INSTRUCTION MANUAL

MW150 & **MW151** MAX

pH / ORP / Temperature Bench Meters

SATISFACTION GUARANTEED

milwaukee

THANK YOU for choosing Milwaukee Instruments!

This instruction manual will provide you the necessary information for correct use of the meters.

TABLE OF CONTENTS

1. PRELIMINARY EXAMINATION

Each bench meter is delivered in a cardboard box and is supplied with:

- **MA917B/1** pH electrode
- **MA831R** Temperature probe
- **MA9315** Electrode holder
- **M10004** pH 4.01 buffer solution (sachet)
- **M10007** pH 7.01 buffer solution (sachet)
- **M10010** pH 10.01 buffer solution (sachet)
- **M10016** Electrode cleaning solution (sachet)
- Graduated pipette
- 12 VDC adapter
- USB cable (**MW151**)
- Instrument quality certificate
- Instruction manual

2. INSTRUMENT OVERVIEW

MW150 and **MW151** pH / ORP / Temperature bench meters perform accurate measurements and present a series of new diagnostic features for improved reliability.

- Up to 3-point (up to 5-point, **MW151**) automatic pH calibration, 7 standard calibration buffers (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45) and two custom buffers (**MW151**)
- Available log space for up to 1000 records (**MW151**)
- Alphanumeric LCD displayed messages for user friendly, intuitive information/ warning/error messages
- Built-in rechargeable battery with an 8-hour capacity
- Auto-off feature to prolong battery life
- Internal clock and date to keep track of different time-dependent functions (calibration timestamp, calibration time out)
- Dedicated GLP key to store and recall data on system status

3. SPECIFICATIONS

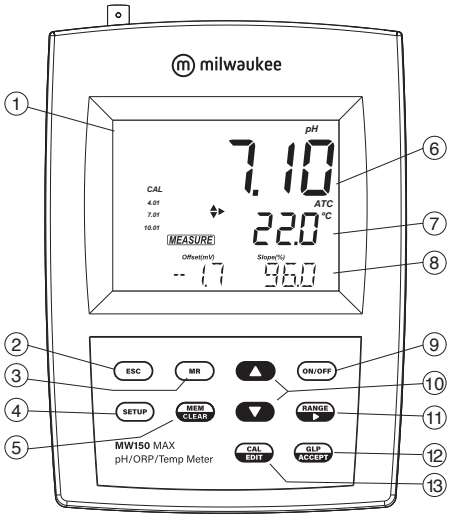
		MW150	MW151
Range *	pH	–2.00 to 20.00 pH	–2.00 to 20.00 pH –2.000 to 20.000 pH
	mV	±2000.0 mV	±2000.0 mV
	Temp.	–20.0 to 120.0 °C (-4.0 to 248.0 °F)	–20.0 to 120.0 °C (-4.0 to 248.0 °F)
Resolution	pH	0.01 pH	0.01 pH 0.001 pH
	mV	0.1 mV	0.1 mV
	Temp.	0.1 °C (0.1 °F)	0.1 °C (0.1 °F)
Accuracy @ 25°C (77°F)	pH	±0.01 pH	±0.01 pH ±0.002 pH
	mV	±1 mV	±1 mV
	Temp.	±0.4 °C (±0.8 °F)	±0.4 °C (±0.8 °F)
pH calibration		up to 3-point automatic 7 standard buffers (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45) no custom buffers	up to 5-point automatic 7 standard buffers (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45) 2 custom buffers
Temperature compensation		Automatic -20.0 to 120.0°C (-4.0 to 248.0 °F) Manual (without temperature probe)	Automatic -20.0 to 120.0°C (-4.0 to 248.0 °F) Manual (without temperature probe)
Log		Memory function	Maximum 1000 log records (stored in up to 100 lots) Log on demand, 200 logs Log on stability, 200 logs Interval logging, 1000 logs
PC connection		none	1 USB port, 1 micro USB port
Power supply		12 VDC adapter	12 VDC adapter, 5 VDC USB adapter
Battery life		8 hours	
Auto-off		5, 10, 30, 60 min. or off	
Environment		0 to 50 °C; max RH 95%	
Dimensions		230 x 160 x 95 mm (9.0 x 6.3 x 3.7″)	
Weight		0.9 kg (2.0 lb.)	
Warranty		3 years	

* Limits will be reduced to actual sensor limits

pH electrode **MA917B/1**	pH range	0 to 14 pH
	Temperature range	0 to 70°C (32 to 158 °F)
	Shaft material	glass
	Reference electrolyte	KCl 3.5M
	Reference junction	ceramic, single
	Reference type	double, Ag/AgCl
	Maximum pressure	0.1 bar
	Connector type	BNC
	Cable length	1 m
	Shaft length	120 mm
	Diameter	12 mm

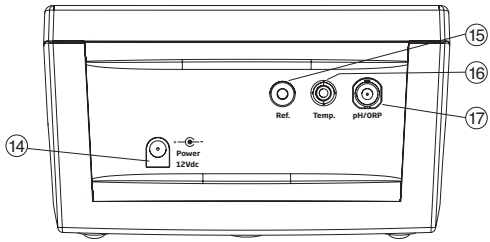
4. FUNCTIONAL & DISPLAY DESCRIPTION

Front Panel MW150



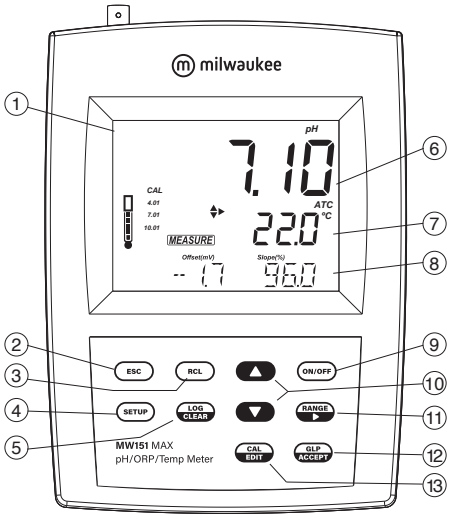
1. Liquid Crystal Display (LCD)
2. ESC key, to leave current mode
3. MR key, to recall the stored value from memory
4. SETUP key, to enter setup mode
5. MEM/CLEAR key, to store the reading or to clear calibration or memory
6. First LCD line, measurement readings
7. Second LCD line, temperature readings
8. Third LCD line, message area
9. ON/OFF key, to turn the meter ON and OFF
10. ▲▼ keys, to change manual temperature, select setup parameters and choose calibration buffers
11. RANGE/▶ key, to select pH or mV
12. GLP/ACCEPT key, to enter GLP or to confirm selected action
13. CAL/EDIT key, to enter/edit calibration settings, edit setup settings

Rear Panel MW150



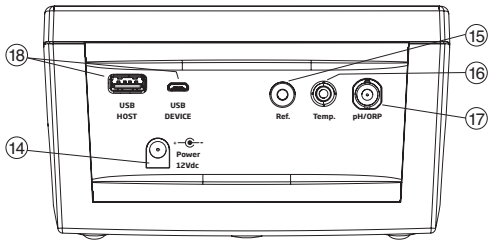
14. Power supply socket
15. Reference electrode socket
16. Temperature probe socket
17. BNC electrode connector

Front Panel MW151



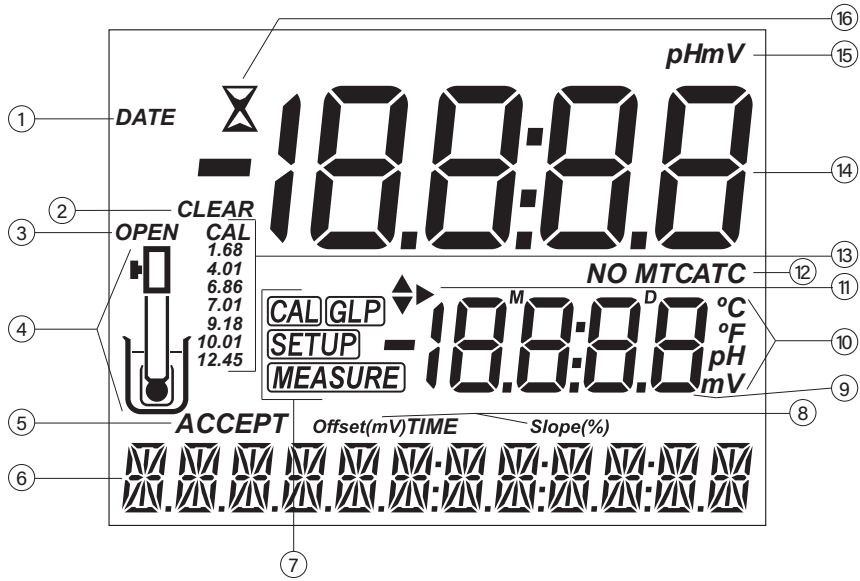
1. Liquid Crystal Display (LCD)
2. ESC key, to leave current mode
3. RCL key, to recall the logged values
4. SETUP key, to enter setup mode
5. LOG/CLEAR key, to log the reading or to clear calibration or logging
6. First LCD line, measurement readings
7. Second LCD line, temperature readings
8. Third LCD line, message area
9. ON/OFF key, to turn the meter ON and OFF
10. ▲▼ keys, to change manual temperature, select setup parameters and choose calibration buffers
11. RANGE/▶ key, to select pH or mV
12. GLP/ACCEPT key, to enter GLP or to confirm selected action
13. CAL/EDIT key, to enter/edit calibration settings, edit setup settings

Rear Panel MW151



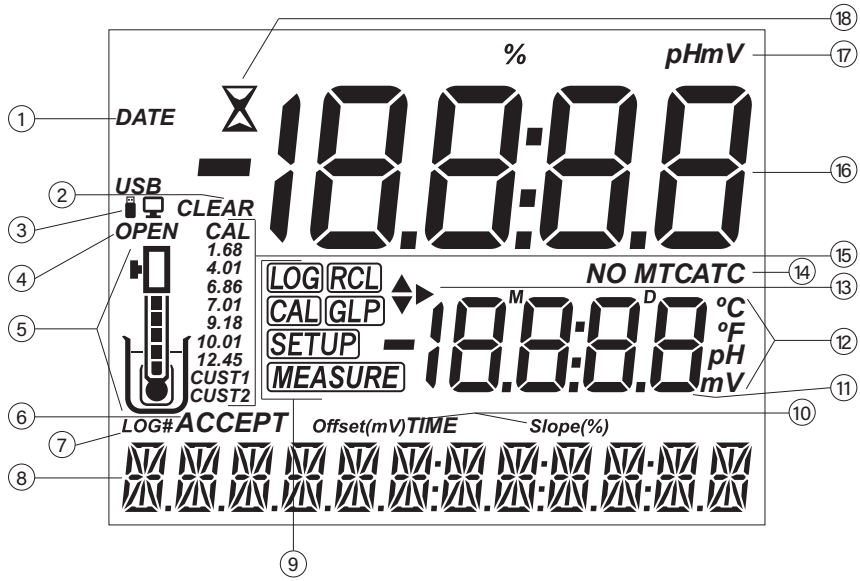
14. Power supply socket
15. Reference electrode socket
16. Temperature probe socket
17. BNC electrode connector
18. USB ports

Display Description MW150



1. Status information
2. Clear message/calibration/memory
3. OPEN is displayed when the electrode cap has to be removed. Refill cap is displayed blinking before calibration.
4. Electrode symbol
5. Accept tag
6. Third LCD line, message area
7. Mode tags
8. Offset/slope indicators
9. Second LCD line, temperature measurement
10. Temperature and measurement units
11. Arrow tags, to help user select required information
12. Temperature compensation status (MTC, ATC)
13. pH calibration buffers
14. Primary LCD, measurement line
15. Measurement units
16. Stability indicator

Display Description MW151



1. Status information
2. Clear message/calibration/memory
3. USB connections status
4. OPEN is displayed when electrode cap has to be removed.
   Refill cap is displayed blinking before calibration.
5. Electrode symbol, filled in segments indicate electrode condition
6. Accept tag
7. Log tag
8. Third LCD line, message area
9. Mode tags
10. Offset/slope indicators
11. Second LCD line, temperature measurement
12. Temperature and measurement units
13. Arrow tags, to help user select required information
14. Temperature compensation status (MTC, ATC)
15. pH calibration buffers
16. Primary LCD, measurement line
17. Measurement units
18. Stability indicator

5. GENERAL OPERATIONS

5.1. BATTERY MANAGEMENT

When using the meter with battery, please charge the battery of the bench meter fully before first use.

Use the supplied 12 VDC adapter, or connect to a PC through USB cable (**MW151** only) to recharge your battery.

Note: *The instrument is equipped with auto-off feature to preserve battery energy.*

5.2. CONNECTING THE ELECTRODE & TURNING THE METER ON

Plug the 12 VDC adapter into the power supply socket.

To prepare the instrument for use, connect the **MW917B/1** pH electrode to the BNC connector and the temperature probe to the appropriate socket on the rear panel of the instrument.

The temperature probe can be used in conjunction with the pH electrode to utilize the instrument's ATC capability, but can also be used independently to take temperature measurements. When the probe is not in use, temperature can be set manually using the ▲▼ keys.

Assemble the electrode holder and press ON/OFF to turn the instrument on. All LCD segments will be displayed for a few seconds (or while the ON/OFF is pressed), and then the instrument will enter normal measurement mode.

After measurement has been taken, switch the meter off, clean the electrode and store it with a few drops of **MA9015** storage solution in the protection cap.

The auto-off feature turns the meter off after 10 minutes of non-use. To disable this feature, see Setup, Auto Off section.

5.3. OPERATION OVERVIEW

MW150 offers simplified pH measurements that are ideal for anyone who requires rapid and reliable results but works on a tight budget.

It displays 0.01 pH resolution and allows a 3-point buffer calibration from the following pH buffers: pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45.

The bench meter shows calibration status and warning messages that indicate that the pH electrode requires maintenance.

MEM/MR function can be used to store/recall measured values.

GLP feature provides offset and slope.

MW151 has a wider range of features and can be used in more complex applications where certain requirements need to be met.

It displays 0.01 or 0.001 pH resolution (set by the user), allows up to 5-point standard buffer calibration and 2 custom buffers.

The bench meter shows calibration status and electrode condition warnings (should the pH electrode require maintenance). It also indicates if the buffer solution is contaminated.

The logging feature supports logging up to 1000 records, organized as: manual log-on demand (max. 200 logs), manual log-on stability (max. 200 logs), interval logging (max. 1000 logs, 100 lots).

	MW150	**MW151**
Calibration	up to 3 points	up to 5 points, including 2 custom buffers
Diagnostics	Error messages GLP	Electrode condition Error messages GLP
Log types	One memorized reading	Manual Log on demand Manual Log on stability (Fast, Medium, Accurate) Interval Logging
Recommended pH electrodes	**MA917B/1**	**MA917B/1**

6. SETUP

Setup mode allows parameters that are not directly related to the measurement to be viewed and modified.

1. Press SETUP to enter in Setup mode.
2. Use ▲▼ keys to select required parameter.
3. Press the CAL/EDIT to enter Edit mode.
4. If various options are available, use RANGE/▶ to select desired option.
5. Use ▲▼ keys to select or change parameter values.
6. Press GLP/ACCEPT to confirm or press CAL/EDIT to exit without changing.
7. Once in Edit mode, below detailed parameters can be set or viewed.

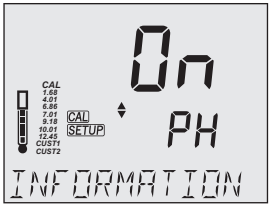
If needed, use ESC to exit Setup mode.

6.1. GENERAL SETUP

pH Information

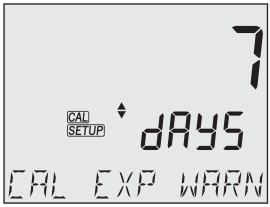
Use ▲▼ keys to select whether the pH buffer calibration information is enabled or not: on – enable (default), off – disable.

When enabled, the electrode segment displays the electrode condition (**MW151** only).



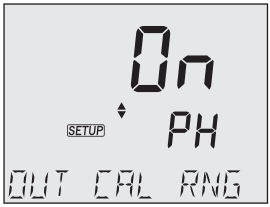
Calibration Expired Warning

Use ▲▼ keys to select the number of days since last calibration has elapsed: 1 to 7 days (default), or off.



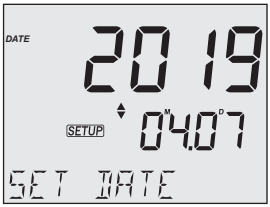
Out of Calibration Range

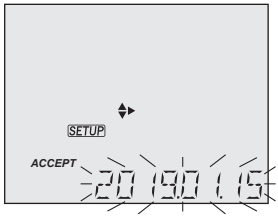
Use ▲▼ keys to enable (on – default) or disable (off) out of calibration range warning.



Set Date

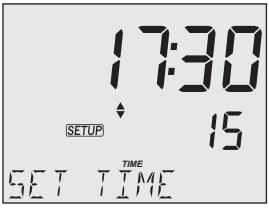
Use RANGE/▶ to change editable value (year, month, day) and use ▲▼ keys to change the value.

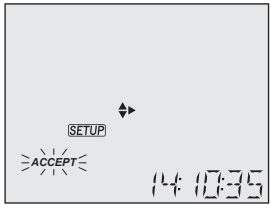




Set Time

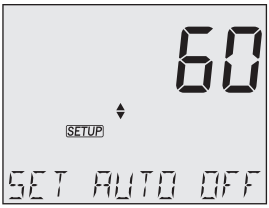
Use RANGE/▶ to change editable value (hour, minute or second) and use ▲▼ keys to change the value.

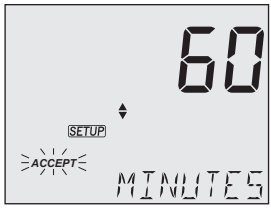




Auto Off

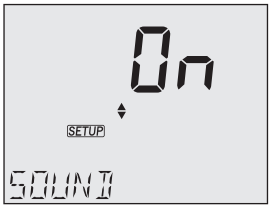
Use ▲▼ keys to select desired auto-off time. Available options are 5, 10 (default), 30, 60 minutes and off.





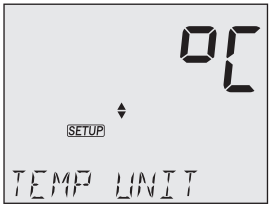
Sound

A short acoustic signal is generated every time a key is pressed. Use ▲▼ keys to enable/disable the acoustic signal. Default option is on.



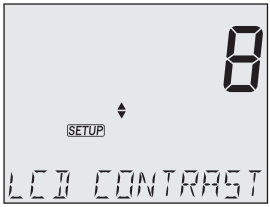
Temperature Unit

Use ▲▼ keys to select desired temperature unit °C (default) or °F.



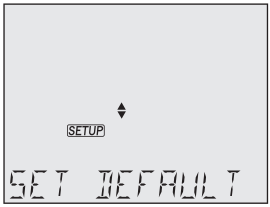
LCD Contrast

Use ▲▼ keys to set LCD contrast values from 1 to 9 with default value being 9.



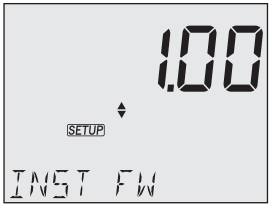
Default Values

Use GLP/ACCEPT to return to default values.



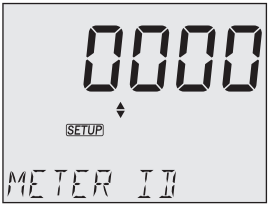
Instrument Firmware Version

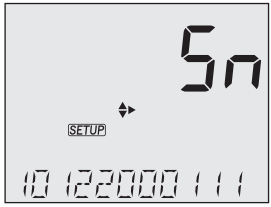
First LCD line displays instrument firmware version.



Meter ID / Serial Number

Use ▲▼ keys to assign meter ID (identification number) from 0 to 9999. Use RANGE/▶ to view meter's serial number.



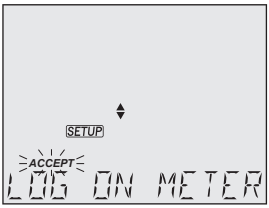


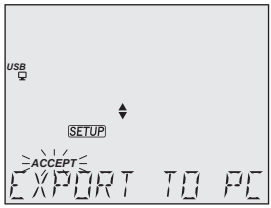
6.2. MW151 SPECIFIC SETUP

In addition to General Setup parameters, when operating **MW151**, the user can set the following specific parameters:

Log on Meter

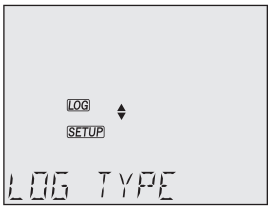
Is displayed when a USB cable or USB flash drive is connected. Enter SETUP, select LOG ON METER, press CAL/EDIT, than use ▲▼ keys to select EXPORT TO PC. Press GLP/ACCEPT to confirm or press CAL/EDIT to return to Setup menu.

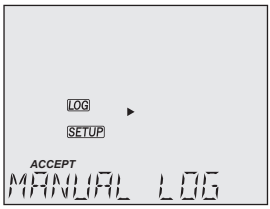


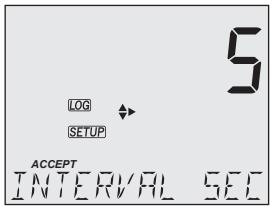


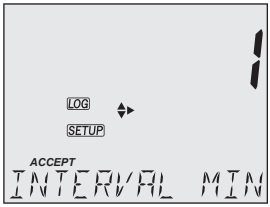
Log Type

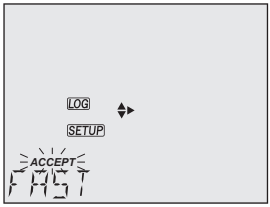
Enter SETUP, select LOG TYPE and press CAL/EDIT to enter Edit mode. Once in Edit mode, use RANGE/▶ to choose between interval log, manual log and stability log. Use ▲▼ keys to set interval time (5 sec – default, 10 sec, 30 sec, 1 min, 2 min, 5 min, 15 min, 30 min, 60 min, 120 min, 180 min) and stability type (fast, medium, accurate). Press CAL/EDIT to return to Setup menu.

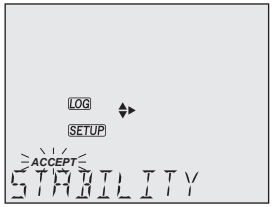






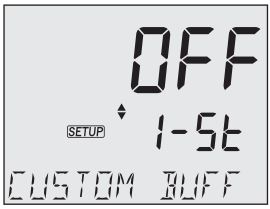






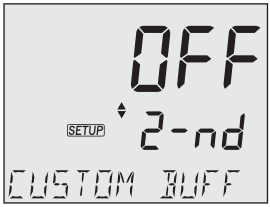
First Custom Buffer

Use ▲▼ keys to set the first custom buffer. Use RANGE/▶ to set a default buffer value as starting value. Press GLP/ACCEPT to confirm or press CAL/EDIT to return to Setup menu.



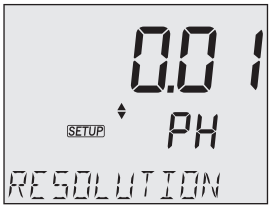
Second Custom Buffer

Use ▲▼ keys to set the second custom buffer. Use RANGE/▶ to set a default buffer value as starting value. Press GLP/ACCEPT to confirm or press CAL/EDIT to return to Setup menu.



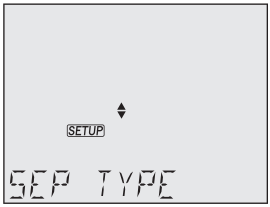
pH Resolution

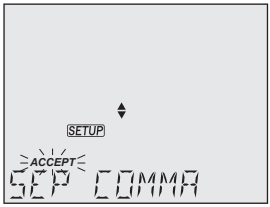
Use ▲▼ keys to set the pH resolution (0.01 – default or 0.001). Press GLP/ACCEPT to confirm or press CAL/EDIT to return to Setup menu.

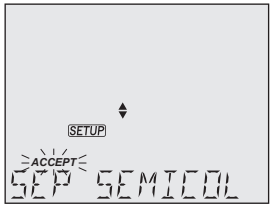


Separator Type

Use ▲▼ keys to select the desired character separator (semicolon or comma) to separate columns in the .csv file. Press GLP/ACCEPT to confirm or press CAL/EDIT to return to Setup menu.







7. pH

7.1. pH PREPARATION

MW150: Up to 3-point calibration with a choice of seven standard buffers.

MW151: Up to 5-point calibration with a choice of 7 standard buffers and, additionally, calibration with custom buffers (CUST1 and CUST2).

1. Pour small quantities of the selected buffer solutions into clean beakers. Use one beaker for rinsing and one for calibration.
2. Remove the protective cap and rinse the electrode with the buffer solution for the first calibration point.

For better accuracy, frequent calibration of the pH sensor is recommended. In addition, the meter must be recalibrated:

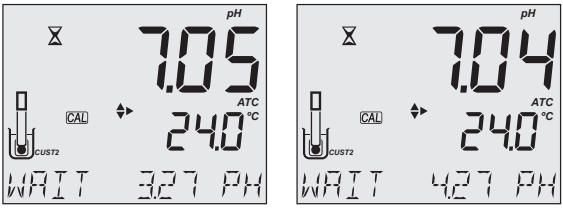
- whenever the pH electrode is replaced
- after testing aggressive chemicals
- when high accuracy is required
- when the calibration time out has expired (if the feature is enabled)
- at least once a week

7.2. pH CALIBRATION

Custom Buffers (MW151 only)

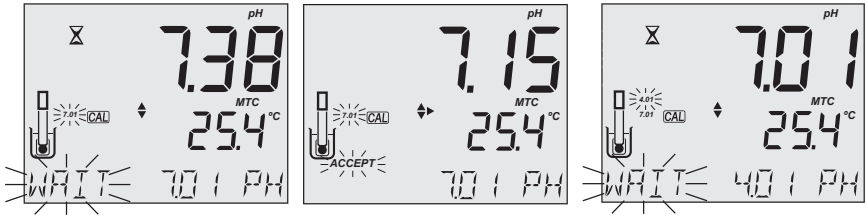
This feature has to be enabled in Setup. Temperature compensation of custom buffers is set to the value of 25°C.

When calibrating with custom buffers, the buffer value can be modified by pressing RANGE/▶. Use the ▲▼ keys to change the buffer value based on the temperature reading. After 5 seconds, the buffer value will be updated.



Calibration

1. Submerse pH electrode tip app. 4 cm (1½") into buffer solution and stir gently. Press CAL/EDIT. If performing a 2-point calibration, use the pH 7.01 (pH 6.86 for NIST) buffer first. The meter will enter calibration mode, displaying 7.01 pH buffer value and "WAIT" message blinking, together with the "CAL" tag and "⧖" symbol. If required, use the ▲▼ keys to select a different buffer value.
2. Once the reading has stabilized and is close to the selected buffer, the "ACCEPT" tag will start blinking. Press GLP/ACCEPT to confirm calibration.
3. After the first calibration point has been confirmed, the calibrated value will be displayed on the first LCD line and the second expected buffer value on the third LCD line (i.e. pH 4.01). The value of the first buffer will be set while the second expected buffer value will be blinking on the screen.



To use only a 1-point calibration, press "CAL/EDIT" to exit calibration. The meter will store the calibration information and return to measurement mode.

To continue calibrating with additional buffers, rinse and submerse the pH electrode tip app. 4 cm (1½") into the second buffer solution and stir gently.
If needed, use the ▲▼ keys to select a different buffer value.
The same procedure is to be followed until the required calibration points (2 or 3) have been set.
At the end of calibration, the instrument displays "SAVING", stores the calibration values and returns to normal measurement mode.

5-Point Calibration (MW151 only)

The 3-point calibration procedure can be continued up to 5-point following the same steps.

For accurate pH measurements, 5-point calibration is recommended and a minimum of 2-point calibration is suggested.

Note: *When performing a new calibration (or adding to an existing calibration) the first calibration point will be treated as an offset. Press CAL/EDIT after the first or second calibration point has been confirmed, and the instrument will store the calibration data and return to measurement mode.*

Expired Calibration

The instrument has a real time clock (RTC) to monitor how much time has passed since the last pH calibration.
The RTC is reset every time the instrument is calibrated and the "expired calibration" status is triggered when the meter detects a calibration time out. The "CAL EXPIRED" will be displayed to warn the user that the instrument should be recalibrated.
Calibration time-out function can be set from 1 to 7 days (with 7 being default option) or disabled (off). See Setup, pH Information for details.

For example, if a 4-day-long time out has been selected, the instrument will issue the alarm 4 days after the last calibration.

> ***Notes:*** *If the instrument is not calibrated or calibration has been cleared (with Clear Cal option), the display will show the "NO CAL" message.*

7.3. pH MEASUREMENT

Remove the electrode protective cap and submerse the tip app. 4 cm (1½") into the sample. pH readings are directly affected by temperature therefore, it is recommended to wait until the sample and the pH electrode reach thermal equilibrium.

If necessary, press the RANGE/▶ until the display changes to the pH mode. Allow the reading to stabilize ("⧖" will turn off).

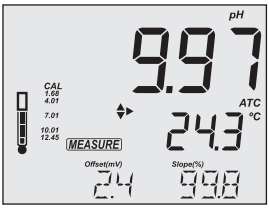
The LCD will display:

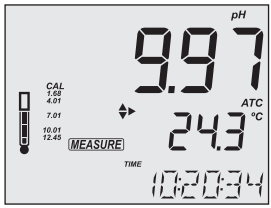
- measured pH reading and temperature
- temperature compensation mode (MTC - manual, ATC - automatic)
- electrode condition (if available, **MW151** only)
- buffers used (if enabled).

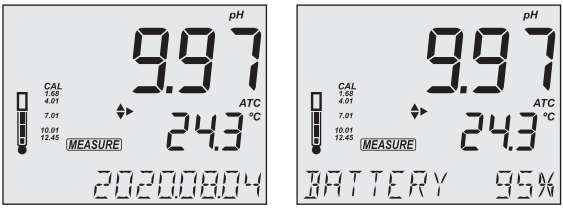
For improved accuracy make sure that the instrument is calibrated (see pH section for details).

Make sure that the electrode is kept hydrated. Rinse the probe with the sample before use. When using the meter's Automatic Temperature Compensation (ATC) feature, immerse the temperature probe into the sample as close to the electrode as possible and wait for a few seconds.

Use the ▲▼ keys to scroll the additional information displayed on the third LCD line: mV offset & slope values, time of measurement, date of measurement, battery status.

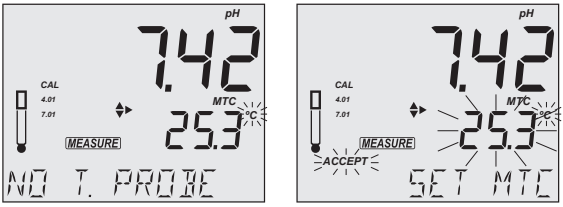




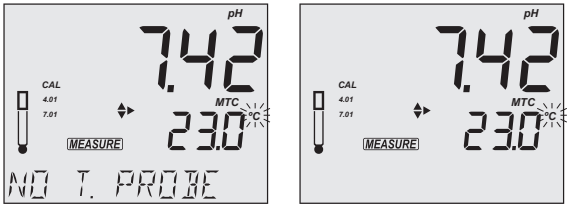


MTC mode

To enable Manual Temperature Compensation (MTC), disconnect the temperature probe from the meter. The display will show a default temperature of 25°C or the last measured temperature value. The MTC tag and the three arrows symbol next to temperature measurement will be displayed. Press CAL/EDIT and use the ▲▼ keys to set the temperature value manually. Press GLP/ACCEPT for the value to be saved (or press ESC or CAL/EDIT to exit without saving).



"NO T. PROBE" message is displayed. Use the ▲▼ keys to enter calibration mode (third LCD line is empty). Press CAL/EDIT to start measurement in MTC mode.



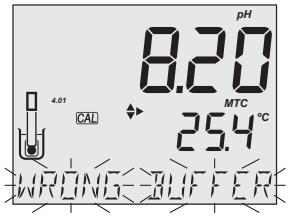
Note: *If the temperature sensor is broken or disconnected, the meter switches to MTC mode automatically.*

7.4. WARNINGS & MESSAGES

The Calibration Check feature flags diagnostic messages during a calibration. As electrode aging is usually a slow process, differences between previous calibrations are likely due to a temporary problem with the probe or buffers.

Wrong Buffer

"Wrong buffer" message is displayed blinking when the difference between the pH reading and the value of the selected buffer is too big. If this error message is displayed, check if you have selected and used the correct calibration buffer.

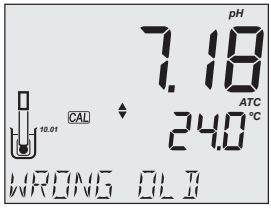


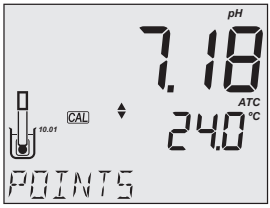
Wrong Old Points Inconsistency

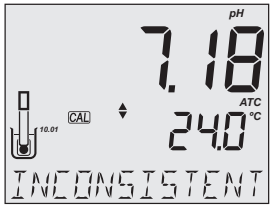
"WRONG OLD POINTS INCONSISTENT" is displayed if the new calibration value differs significantly from the last value of that probe in that buffer. Clear the previous calibration and attempt a new calibration with fresh buffers.

To clear calibration information, press CAL/EDIT then press LOG/CLEAR (MEM/CLEAR). The "CLEAR CAL" message will be displayed. Press the GLP/ACCEPT to confirm or press CAL/ EDIT to exit without clearing. The probe may retain a single point calibration if the first point was accepted.

Once calibration information is cleared, the message "NO CAL" will be displayed.



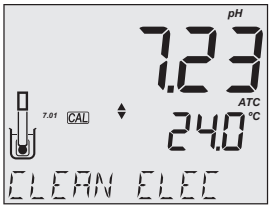




Clean Electrode

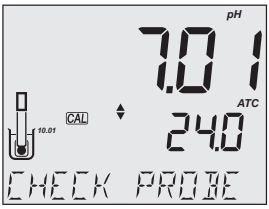
"CLEAN ELEC" indicates poor electrode performance (the offset is out of the accepted window, or the slope is under the accepted lower limit). Clean the probe to improve response time. See pH Electrode Conditioning and Maintenance for details.

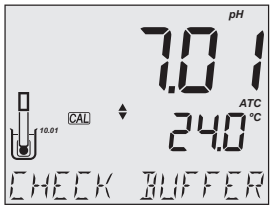
Repeat calibration after cleaning.



Check Probe / Check Buffer

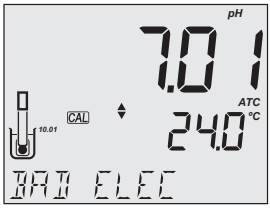
"CHECK PROBE CHECK BUFFER" is displayed when the electrode's slope exceeds the highest accepted slope limit. Inspect the electrode and make sure the buffer solution is fresh. Clean the probe to improve response time.





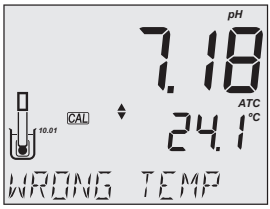
Bad Electrode

"BAD ELEC" is displayed if the cleaning procedure, performed after the above two messages, is found to be unsuccessful. Replace the probe.



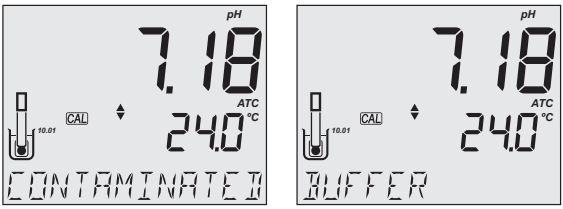
Wrong Buffer Temperature

"WRONG TEMP" is displayed if the temperature of the buffer is out of range. The calibration buffers are affected by temperature changes. During calibration, the instrument will automatically calibrate to the pH value corresponding to the measured temperature but compensate it to the value of 25 °C.



Contaminated Buffer

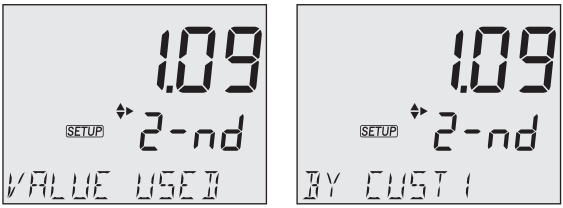
If "CONTAMINATED BUFFER" is displayed, the buffer is contaminated. Replace your buffer with a new one and continue the calibration.



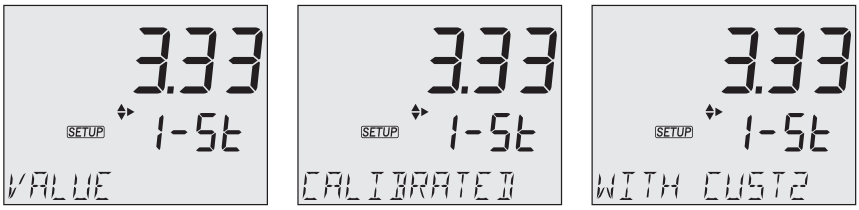
Identical Custom Buffer Values

Make sure that set custom buffers have different values. Otherwise, if attempting to set a custom buffer of the same value as the one previously set, below listed messages may appear:

- VALUE USED BY CUST1 - before calibrating with any of these values



- VALUE CALIBRATED WITH CUST2 - value already used in a previous calibration



8. ELECTRODE CONDITION & MAINTENANCE

Electrode Condition (MW151 only)

The **MW151** displays a probe icon (unless the feature is disabled from setup) which indicates the electrode status after calibration. The assessment of the electrode's status remains active for 12 hours and is based on the pH electrode offset and slope characteristics at the time of calibration.

If electrodes are not cleaned after use they will lose their accuracy and the measurement precision of the bench meter decreases. This can be observed as a steady decrease in the slope of the electrode.

The slope (%) indicates the sensitivity of the glass membrane, the offset value (mV) indicates the age of electrode and provides an estimation when the electrode needs to be changed.

Milwaukee Instruments recommends that the offset does not exceed ±30 mV and that the slope percentage is between 85-105%.

When the slope value drops below 50 mV per decade (85 % slope efficiency) or the offset at the zero point exceeds ± 30 mV, reconditioning may return the electrode to the level of expected performance, but a change of electrode may be necessary to ensure accurate pH measurements.

An electrode is characterized by both its zero point and its slope and it is advisable to do a minimum of a two point calibration for reliable measurements and better precision. Also, the electrode condition is evaluated only if the current calibration has a minimum of two points. Its performance is expected to slowly decrease over time.

5 bars: excellent condition
4 bars: very good condition
3 bars: good condition
2 bars: fair condition
1 bar: poor condition
1 bar blinking: very poor condition

With 1 bar it is recommended to clean the electrode and recalibrate. If after recalibrating there is still only 1 bar or 1 bar blinking, replace the probe.

0 bar indicates that the instrument has not been calibrated on the current day or a one point calibration has been performed with previous calibration not yet deleted.

This information can also be viewed in the GLP data.

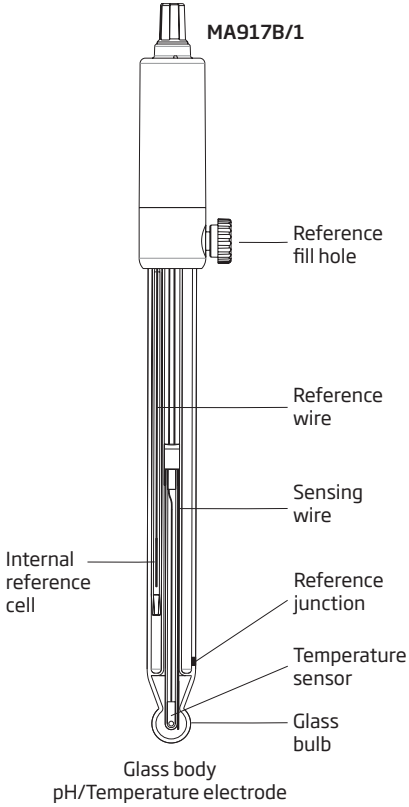
Preparation Procedure

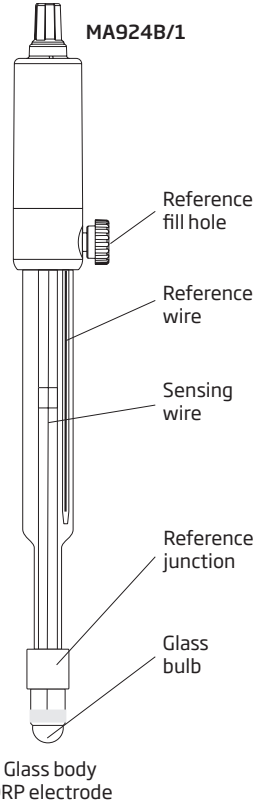
Remove the electrode protective cap. Do not be alarmed if salt deposits are present, this is normal. Rinse the electrode with water.

Shake the electrode gently, as you would do with a clinical thermometer, to eliminate any air bubbles inside the glass bulb.

If the glass bulb and/or junction are dry, soak the electrode in **MA9016** Cleaning solution for a minimum of 30 minutes. For refillable electrodes, if the refill solution (electrolyte) has dropped more than 2½ cm (1") below the fill hole, add the appropriate electrolyte solution.

Rinse with water and calibrate before using. To ensure a quick response and to avoid cross-contamination of the samples, rinse the electrode tip with the solution to be tested before taking any measurements.





Storage Procedure

To minimize clogging and ensure quick response time, the glass bulb and the junction should be kept hydrated.

Add a few drops of **MA9015** Storage solution (not included with the bench meter) to the protective cap. Replace the storage cap when the electrode is not in use.

Note: *Never store the electrode in distilled or deionized water.*

Regular Maintenance

1. Inspect the electrode for any scratches or cracks. If any present, replace the electrode.
2. Inspect the cable. The connection cable and insulation must be intact.
3. Connectors should be clean and dry.
4. Rinse off salt deposits with water.
5. Follow storage procedure above.

For refillable electrodes:

Refill the electrode with fresh electrolyte solution (see the electrode's specifications to select the correct refilling solution). Keep the electrode upright for 1 hour. Follow the storage procedure above.

Cleaning Procedure

General: Soak the electrode in **MA9016** Electrode cleaning solution for approximately 30 minutes (not included with bench meters).

IMPORTANT: After performing any of the cleaning procedures, rinse the electrode thoroughly with distilled water and soak in MA9015 Storage solution for at least 1 hour before taking measurements.

9. ORP

9.1. PREPARATION

To perform ORP measurements, connect an ORP electrode (see "Accessories" section for code) to the instrument and turn it ON.

9.2. ORP CALIBRATION

The ORP range is factory calibrated and cannot be calibrated by the user. **MA9020** ORP Solution can be used to confirm that the ORP sensor measures correctly. mV readings are not temperature compensated.

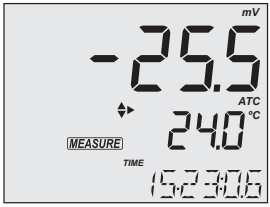
9.3. ORP MEASUREMENT

MW150 and **MW151** are factory calibrated.

If necessary, enter the mV mode by pressing the RANGE/▶ until the display changes to mV.

Immerse the ORP electrode tip app. 4 cm (/1½") into the sample and wait until the stability indicator (hourglass icon) disappears.

The bench meter will show the ORP (mV) value on the primary LCD together with temperature of the sample on the secondary LCD.



For accurate ORP measurements, the surface of the electrode must be clean and smooth. Pretreatment solutions are available to condition the electrode and improve its response time (see "Accessories" section).

Notes: *When the reading is out of range, the display will flash the closest full-scale value. If using pH electrode while in mV mode, the instrument will measure the mV generated by the pH electrode.*

10. LOGGING (MW151)

MW151 features three different types of logging: manual log on demand, log on stability and interval logging. The logging type is set in the Setup menu (see Log Type for details).

The meter can hold up to 1000 records. It can hold up to 200 manual log on demand records, up to 200 log on stability records and up to 1000 interval logging records.

Logging records are grouped in lots (up to 100 lots). Lot numbering goes up to 100 and restarts if all lots are deleted. Manual log on demand and log on stability are each stored in a separate lot.

Note: *An interval logging session can log up to 1000 records. When the logging session exceeds 600 records, a second lot (up to 400 records) is generated automatically.*

When log memory is full, "LOG FULL" is displayed on the third LCD line and logging will cease. The meter will return to the measurement mode (see Deleting Data procedure).

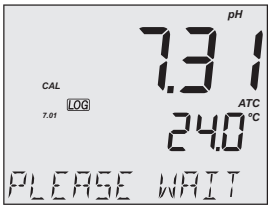
10.1. TYPES OF LOGGING

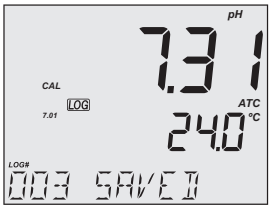
1. **Manual log on demand:** Readings are logged each time LOG/CLEAR is pressed. All readings are stored in a single lot for the measurement type. New records are stored in the same lot (i.e. readings made on different days).
2. **Log on stability:** Readings are logged each time LOG/CLEAR is pressed and the stability criteria is reached. Stability criteria may be set to fast, medium or accurate.
3. **Interval logging:** Readings are logged at given time intervals set by the user (i.e. every 5 minutes, every 10 minutes).

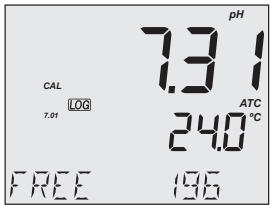
A complete set of GLP information including date, time, range selection, temperature reading and calibration information is stored with each log.

Manual Log on Demand

When Manual log is selected, data points are added to the log file every time LOG/CLEAR is pressed. When LOG/CLEAR is pressed, "PLEASE WAIT" is displayed followed by number of saved logs and available log space.

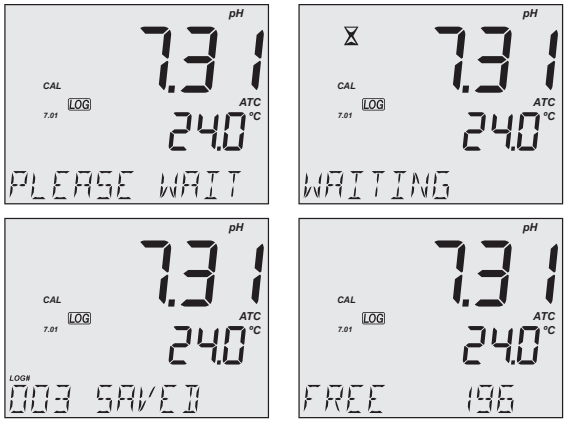






Log on Stability

When Stability log is selected, data points are added to the log file every time LOG/ CLEAR is pressed. When LOG/CLEAR is pressed, "PLEASE WAIT" is displayed followed by "WAITING". Once the measurement is stable, the number of saved logs is displayed followed by available log space.



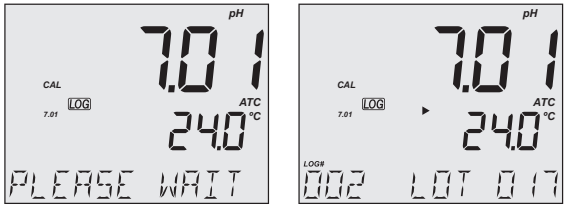
While the "WAITING" message is displayed, press ESC or LOG/CLEAR again to exit without logging.

Interval Logging

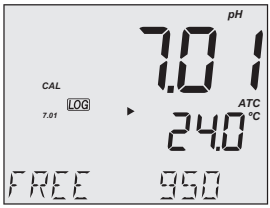
When Interval logging is selected, a new lot is created and data points are added to it at the selected time interval until LOG/CLEAR is pressed again. This will stop the log session within the active lot.

If the maximum lot number is exceeded, "MAX LOTS" will be displayed and some lots will need to be deleted.

When LOG/CLEAR is pressed, "PLEASE WAIT" message is displayed followed by the number of free spaces available. During active logging, lot information is displayed on the third LCD line indicating where data will be saved.



When RANGE/▶ is pressed, the number of available logs is displayed.



When LOG/CLEAR is pressed again, "LOG STOPPED" is displayed indicating the end of interval logging session.

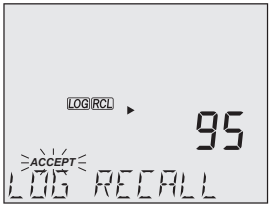
When a sensor failure is detected, "OUT OF SPEC." is displayed.

10.2. DATA MANAGEMENT

The user can view, delete and export data by pressing RCL.

Viewing data

When RCL is pressed, "LOG RECALL" is displayed together with the total number of logs. Press GLP/ACCEPT to confirm.



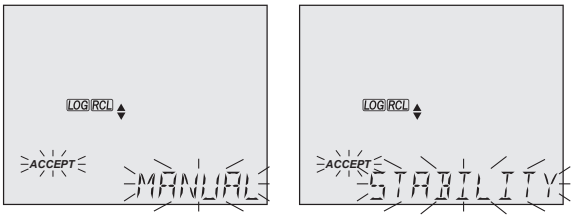
Use the ▲▼ keys to select the log type (or lot number within interval logging) and press GLP/ACCEPT to confirm.

If the selected log type does not contain any records, an error message appears (e.g. "NO STAB. LOGS").

Deleting Data

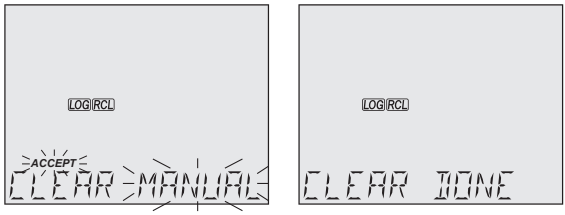
Manual Log on Demand & Stability Log

Press RCL then GLP/ACCEPT to select between log types (manual log on demand or stability).



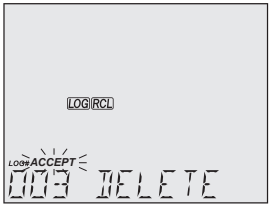
Use the ▲▼ keys to scroll between log types (manual or stability).

Press LOG/CLEAR to delete entire lot (either manual or stability lots).



Press GLP/ACCEPT to enter chosen lot.

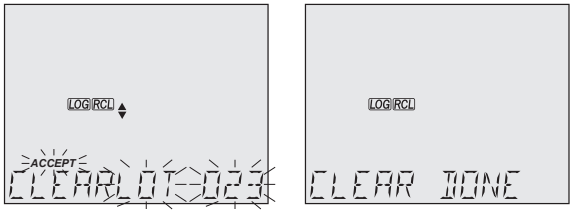
Use the ▲▼ keys to scroll between data points and press LOG/CLEAR to delete data. Press GLP/ACCEPT to confirm. If needed, press CAL/EDIT or ESC to return without saving.



Log on Interval

Press RCL then GLP/ACCEPT and use the ▲▼ keys to scroll between interval lots. Press LOG/CLEAR to delete lot.

"CLEAR DONE" is displayed for a few seconds after selected lot has been deleted.



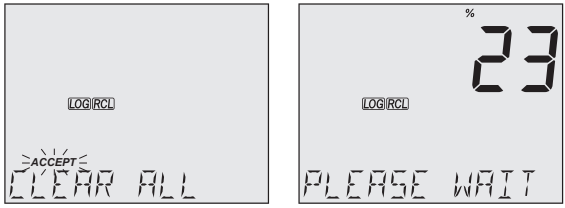
A lot number is used to identify a particular set of data. Lot numbers are allocated successively up to 100 even if some lots have been deleted.

If log space is full (100 lots) users need to delete some of them to free up log space. If lot number has reached 100, users need to delete all lots to restart lot numbering.

Delete All

Press RCL and the total number of logs is displayed. Press LOG/CLEAR to delete all logs.

"CLEAR ALL" will be displayed with "ACCEPT" tag blinking. Press GLP/ACCEPT to confirm (or press ESC to exit Log recall). "PLEASE WAIT" and the percent cleared will be displayed until completed.



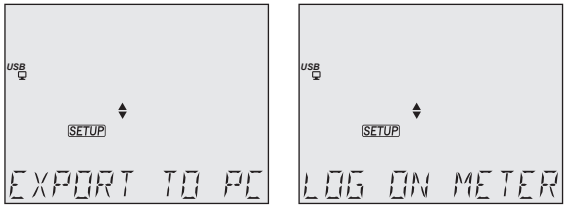
Note: *If LOG/CLEAR was pressed by mistake, press LOG/CLEAR again to exit without deleting.*

Export Data

PC

1. Connect the **MW151** to the PC using the supplied USB cable.
2. Turn the meter on with the ON/OFF button.
3. The PC will detect the bench meter as a removable flash drive.
4. If you connect the meter to the PC, the default setting is EXPORT TO PC mode.
5. Use a file manager (e.g. Windows Explorer, MacOS Finder) to move the files from the meter to the PC.
6. When the USB cable is attached to the PC and EXPORT TO PC mode is enabled, logging is not possible.

Note: *To enable logging while connected to the PC, enter SETUP and change "EXPORT TO PC" mode by pressing CAL/EDIT and using the arrow keys to "LOG ON METER" mode.*



The .csv file (comma separated values) may be opened with text editor or spreadsheet application.

Note: *Field separator may be set as comma or semicolon, depending on region preferences. Western Europe (ISO-8859-1) character set and English language are suggested settings. Other files may be visible depending upon computer settings.*

Files with interval lots are named as PHLOT, followed by lot number, e.g. PHLOT001, PHLOT002. Manual logs are named as PHLOTMAN, and stability logs are named as PHLOTSTAB.

Notes:

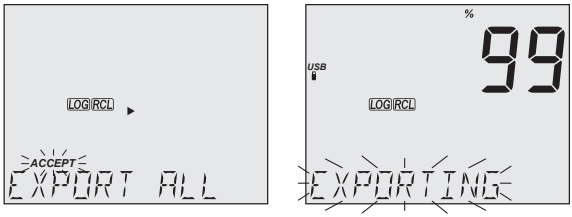
If "°C!" appears in logged data, the electrode/probe was used beyond its operation specifications and the data is not considered reliable.

If "°C!!" appears in logged data, the meter was in MTC mode.

USB

Logged data can be transferred to a USB flash drive.

1. Insert a USB flash drive into the USB port located on the top of the meter.
2. Press RCL.
3. Use the RANGE/▶ to select the "EXPORT ALL" option then press GLP/ACCEPT to confirm. The meter will display the percentage of export.



When the export is finished, the USB flash drive can be removed.

Note: *Do not remove USB flash drive during an active export transfer.*

When the battery is low, the "BATTERY LOW" message is displayed blinking and the export is not executed.

When the flash drive is missing or not inserted properly, the "NO MEMSTICK" message is displayed.

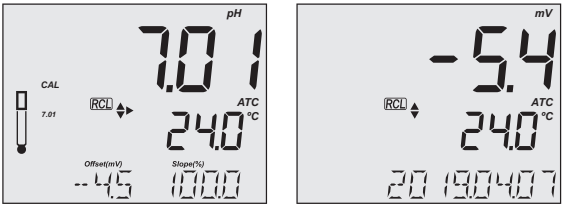
When identically named lots have already been exported to USB, the "OVR." message appears with the overwritten lot number blinking. Use the ▲▼ keys to scroll between "YES", "NO", "YES ALL", "NO ALL" options. Press GLP/ACCEPT to confirm.

11. MEM & MR FUNCTIONS (MW150)

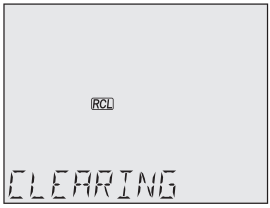
When in measurement mode, press MEM/CLEAR. The LCD will display "MEMORY" and will save the measured pH value (as well as ORP mV and temperature values) and the current calibration. When pressing MR, the LCD will display the memorized value. The ▲▼ keys can be used to see all information.

Press MR to recall the last memorized pH, ORP, temperature and calibration values. If required press RANGE/▶ to switch between pH and ORP mV values.

With pH selected, use ▲▼ keys to switch between calibration offset/slope, date and time. With mV selected, use ▲▼ keys to switch between date and time.



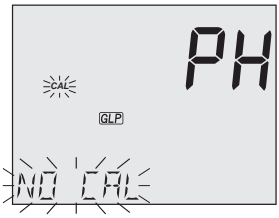
When MEM/CLEAR is pressed, "CLEARING" message is displayed briefly and the saved value is deleted. The instrument returns to measurement mode.



12. GLP

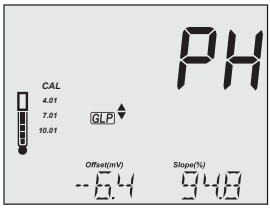
Good Laboratory Practice (GLP) refers to a quality control function used to ensure uniformity of sensor calibrations and measurements. Press GLP/ACCEPT to open latest calibration file. Use the ▲▼ keys to scroll stored information (offset and slope values, used buffers together with the temperature, time and date of the last calibration, calibration warnings). This information is also included with every data log.

If the instrument has not been calibrated, blinking CAL tag and "NO CAL" message are displayed.

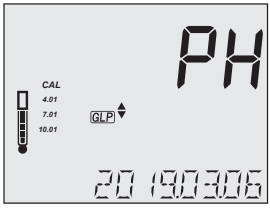


The GLP slope percentage is referenced to the ideal slope value at 25 °C.

Additionally, for **MW151,** the electrode condition indicator displays its status after the last calibration.

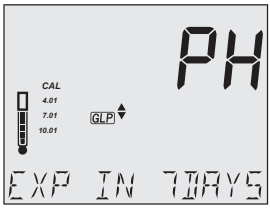


Use the ▲▼ keys to display the last calibration date (yyyy.mm.dd) together with the current reading.



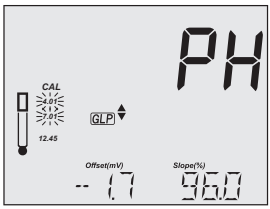
Note: *When using custom buffers, "CUST1" and "CUST2" tags are displayed. If only one custom buffer is used, "CUST1" is displayed together with its value. (MW151 only)*

If enabled, the number of days until the calibration alarm "CAL DUE" will be displayed (e.g. "EXP IN 7DAYS"). If disabled, "EXP WARN DIS" is displayed.



The number of days since the calibration expired. (e.g. "CAL EXPIRED").

If a new buffer is used, which was not used in the last calibration, the buffer tag will be displayed with the tags for the previously used buffers displayed blinking.



For **MW151**, electrode condition and response times are visible on the day of calibration (See Electrode Condition & Maintenance section). If configured in Setup, a countdown message displays the number of elapsed days since last calibration.

13. TROUBLESHOOTING

SYMPTOMS	PROBLEM	SOLUTION
Slow response / excessive drift	Dirty pH electrode	Soak the electrode tip in **MA9016** for 30 minutes, then follow the cleaning procedure
Reading fluctuates up and down (noise)	Clogged/Dirty junction. Low electrolyte level (refillable electrodes only)	Clean the electrode. Refill with fresh electrolyte **MA9012**
Full scale value displayed blinking	Reading out of range	Check if the sample is within measurable range; check electrolyte level and general electrode status
mV scale out of range	Dry membrane or dry junction	Soak electrode in **MA9015** storage solution for at least 30 minutes
°C or °F displayed blinking	Out of order temperature probe	Replace temperature probe
Meter does not work with temperature probe	Broken temperature probe	Replace temperature probe
Meter fails to calibrate or gives faulty readings	Broken pH electrode	Replace electrode
"WRONG CAL" is displayed during pH calibration	Wrong or contaminated buffer	Check that buffer solution is correct and fresh
"Internal Er X"	Internal error	Restart the meter. If error persists, contact Milwaukee Technical Service.
"CAL ERROR"	Loaded default pH calibration values	Perform pH calibration

14. ACCESSORIES

MA9001	pH 1.68 Buffer Solution (230 mL)
MA9004	pH 4.01 Buffer Solution (230 mL)
MA9006	pH 6.86 Buffer Solution (230 mL)
MA9007	pH 7.01 Buffer Solution (230 mL)
MA9009	pH 9.18 Buffer Solution (230 mL)
MA9010	pH 10.01 Buffer Solution (230 mL)
MA9012	Refilling Solution for pH electrode (230 mL)
MA9015	Storage Solution (230 mL)
MA9016	Electrode Cleaning Solution (230 mL)
MA9020	200-275 mV ORP Solution (230 mL)
MA9112	pH 12.45 Buffer Solution (230 mL)
MA9310	12 VDC Adapter, 220 V
MA9311	12 VDC Adapter, 110 V
MA9315	Electrode holder
MA917B/1	pH Electrode, glass body, refillable
MA924B/1	ORP Electrode, glass body, refillable
MA831R	Temperature Probe

For your safety don't use or store the instrument in hazardous environment.
To avoid damage or burn, do not perform any measurement in microwave ovens.

CERTIFICATION

Milwaukee Instruments conform to the CE European Directives.

Disposal of Electrical & Electronic Equipment. Do not treat this product as household waste. Hand it over to the appropriate collection point for the recycling of electrical and electronic equipment.

Please note: proper product and battery disposal prevents potential negative consequences for human health and the environment.

RECOMMENDATION

Before using this product, make sure it is entirely suitable for your specific application and for the environment in which it is used. Any modification introduced by the user to the supplied equipment may compromise the meter's performance. For your and the meter's safety do not use or store the meter in hazardous environment. To avoid damage or burn, do not perform any measurement in microwave ovens.

WARRANTY

These instruments are warranted against defects in materials and manufacturing for a period of 3 years from the date of purchase. Electrodes and Probes are warranted for 6 months. This warranty is limited to repair or free of charge replacement if the instrument cannot be repaired. Damage due to accidents, misuse, tampering or lack of prescribed maintenance is not covered by warranty. If service is required, contact your local Milwaukee Instruments Technical Service. If the repair is not covered by the warranty, you will be notified of the charges incurred. When shipping any meter, make sure it is properly packaged for complete protection.

Milwaukee Instruments reserves the right to make improvements in design, construction and appearance of its products without advance notice.

THANK YOU FOR CHOOSING