conductivity of a solution is performed automatically by the meter's internal processor with data derived from chemical tables. Any dissolved salt at a known temperature has a known ratio of conductivity to concentration. Tables of conversion ratios referenced to 25 ºC have been published by chemists for decades.

B.2 Solution characteristics

Real-world applications have to measure a wide range of materials and mixtures of electrolyte solutions. To address this problem, industry applications tend to use the characteristics of a standard material as a model for their solution, such as KCl, which is favored by chemists for its stability.

Users who deal with sea water, etc., use NaCl as the model for their concentration calculations. Users who deal with freshwater work with mixtures including sulfates, carbonates and chlorides. These are modeled in the 442 standard solutions.

The meter contains algorithms for these three most commonly referenced compounds. The solution type in use is shown on the left side of the display. In addition to KCl, NaCl, and 442, a User choice is available. The User mode allows the user to enter the temperature compensation and TDS ratio by hand. This increases the accuracy of readings for a specific solution. That value remains a constant for all measurements, and should be reset for different dilutions or temperatures.

Appendix C Temperature compensation and TDS derivation

The MP series handheld meters contain internal algorithms for characteristics of the three most commonly referenced compounds. The selected solution type is shown on the left of the display. In addition to KCl, NaCl and 442, a User choice is available. The User mode allows the user to enter the temperature compensation and the TDS conversion ratio of a unique solution.

C.1 Conductivity characteristics

When taking conductivity measurements, the Solution Selection determines the characteristic assumed as the instrument reports what a measured conductivity would be if it were at 25 °C. The characteristic is represented by the temperature compensation, expressed in %/°C.

If a solution of 100 µS at 25 °C increases to 122 µS at 35 °C, then a 22% increase has occurred over this change of 10 °C. The solution is then said to have a temperature compensation of 2.2%/°C.

Temperature compensation always varies among solutions because it is dependent on their individual ionization activity, temperature and concentration. This is why the MP meters feature mathematically generated models for known salt characteristics that also vary with concentration and temperature.

C.2 Temperature compensation of unknown solutions

The user may need to find the corrected conductivity of a solution that differs from the three standard salts. In order to enter a custom fixed temperature compensation for a limited measurement range, enter a specific value through the User function. The temperature compensation can be determined by two different methods.

C.2.1 Find temperature compensation by calculation

1. Heat or cool a sample of the solution to 25 ºC, and measure its conductivity.
2. Heat or cool the solution to a typical temperature where it is normally measured.
3. Select the **User** function.
4. Set the temperature compensation to 0%/ºC (see section 3.12.1 on page 20).
5. Measure the new conductivity and the new temperature.
6. Divide the percentage decrease or percentage increase by the 25 ºC value.
7. Divide that result by the temperature difference.

C.2.2 Find temperature compensation by adjustment

1. Heat or cool a sample of the solution to 25 ºC, and measure its conductivity.
2. Heat or cool the solution to a typical temperature where it is normally measured.

3. Set the temperature compensation to an expected value (see section 3.12 on page 20).
4. See if the compensated value is the same as the 25 ºC value.
5. If the value is not the same, raise or lower the temperature compensation and measure again until the 25 ºC value is read.

C.3 TDS ratio of unknown solutions

When the effect of temperature is removed, the compensated conductivity varies with the concentration (TDS). The ratio of TDS to compensated conductivity for any solution also varies with concentration. The ratio is set during calibration in the User mode (see section 3.13 on page 20). Measure the TDS of an unknown solution by evaporation and weighing. Then measure the conductivity of the solution, with the now-known TDS, and calculate the ratio. The next time this solution is measured, the ratio is known.

Appendix D Additional information on pH and ORP (MP-6 and MP-6p models)

D.1 pH

D.1.1 pH as an indicator

pH measures the acidity or alkalinity of an aqueous solution. Another way to describe pH is as the hydrogen ion activity of a solution.

pH measures the effective, not the total acidity of a solution. A 4% solution of acetic acid (pH 4, vinegar) can be quite palatable, but a 4% solution of sulfuric acid (pH 0) is a violent poison. pH provides the needed quantitative information by expressing the degree of activity of an acid or base.

In a solution of one known component, pH indicates concentration directly. Very dilute solutions may be very slow reading because very few ions take time to accumulate.

D.1.2 pH units

The acidity or alkalinity of a solution measures the relative availability of hydrogen (H^+) and hydroxide (OH^-) ions. An increase in H^+ ions increases acidity, while an increase in OH^- ions increases alkalinity.

pH is defined as the negative logarithm of hydrogen ion concentration. Where H^+concentration falls below 10^{-7} mol/liter, solutions are less acidic than neutral, and therefore are alkaline. A concentration of 10^{-9} mol/liter of H^+ has 100 times less H^+ ions than OH^- ions and is an alkaline solution of pH 9.

D.1.3 pH sensor

The active part of a pH sensor is a thin glass surface that is selectively receptive to hydrogen ions. Available hydrogen ions in a solution accumulate on this surface and a charge builds up across the glass interface. The voltage can be measured with a high impedance voltmeter circuit.

The glass surface encloses a captured solution of potassium chloride that holds an electrode of silver wire coated with silver chloride. This is the most inert connection possible from a metal to an electrolyte. It can still produce an offset voltage, but using the same materials to connect to the solution on the other side of the membrane cancels the two equal offsets.

The other electrode, also called the reference junction, allows the junction fluid to contact the test solution, without significant migration of liquids, through the plug material.

The pH/ORP sensor in the MP series meters (MP-6 and MP-6p) (Figure 10) is a single construction in an easy-to-replace package. The sensor body holds an oversize solution supply for long life. The reference junction is a wick that is porous so that it can provide a stable, low, permeable interface. It is located under the glass pH sensing electrode.

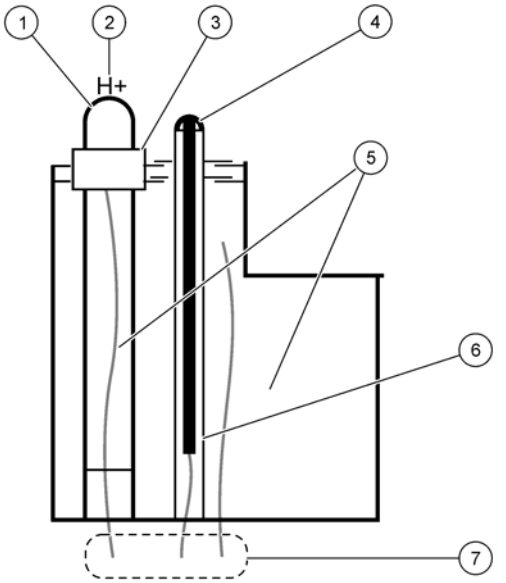


Figure 10 pH/ORP sensor construction

1	Glass surface	**5**	KCl solution
2	H^+ ions	**6**	Glass
3	Junction plug	**7**	Electrode wires
4	Platinum button		

D.1.4 Sources of error

D.1.4.1 Reference junction

The most common sensor problem is a clogged junction because a sensor is allowed to dry out. The symptom is a drift in the zero setting at pH 7. This explains why MP series meter does not allow more than one pH unit of offset during calibration.

D.1.4.2 Sensitivity errors

Sensitivity is the receptiveness of the glass surface. A film on the surface can diminish the sensitivity and cause a long response time.

D.1.5 Temperature compensation

pH sensor glass changes sensitivity slightly with temperature. When the solution is further from pH 7, this effect increases. For example, a pH of 11 at 40 ºC is off by 0.2 units. The MP series meter senses the sensor cup temperature and compensates the reading.

D.2 Oxidation Reduction Potential/Redox (ORP)

D.2.1 ORP as an indicator

ORP measures the ratio of oxidizing activity to reducing activity in a solution. It is the potential of a solution to give up electrons (to oxidize other things) or gain electrons (reduce).

Similar to acidity and alkalinity, one aspect increases at the expense of the other. Therefore, a single voltage is called the Oxidation-Reduction Potential, and a positive voltage shows a solution that wants to steal electrons (an oxidizing agent). For example, chlorinated water shows a positive ORP value.

D.2.2 ORP units

ORP is measured in millivolts, with no correction for solution temperature. Like pH, it is not a measurement of concentration directly, but of activity level. In a solution of only one active component, ORP indicates concentration. Also, similar to pH, a very dilute solution takes time to accumulate a readable charge.

D.2.3 ORP sensor

An ORP sensor uses a small platinum surface to accumulate charge without reacting chemically. That charge is measured relative to the solution, so the solution “ground” voltage comes from a reference junction. Figure 10 shows the platinum button in a glass sleeve. The same reference is used for both the pH and the ORP sensors. Both pH and ORP indicates 0 for a neutral solution. Calibration at zero corrects the error in the reference junction.

A zero calibration solution for ORP is not practical, so the MP series meters use the offset value determined during calibration to 7 in pH calibration (pH 7 = 0 mV). Sensitivity of the ORP surface is fixed so there is no gain adjustment.

D.2.4 Sources of error

Sources of error are similar to pH. Even though the platinum surface does not break like the glass pH surface, its protective glass sleeve can be broken. A surface film will slow the response time and diminish sensitivity.