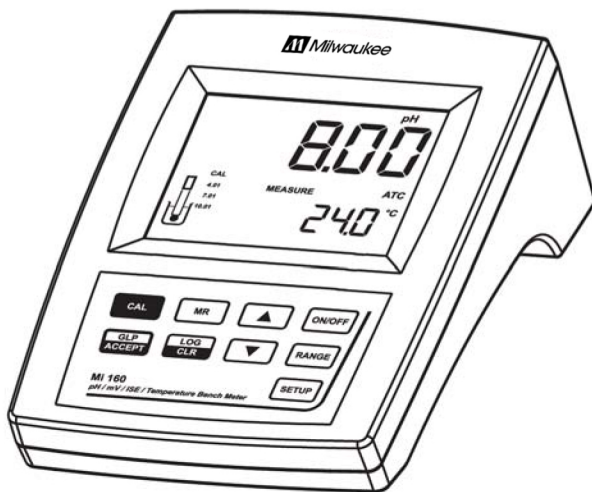


# INSTRUCTION MANUAL

## Bench Meter



### ■ Mi 160 pH/mV/ISE/Temperature



 Milwaukee

[www.milwaukeeinst.com](http://www.milwaukeeinst.com)

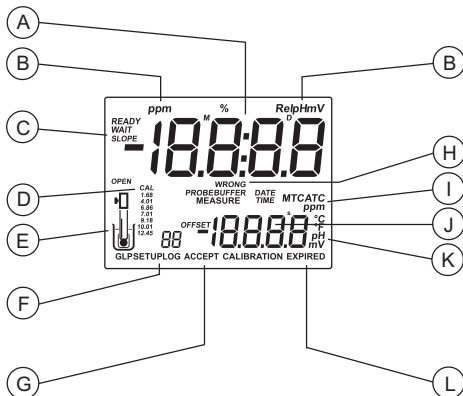
# Instruction Manual Mi 160 Bench Meter

GENERAL DESCRIPTION .....	4
FUNCTIONAL DESCRIPTION .....	2
SPECIFICATIONS .....	5
OPERATIONAL GUIDE .....	6
pH CALIBRATION .....	9
pH BUFFER TEMPERATURE DEPENDENCE .....	12
RELATIVE mV CALIBRATION .....	13
ISE CALIBRATION .....	14
GOOD LABORATORY PRACTICE (GLP) .....	16
LOGGING .....	21
SETUP .....	26
mV CALIBRATION .....	28
TEMPERATURE CALIBRATION .....	29
PC INTERFACE .....	30
ELECTRODE CONDITIONING & MAINTENANCE .....	32
TROUBLESHOOTING .....	33
ACCESSORIES .....	34

## FUNCTIONAL DESCRIPTION

### DISPLAY

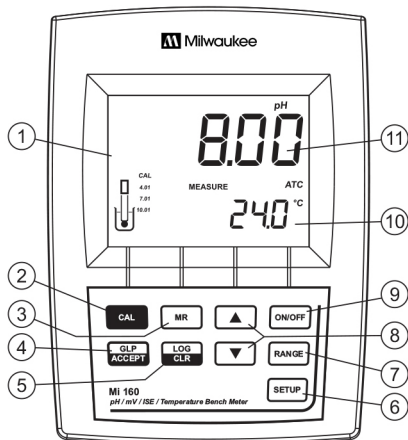
- A. PRIMARY DISPLAY
- B. MEASURING UNIT FOR PRIMARY DISPLAY
- C. CALIBRATION MESSAGES
- D. MEMORIZED pH CALIBRATION BUFFERS
- E. CALIBRATION TAGS
- F. MODE INDICATORS
- G. REQUIRE USER CONFIRMATION
- H. CALIBRATION MESSAGES
- I. TEMPERATURE COMPENSATION MODE INDICATOR
- J. SECONDARY DISPLAY
- K. MEASURING UNIT FOR SECONDARY DISPLAY
- L. CALIBRATION REQUESTED



## FUNCTIONAL DESCRIPTION

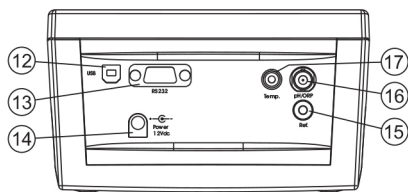
### FRONT PANEL

1. Liquid Crystal Display (LCD)
2. CAL key, to enter/exit calibration mode
3. MR key, to enter/exit memory recall
4. GLP/ACCEPT key, to display GLP data or to confirm value
5. LOG/CLR key, to store reading in memory or to clear calibration
6. SETUP key, to enter/exit setup mode or to toggle between delete one and all logged data
7. RANGE key, to select measurement range or to switch focused data.
8. UP and DOWN arrow keys, to manually increase/decrease temperature or other parameters value
9. ON/OFF key, to turn the meter ON and OFF
10. Secondary LCD
11. Primary LCD



### REAR PANEL

12. USB connector
13. RS232 connector
14. Power supply socket
15. Reference electrode socket
16. BNC electrode connector
17. Temperature probe socket



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## **GENERAL DESCRIPTION**

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Thank you for choosing Milwaukee Instruments. This instruction manual will provide you the necessary information for correct use of the meter.

**Mi 160** is a logging microprocessor-based pH, ORP, ISE and temperature bench meter. This meter is provided with a series of new diagnostic features which add an entirely new dimension to the measurement of pH/ORP/ISE, by allowing the user to dramatically improve the reliability of the measurement:

- 7 memorized buffers (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45) for pH calibration
- pH calibration up to 3 points
- ISE calibration up to 2 points; six standard solutions available: 0.01, 0.1, 1, 10, 100, 1000 ppm
- Messages on the LCD to make the calibration easy and accurate
- Relative mV feature
- GLP feature, to view last calibration data for pH or ISE
- User-selectable alarm time out to alert the user that too much time elapsed since the last pH calibration
- Log-on-demand (50 samples for each range: pH, mV/Rel mV, ISE)

Moreover, it offers an extended temperature range from  $-20^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$ ) to  $120^{\circ}\text{C}$  ( $248^{\circ}\text{F}$ ), using **MA 831R** interchangeable temperature probe.

For accurate measurements, use *the* electrode holder supplied with the meter.

This Bench Meter is supplied with:

- MA 917B/1 pH Electrode
- MA 831R Temperature Probe
- MA 9315 Electrode Holder
- M 10004 pH 4.01 Sachet Buffer Solution
- M 10007 pH 7.01 Sachet Buffer Solution
- M 10010 pH 10.01 Sachet Buffer Solution
- M 10016 Sachet Electrode Cleaning Solution
- Mi 5200 Application Software
- MA 9350 RS232 Connector cable (2 meters)
- Graduate Pipet • 12 VDC Adapter • Instruction Manual

## SPECIFICATIONS

Range	-2.00 to 16.00 pH ±699.9 mV / ±2000 mV 0.001 to 19999 ppm (ISE) -20.0 to 120.0 °C (-4.0 to 248.0 °F)
Resolution	0.01 pH 0.1 mV / 1 mV 0.001 (0.001 to 9.999) ppm 0.01 (10.00 to 99.99) ppm 0.1 (100.0 to 999.9) ppm 1 (1000 to 19999) ppm 0.1 °C (0.1 °F)
Accuracy (@20 °C / 68 °F)	±0.01 pH ±0.2 mV / ±1 mV ±0.5% F.S. (ISE) ±0.4 °C (±0.8 °F)
Rel mV offset	±2000 mV
pH Calibration	1, 2 or 3 points calibration, with 7 memorized buffers
ISE Calibration	1 or 2 points calibration, 6 standard solutions available
Temperature	Automatic, from -20.0 to 120.0 °C (-4.0 to 248.0 °F)
Compensation	or manual, without temperature probe
pH Electrode	MA 917B/1 (included)
Temperature Probe	MA 831R (included)
Input Impedance	10 <sup>12</sup> ohm
Power supply	12 VDC power adapter
Dimensions	230 x 160 x 95 mm (9.0 x 6.3 x 3.7")
Weight	1.1 kg (2.4 lb.)
Environment	0 to 50 °C ; max RH 95%
Warranty	3 years

*This instrument is in compliance with the CE Directives.*

## OPERATIONAL GUIDE

### INITIAL PREPARATION

Plug the 12 VDC adapter to the power supply socket. To prepare the instrument for use, connect the pH electrode to the BNC connector and the temperature probe to the appropriate socket on the rear panel of the instrument. The temperature probe is used in conjunction with the pH electrode to utilize the instrument's ATC capability, but it can also be used independently to take temperature measurements.

For electrodes with a separate reference, connect the electrode's BNC to the BNC connector and the reference electrode plug to the reference socket.

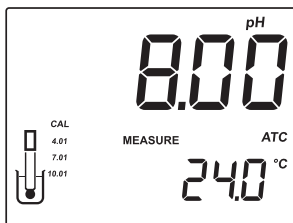
For temperature measurements and automatic temperature compensation connect the temperature probe to the appropriate socket. After measurement switch the meter off, clean the electrode and store it with a few drops of **MA9015** storage solution in the protection cap. The auto-off feature turns the meter off after 20 minutes of non-use. To disable this feature, see SETUP menu on page 26.

The instrument enters the same range and mode as it was at power off, while the "OPEN" tag and the "V" and "U" symbols from the electrode blink on the LCD for a few seconds to remind the user to unscrew the electrode refilling cap, and to remove the protective cap before taking measurements.

### pH MEASUREMENTS

Make sure the instrument has been calibrated before taking pH measurements.

- Submerge the tip of the electrode (4cm/1½") and the temperature probe into the sample to be tested and stir gently. Allow for the electrode to stabilize.
- If necessary, press the RANGE key until the display changes to pH mode.
- The pH measurement is displayed on the primary LCD and the temperature on the secondary LCD.



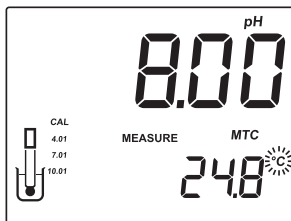
- If the reading is out of range, the closest full-scale value will blink on the primary LCD.

If measurements are taken successively in different samples, it is recommended to rinse the electrode thoroughly with water and then with some of the sample to be tested.

The pH reading is affected by temperature. In order to measure the pH accurately, the temperature effect must be compensated. To use the Automatic Temperature Compensation (ATC) feature, connect and submerge the **MA 831R** temperature probe into the sample as close as possible to the electrode and wait for a few seconds. The "ATC" tag will be displayed.

If Manual Temperature Compensation (MTC) is desired, the temperature probe must be disconnected from the instrument.

The display will show the default temperature of 25 °C or the last temperature reading with the blinking "MTC" and "°C" (or "°F") tags.



The temperature can now be adjusted with the UP and DOWN arrow keys (from -20.0 °C to 120.0 °C).

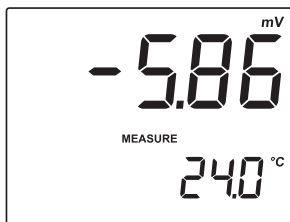
### mV / REL mV MEASUREMENTS

An optional ORP electrode must be used to perform ORP measurements (see "Accessories" section).

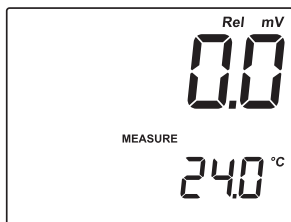
Oxidation-Reduction Potential (ORP) measurements provide the quantification of the oxidizing or reducing power of the tested sample.

To perform an ORP measurement correctly, the surface of the electrode must be clean and smooth.

- If necessary, press the RANGE key until the display changes to mV/Rel mV.
- Submerge the ORP electrode tip (4cm/1½") into the sample to be tested and allow a few seconds for the reading to stabilize.
- The instrument displays the mV reading on the primary LCD or Rel mV reading if a Rel mV calibration has been performed and the temperature on the secondary LCD.



OR

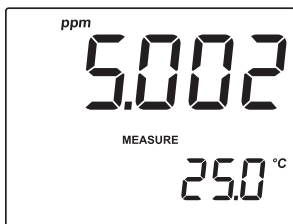


## **Notes:**

- When the reading is out of range, the closest full-scale value is displayed blinking.
- If using a pH electrode while in mV mode, the instrument will measure the mV generated by the pH electrode.
- If the instrument displays a Rel mV reading and it is desired to take mV measurements, simply clear the Rel mV calibration (see Rel mV calibration section at page 17).

## **ISE MEASUREMENTS**

- Press the RANGE key to enter ISE measurement mode.
- Submerge the tip of the ISE electrode (4 cm/1½") into the sample to be tested and allow a few seconds for the reading to stabilize.
- The instrument displays the ppm reading on the primary LCD and the temperature on the secondary LCD.





## **pH CALIBRATION**

It is recommended to calibrate the instrument frequently, especially if high accuracy is required.

The pH calibration is also necessary in the following cases:

- Whenever the pH electrode is replaced.
- At least once a week.
- After testing aggressive chemicals.
- When extreme accuracy is required.
- If "CALIBRATION EXPIRED" tag is blinking during measurement.

Every time you calibrate the instrument use fresh buffers and perform an electrode Cleaning Procedure (see page 42).

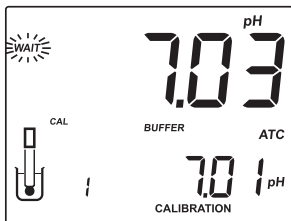
### **PROCEDURE**

One, two or three points calibration can be performed, from the 7 memorized buffers (1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45 pH).

- Pour small quantities of selected buffer solutions into clean beakers. For accurate calibration use two beakers for each buffer solution, the first one to rinse the electrode and the second one for calibration.
- Remove the protective cap and rinse the electrode with some of the buffer solution to be used for the first calibration point.

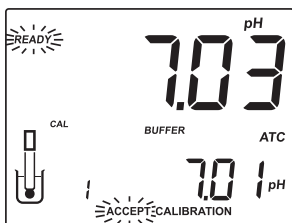
### **THREE-POINT CALIBRATION**

- Immerse the pH electrode and the temperature probe approximately 4 cm (1½") into a buffer solution of your choice (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01 or 12.45) and stir gently. The temperature probe should be close to the pH electrode.
- Press the CAL key. The "CAL", "1" and "CALIBRATION" tags will appear and the secondary LCD will display buffer "7.01".

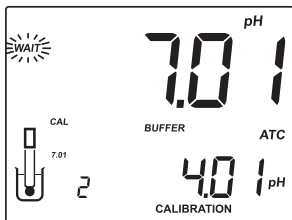


# Instruction Manual Mi 160 Bench Meter

- If necessary, press the UP and DOWN arrow keys to select a different buffer value.
- The “WAIT” tag will blink on the LCD until the reading is stable.
- When the reading is stable and close to the selected buffer, the “READY” and “ACCEPT” tags will blink on the LCD.



- Press the GLP/ACCEPT key to confirm calibration.
- The calibrated value will be displayed on the primary LCD and the second expected buffer value on the secondary LCD, along with the tag of the buffer already calibrated.



- After the first calibration point is accepted, immerse the pH electrode and the temperature probe approximately 4 cm (1½”) into the second buffer solution and stir gently. The temperature probe should be close to the pH electrode.
- If necessary, press the UP and DOWN arrow keys to select a different buffer value.
- The “WAIT” tag will blink on the LCD until the reading is stable.
- When the reading is stable and close to the selected buffer, the “READY” and “ACCEPT” tags will blink on the LCD.
- Press the GLP/ACCEPT key to confirm calibration.
- The calibrated value will be displayed on the primary LCD and the third expected buffer value on the secondary LCD, along with the tags of the buffers already calibrated.

- After the second calibration point is accepted, immerse the pH electrode and the temperature probe approximately 4 cm (1½") into the third buffer solution and stir gently. The temperature probe should be close to the pH electrode.
- If necessary, press the UP and DOWN arrow keys to select a different buffer value.
- The "WAIT" tag will blink on the LCD until the reading is stable.
- When the reading is stable and close to the selected buffer, the "READY" and "ACCEPT" tags will blink on the LCD.
- Press the GLP/ACCEPT key to confirm calibration.
- The instrument stores the calibration values and returns to normal measurement mode.

### **Notes:**

- The instrument automatically skips the buffers already used for the previous calibration points to avoid erroneous procedure.
- If the value measured by the instrument is not close to the selected buffer, "WRONG BUFFER" and "WRONG PROBE" messages will blink alternately. In this case, check if the correct buffer has been used or regenerate the electrode by following the Cleaning Procedure (see page 33). If necessary, change the buffer or the electrode.
- If "WRONG BUFFER" and "Old" messages on the secondary LCD are displayed blinking, an inconsistency between new and previous (old) calibration is detected. Clear calibration parameters by pressing the LOG/CLR key and proceed with calibration from the current calibration point (the instrument will keep all confirmed values during current calibration).
- The "WRONG BUFFER" message and the temperature value blink if temperature reading is out of the defined temperature range for the buffer. Calibration cannot be confirmed in this situation.
- Press the RANGE key to display the temperature reading during calibration.
- To clear a previous calibration and return to the default values, press the LOG/CLR key at any time after entering calibration mode. The LCD will show "CLr CAL" for one second, and then the meter will return to normal measurement mode.



# Instruction Manual Mi 160 Bench Meter

## 1 OR 2 POINT CALIBRATION

- Proceed as described in “Three-point calibration” section.
- Press the CAL key after the appropriate calibration point is accepted.

The instrument will return to measurement mode, will memorize the calibration data, and the appropriate tags for the calibrated buffers will be displayed on the LCD only if the “disp” option from the SETUP menu is ON (see page 32).

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## **pH BUFFER TEMPERATURE DEPENDENCE**

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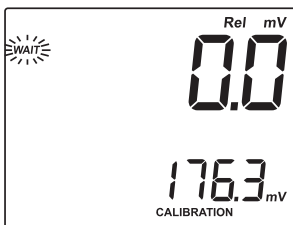
The temperature has an effect on pH. The calibration buffer solutions are affected by temperature changes to a lesser degree than normal solutions. During calibration the instrument will automatically calibrate to the pH value corresponding to the measured or set temperature.

During calibration the instrument will display the pH buffer value at 25 °C.

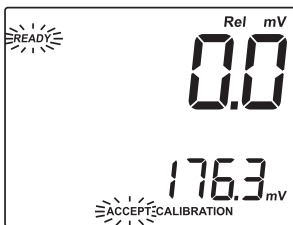
TEMP		pH BUFFERS						
°C	°F	1.68	4.01	6.86	7.01	9.18	10.01	12.45
0	32	1.67	4.01	6.98	7.13	9.46	10.32	13.38
5	41	1.67	4.00	6.95	7.10	9.39	10.24	13.18
10	50	1.67	4.00	6.92	7.07	9.33	10.18	12.99
15	59	1.67	4.00	6.90	7.05	9.27	10.12	12.80
20	68	1.68	4.00	6.88	7.03	9.22	10.06	12.62
25	77	1.68	4.01	6.86	7.01	9.18	10.01	12.45
30	86	1.68	4.02	6.85	7.00	9.14	9.96	12.29
35	95	1.69	4.03	6.84	6.99	9.11	9.92	12.13
40	104	1.69	4.04	6.84	6.98	9.07	9.88	11.98
45	113	1.70	4.05	6.83	6.98	9.04	9.85	11.83
50	122	1.71	4.06	6.83	6.98	9.01	9.82	11.70
55	131	1.72	4.08	6.84	6.98	8.99	9.79	11.57
60	140	1.72	4.09	6.84	6.98	8.97	9.77	11.44
65	149	1.73	4.11	6.84	6.99	8.95	9.76	11.32
70	158	1.74	4.12	6.85	6.99	8.93	9.75	11.21
75	167	1.76	4.14	6.86	7.00	8.91	9.74	11.10
80	176	1.77	4.16	6.87	7.01	8.89	9.74	11.00
85	185	1.78	4.17	6.87	7.02	8.87	9.74	10.91
90	194	1.79	4.19	6.88	7.03	8.85	9.75	10.82
95	203	1.81	4.20	6.89	7.04	8.83	9.76	10.73

## RELATIVE mV CALIBRATION

- Press the CAL key when the instrument is in mV / Rel mV measurement mode. The “CALIBRATION” tag will appear on the LCD.
- Relative mV value is displayed on the primary LCD and the absolute mV value on the secondary LCD.



- The “WAIT” tag will blink until the reading is stable.
- When the absolute reading is stable and in measurement range, the “READY” and “ACCEPT” tags blink on the LCD, asking for confirmation.



- If the reading is out of range, the absolute mV value and the “WRONG” tag will blink.
- Press the GLP/ACCEPT key to confirm the calibration. The instrument enters Rel mV measurement mode.

### Notes:

- If a Rel mV calibration is performed, the range changes from mV to Rel mV.
- To return to mV measurement mode, clear the Rel mV calibration by pressing LOG/CLR after entering calibration mode. The “CLr CAL” message will appear on the LCD for one second and the instrument will enter mV measurement mode.

## **ISE CALIBRATION**

For greatest accuracy, it is recommended to calibrate the instrument frequently.

Due to electrode conditioning time, the electrode must be kept immersed a few seconds to stabilize.

### **PROCEDURE**

One or two-point calibration can be performed, with six memorized standards: 0.01, 0.1, 1, 10, 100 and 1000 ppm.

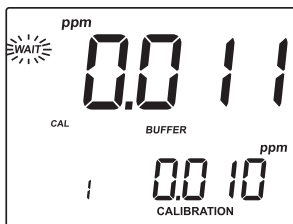
In **SETUP** menu, select the proper ion charge.

**Note:** If “UndF” option is selected in **SETUP** menu, calibration must be performed in two points, otherwise “----” will be displayed on the LCD if exiting calibration after accepting the first used standard.

- Pour small quantities of the standard solutions into clean beakers. If possible, use plastic beakers to minimize any EMC interferences. For accurate calibration use two beakers for each standard solution: one to rinse the electrode and one for calibration.
- Select ISE measurement range by pressing the **RANGE** key. Remove the protective cap from the ISE electrode

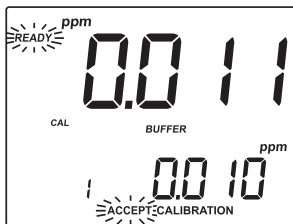
### **TWO-POINT CALIBRATION**

- Immerse the ISE electrode approximately 4 cm (1½”) into the selected solution and stir gently.
- Press the **CAL** key. The primary LCD will display the ppm value using the current offset and slope. The “CAL”, “BUFFER”, “1”, “CALIBRATION” tags will appear and the “0.010” ppm standard will be displayed on the secondary LCD.

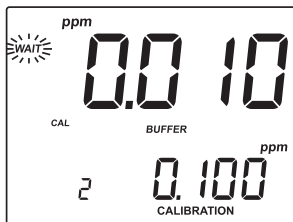


- If necessary, press the **UP** and **DOWN** arrow keys to select a different standard value.
- The “**WAIT**” tag will blink on the LCD until the reading is stable.

- When the reading is stable and close to the selected standard, the “READY” and “ACCEPT” tags will blink.



- Press the GLP/ACCEPT key to confirm calibration.
- The calibrated value will be displayed on the primary LCD and the second expected standard value on the secondary LCD.



**Note:** The instrument will automatically skip the standard used for the first point.

- After the first calibration point is accepted, immerse the ISE electrode approximately 4 cm (1½”) into the second calibration solution.
- If necessary, press the UP and DOWN arrow keys to select the standard value.
- The “WAIT” tag will blink on the LCD until the reading is stable.
- When the reading is stable and close to the selected standard, the “READY” and “ACCEPT” tags will blink.
- Press the GLP/ACCEPT key to confirm calibration.
- The instrument stores the calibration value and returns to normal measurement mode.

**Notes:**

- If the mV value is out of the mV range ( $\pm 2000$ ), the closest full-scale value will be displayed blinking.

- If the new slope is out of the slope window, “WRONG BUFFER” and “WRONG PROBE” messages will blink alternately. In this case, check if the correct standard has been used or refresh the electrode by following the cleaning procedure. If necessary, change the standard or the electrode.

The slope window is within  $\pm 20$  mV and  $\pm 105$  mV if ion charge is not specified (UndF option in SETUP menu), or between 50% and 120% of default slope for the corresponding ion charge.

Default slope values (mV/decade):

- 59.16 (monovalent anion) - ion charge is  $-1$   
59.16 (monovalent cation) - ion charge is  $1$
  - 29.58 (divalent anion) - ion charge is  $-2$   
29.58 (divalent cation) - ion charge is  $2$   
100 - ion charge is “UndF”
- Press LOG/CLR during calibration if you want to clear calibration data and return to the default values. The instrument will display “CLR CAL” message and then return to measurement mode.
  - Press the RANGE key to display temperature reading during calibration.

## **ONE-POINT CALIBRATION**

- Press the CAL key after first calibration point is accepted. The instrument memorizes the one-point calibration data and returns to measurement mode.

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## **GOOD LABORATORY PRACTICE (GLP)**

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GLP is a set of functions that allows storage and retrieval of calibration data and electrode status. All data regarding pH and ISE calibration is stored for the user to review when necessary.

### **CALIBRATION ALARM TIME-OUT**

For pH calibration, Mi 160 allows the user to set the number of days (1 to 14) before the next required calibration. The default setting is OFF (disabled).

The instrument checks the time-out and out the time elapsed, the “CALIBRATION EXPIRED” message will blink as a reminder.

**Note:** If the instrument is not calibrated, the “CALIBRATION EXPIRED” message will be displayed even if the calibration time-out feature is disabled in SETUP menu.

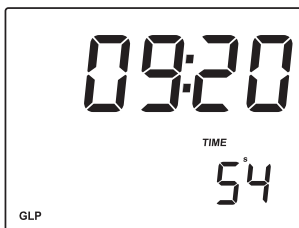


## LAST pH CALIBRATION DATA

pH calibration data is stored automatically after a successful calibration.

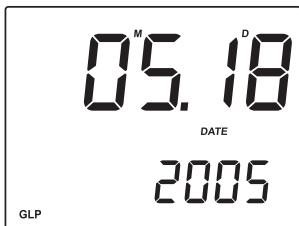
To view the last pH calibration data, press the GLP/ACCEPT key while in pH measurement mode.

The instrument will display the time (hh:mm:ss) of the last calibration.

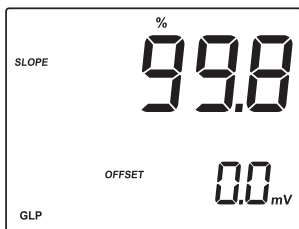


Press the arrow keys and the instrument will display the next calibration parameter (pressing the UP key):

- The date (MM.DD.YYYY).



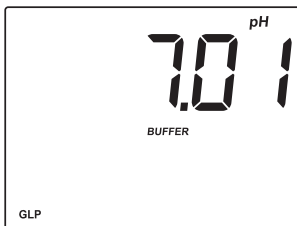
- The pH calibration slope value on the primary LCD and the offset on the secondary LCD.



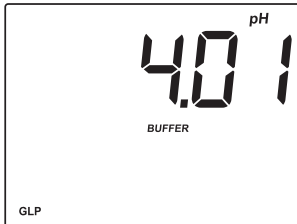
# Instruction Manual Mi 160 Bench Meter

- The pH calibration buffers in calibrating order.

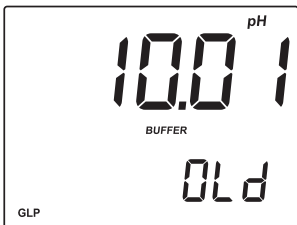
The first pH calibration buffer:



- The second pH calibration buffer:



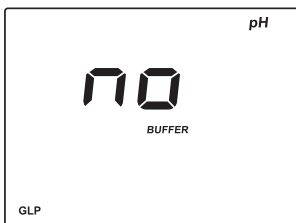
- The third pH calibration buffer:



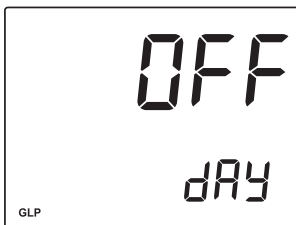
## Notes:

- The "Old" message displayed beneath the pH value means that this buffer was not used during last calibration. Press SETUP if you want to see calibration date (or time if old calibration was performed in the same day with current calibration).

- The “no BUFFER” message means that the instrument was calibrated in less than three points.



- The meter displays “OFF” if the function is disabled,



or the number of days before the calibration alarm will be displayed (e.g. 5 days), or from the time calibration expired (e.g. -3 days).

- Instrument Identification Code. When using several identical meters it may be useful to uniquely identify them by assigning an ID code to each meter.



## LAST ISE CALIBRATION DATA

ISE calibration data is stored automatically after a successful calibration.

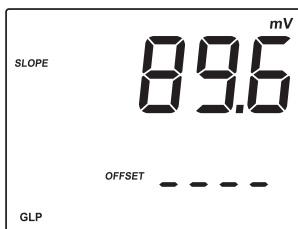
To view last ISE calibration data, press the GLP/ACCEPT key while in ISE measurement mode.

The instrument will display the time (hh:mm:ss) of the last calibration as in pH GLP mode.

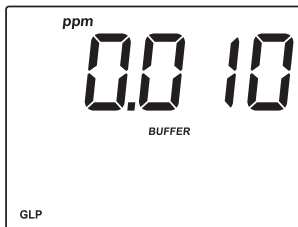
Press the arrow UP key and the instrument will display the following calibration parameters:

# Instruction Manual Mi 160 Bench Meter

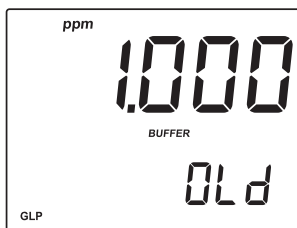
- The date (MM.DD.YYYY) as in pH GLP mode.
- The value slope on the primary LCD and the offset on the secondary LCD.



- The first calibration standard.



- The second calibration standard.

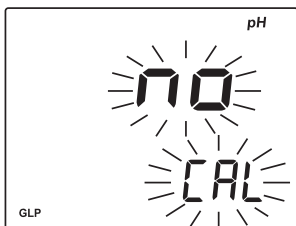


- The instrument ID as in pH GLP mode.

## **Notes:**

- The "OLD" message displayed beneath the ppm value means that this standard was not used during last calibration. Press SETUP if you want to see calibration date (or time if old calibration was performed in the same day with current calibration).

- If “no BUFFER” message appears on the LCD, the instrument informs you that calibration was performed in only one point.
- If a one-point calibration is performed after a two-point calibration, the instrument will keep the old slope.
- Press the GLP/ACCEPT key at any moment and the instrument will return to measurement mode.
- If calibration has not been performed for the selected range, the instrument displays “no CAL” message blinking.



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## LOGGING

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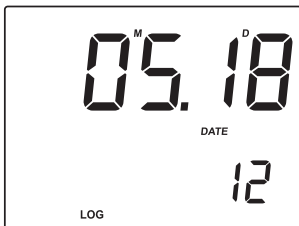
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Up to 50 readings can be stored into memory for each measurement range (pH, mV/Rel mv and ISE).

### LOGGING THE CURRENT DATA

To store the current reading into memory press the LOG/CLR key while in measurement mode.

The instrument will display the current date (MM.DD) on the primary LCD and the record number on the secondary LCD, along with “LOG” tag (see example below: record No. 12, dated May 18).

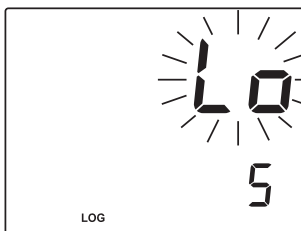


# Instruction Manual Mi 160 Bench Meter

The instrument then displays the amount of free log space for about one second and returns to normal measurement mode (e.g. 45 records free).



If there are less than 6 memory locations remaining, the record number and "Lo" message will blink to alert the user.



If the log space is full, "FULL LOC" message will be displayed and no more data will be saved.

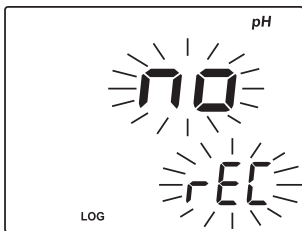


If the LOG/CLR key is pressed while in measurement mode, a complete set of information is stored.

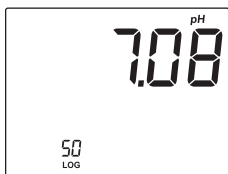
## **VIEW LOGGED DATA**

Press the MR key to retrieve the information stored while in measurement mode.

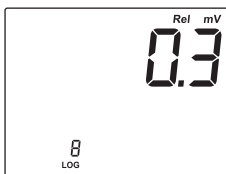
If no data is logged, the instrument displays "no rEC" message for the selected range.



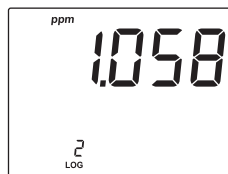
Otherwise, the instrument will display the **pH**, **Rel mV** or **ppm** value on the primary LCD and the last stored record number along with "LOG" tag.



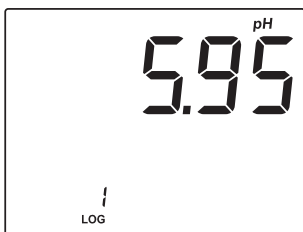
or



or



Pressing the arrow keys, the instrument will display the same parameter but for a different record:



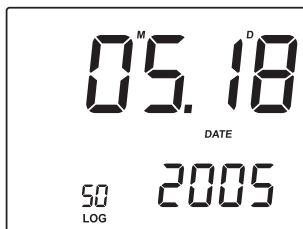
Press the RANGE key and the instrument will display the next logged parameter:

- The mV value on the primary LCD and the temperature on the secondary LCD.



# Instruction Manual Mi 160 Bench Meter

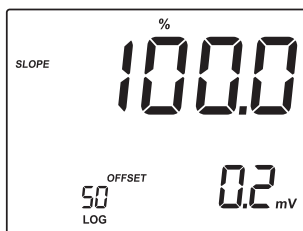
- The date: month and day on the primary LCD and the year on the secondary LCD, along with "DATE" tag.



- The time: hour and minutes on the primary LCD and the seconds on the secondary LCD, along with "TIME" tag.



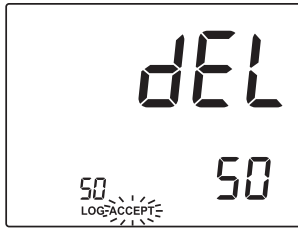
- The slope on the primary LCD and the offset on the secondary LCD, along with "SLOPE" and "OFFSET" tags.



**Note:** If in Rel mV RECALL mode, the instrument will display dashes for slope and if in ISE RECALL mode, it will display dashes for offset.

- The "dEL" message on the primary LCD and the record number on the secondary LCD, along with "ACCEPT" tag blinking.



**Notes:**

- If one of the arrow keys is pressed while “dEL” message is displayed, the next/previous record number will be selected.
- If the SETUP key is pressed, the secondary LCD will toggle between the record number and “ALL” message.



- Press the GLP/ACCEPT key to delete the selected or all records.
- If “dEL ALL” option was selected, all records for the selected range are deleted and the instrument returns to measurement mode.
- After deleting a record, the “nuLL” message is displayed on the LCD for the selected record. Press the MR key to exit the RECALL mode at any time.

## SETUP

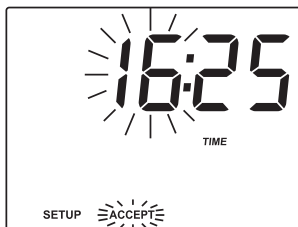
Setup mode allows viewing and modifying the following parameters:

- Calibration Alarm Time-Out (pH range only)
- Buffer Display (pH range only)
- Ion Charge (ISE range only)
- Current Time (hh:mm)
- Current Date (MM.DD.YYYY)
- Beep Status
- Baud Rate (serial communication)
- Instrument ID
- Temperature Unit

To enter SETUP mode, press and hold the SETUP key for about 3 seconds while in normal measurement mode.

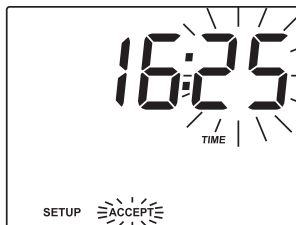
Select the desired setup parameter using the UP and DOWN arrow keys.

Press the CAL key if you want to change the item value. The selected item (e.g. hour) will start blinking.



Press the arrow keys to change the blinking value.

If there is another item to be set (e.g. minutes), press the RANGE key, and that item will start blinking.



Press the arrow keys to change the blinking value.

Press the GLP/ACCEPT key to accept the value or the CAL key to escape.

Press the arrow keys to select the next/previous parameter.

Press the SETUP key to exit SETUP menu at any time.

The following table lists the SETUP parameters, their valid values range and the factory settings (default):

Item	Description	Valid values	Default
OFF dAY	Alarm Time Out	OFF or 1 to 14 days	OFF
dISP	Display Cal Buffers	ON/OFF	ON
IonCG	Ion Charge	UndF or -2; -1; 1; 2	UndF
TIME	Time (hh:mm)	00:00 to 23:59	00:00
DATE	Date (MM.DD.YYYY)	01.01.2000-12.31.2099	01.01.2005
bEEP	Beep Status	ON/OFF	OFF
bAud	Baud Rate	600;1200;2400;4800;9600	2400
In Id	Instrument ID	0000 to 9999	0000
tEMP	Temperature Unit	°C or °F	°C

#### Notes:

- If "dISP" option is ON, the tags corresponding to the calibrated buffers are displayed on the LCD while in pH measurement mode.
- To select the right ion charge, different ion types and their charge are listed in the table below:

#### ION CHARGE

-2 (divalent anions)

-1 (monovalent anions)

1 (monovalent cations)

2 (divalent cations)

UndF

#### ION types

S, CO<sub>3</sub>

F, Cl, Br, I, CN, SCN, ClO<sub>4</sub>, NO<sub>3</sub>

H, Na, K, Ag, NH<sub>4</sub>

Mg, Ca, Ba, Cd, Cu, Pb

Undefined ion

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## ***mV CALIBRATION (for technical personnel only)***

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The Mi160 is factory calibrated for mV.

Milwaukee's ORP electrodes are interchangeable and no mV calibration is needed when they are replaced.

If the mV measurements are inaccurate, mV recalibration should be performed.

For an accurate recalibration, contact your dealer or Milwaukee Instruments, or follow the instructions below.

A two or three-point calibration can be performed at 0.0 mV, 600.0 mV and 1800.0 mV.

- Attach to the BNC connector a mV simulator with an accuracy of  $\pm 0.1$  mV.
- With the instrument off, press and hold the CAL & GLP/ACCEPT keys, then power on the instrument. The "CALIBRATION" tag will appear, and the secondary LCD will show 0.0 mV.
- Set 0.0 mV on the simulator.
- When the reading is stable and close to the selected calibration point, the "READY" and "ACCEPT" tags will blink.
- Press the GLP/ACCEPT key to accept the calibration point. The secondary LCD will display 600 mV.
- Set 600.0 mV on the simulator.
- When the reading is stable and close to the selected calibration point, the "READY" and "ACCEPT" tags will blink.
- Press the GLP/ACCEPT key to accept the calibration point. The secondary LCD will display 1800 mV.
- Set 1800.0 mV on the simulator.
- When the reading is stable and close to the selected calibration point, the "READY" and "ACCEPT" tags will blink.
- Press the GLP/ACCEPT key to accept the calibration point. The instrument returns to measurement mode.

### **Notes:**

- If the reading is not close to the selected calibration point, "WRONG" tag will blink. Verify calibration condition or contact your vendor if you cannot calibrate.
- To exit the calibration mode press the CAL key in any moment and the instrument will return to measurement mode. If you exit calibration after 600 mV is confirmed, the 600 mV range is calibrated and calibration parameters are memorized.

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**TEMPERATURE CALIBRATION (for technical personnel only)**

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The Mi160 is factory calibrated for temperature.

Milwaukee's temperature probes are interchangeable and no temperature calibration is needed when they are replaced.

If the temperature measurements are inaccurate, temperature recalibration should be performed.

For an accurate recalibration, contact your dealer or Milwaukee Instruments, or follow the instructions below.

- Prepare a vessel containing ice and water and another one containing hot water (at 50 °C). Place insulation material around the vessels to minimize temperature changes.
- Use a calibrated thermometer with a resolution of 0.1 °C
- With the instrument off, press and hold the MR & LOG/CLR keys, then power on the instrument. The "CALIBRATION" tag will appear and the secondary LCD will show 0.0 °C.
- Immerse the temperature probe in the vessel with ice and water as near as possible to the reference thermometer. Allow a few seconds for the probe to stabilize.
- Use the UP and DOWN arrow keys to set the reading on the secondary LCD to the one measured by the reference thermometer. When the reading is stable and close to the selected calibration point, the "READY" and "ACCEPT" tags will blink.
- Press the GLP/ACCEPT key to accept the calibration point. The secondary LCD will show 50.0 °C.
- Immerse the temperature probe in the second vessel as near as possible to the reference thermometer. Allow a few seconds for the probe to stabilize.
- Use the UP and DOWN arrow keys to set the reading on the secondary LCD to that of the hot water.
- When the reading is stable and close to the selected calibration point, the "READY" and "ACCEPT" tags will blink.
- Press the GLP/ACCEPT key to accept the calibration point. The instrument returns to measurement mode.

**Note:** If the reading is not close to the selected calibration point, "WRONG" tag will blink. Change the temperature probe and restart calibration.

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## **PC INTERFACE**

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Data transmission from the instrument to the PC can be done with the **Mi 5200** Windows® compatible software, when using the RS232 or USB serial interface. **Mi 5200** also offers graphing and on-line help feature.

Data can be exported to the most popular spreadsheet programs for further analysis. To connect the instrument to a PC through the RS232 port, use the MA 9350 cable connector.

To connect the instrument to a PC through the USB port, use a standard USB cable. Make sure that your instrument is switched off and plug one connector of the cable to the instrument RS232/USB connector and the other to the serial port of your PC.

### **Notes:**

- Other cables than **MA 9350** may use a different configuration. In this case, communication between instrument and PC may not be possible.
- Keep only one cable connected (RS232 or USB) during PC communication to avoid possible errors.
- If you are not using Mi 5200 software, please see the following instructions.

## **SENDING COMMANDS FROM PC**

It is also possible to remotely control the instrument with any terminal program. Use **MA 9350** cable to connect the instrument to a PC, start the terminal program and set the communication options as follows: 8, N, 1, no flow control.

### **COMMAND TYPES**

To send a command to the instrument follow the next scheme:

<\*> <command> <CR>

where: <\*> is the command prefix.

<command> is the command code.

**Note:** Either small or capital letters can be used.

### **UNIT CHANGE COMMAND**

**CHU xx** Change the instrument unit according with the parameter value (xx):

- xx=01 pH range/0.01 resolution
- xx=03 mV / Rel mV range
- xx=05 ppm range

The instrument will answer for this command with:

<STX> <answer> <ETX>

where: <STX> is 02 ASCII code character (start of text)

<ETX> is 03 ASCII code character (end of text)

<answer>:

<ACK> is sent for a recognized command

<CAN> is sent when the instrument is logging

<Err6>/<Err8> is sent when the command is incorrect or the instrument is not in measurement mode.

## **COMMANDS REQUIRING AN ANSWER**

The instrument will answer for these commands with:

<STX> <answer> <checksum> <ETX>

where the checksum is the bytes sum of the answer string sent as 2 ASCII characters.

All the answer messages are with ASCII characters.

<b>RPH</b>	Causes the instrument to send a complete set of readings in according with the pH range.
<b>RMV</b>	Causes the instrument to send a complete set of readings in according with the mV / Rel mV range.
<b>RIS</b>	Causes the instrument to send a complete set of readings in according with the ISE range.
<b>MDL</b>	Requests the instrument model name and firmware code (16 ASCII chars).
<b>INF</b>	Requests the calibration data and the setup parameters.
<b>SAM</b>	Requests the number of logged samples (12 chars).
<b>LDPH</b>	Requests the xxx <sup>th</sup> pH record logged data.
<b>LDMV</b>	Requests the xxx <sup>th</sup> mV/Rel mV record logged data.
<b>LDIS</b>	Requests the xxx <sup>th</sup> ISE record logged data.
<b>LAPH</b>	Requests all pH Log on demand.
<b>LAMV</b>	Requests all mV/Rel mV Log on demand.
<b>LAIS</b>	Requests all ISE Log on demand.

### **Notes:**

- "Err8" is sent if the instrument is not in measurement mode.
- "Err6" is sent if the requested range is not available.
- "Err4" is sent if the requested set parameter is not available.
- "Err3" is sent if the Log on demand is empty.
- Invalid commands will be ignored.

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## **ELECTRODE CONDITIONING & MAINTENANCE**

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### **PREPARATION PROCEDURE**

Remove the electrode protective cap.

DO NOT BE ALARMED IF ANY SALT DEPOSITS ARE PRESENT. This is normal with electrodes and they will disappear when rinsed with water.

During transport tiny bubbles of air may have formed inside the glass bulb. The electrode cannot function properly under these conditions. These bubbles can be removed by "shaking down" the electrode as you would do with a glass thermometer.

If the bulb and/or junction are dry, soak the electrode in **MA 9015** storage solution for at least one hour.

For refillable electrodes, if the refill solution (electrolyte) is more than 2½ cm (1") below the fill hole, add the appropriate electrolyte solution.

### **MEASUREMENT**

Rinse the electrode tip with distilled water, immerse it (4 cm / 1½") into the sample and stir gently for a few seconds.

For a faster 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 a quick response time, the glass bulb and the junction should always be kept moist.

When not in use, store it with a few drops of **MA 9015** storage solution in the protective cap.

**NEVER STORE THE ELECTRODE IN DISTILLED OR DEIONIZED WATER.**

### **PERIODIC MAINTENANCE**

Inspect electrode and cable. The cable used for the connection to the instrument must be intact and there must be no points of broken insulation on the cable or cracks on the electrode stem or bulb. If any scratches or cracks are present, replace the electrode.

Rinse off any salt deposits with water.

Connectors must be perfectly clean and dry.

#### *For refillable electrodes:*

Refill the electrode with fresh electrolyte (see the electrode's specifications to select the correct refilling solution). Allow the electrode to stand upright for 1 hour. Follow the Storage Procedure above.



**CLEANING PROCEDURE**

- *General* Soak in **MA 9016** General Cleaning Solution for approx. ½ hour.

**IMPORTANT:** After performing any of the cleaning procedures, rinse the electrode thoroughly with distilled water and soak it in **MA 9015** storage solution for at least 1 hour before taking measurements.

**TROUBLESHOOTING**

<b>SYMPTOMS</b>	<b>PROBLEM</b>	<b>SOLUTION</b>
Slow reponse/excessive drift.	Dirty pH electrode.	Soak the electrode tip in MA9016 for 30 minutes and 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 (refillable electrodes only).
Display shows blinking full scale value	Reading out of range.	Check the sample is within measurable range; Check electrolyte level and general electrode status.
mV scale out of range.	Dry membrane or dry junction.	Soak the electrode in MA9015 storage solution for at least 30 minutes.
Display shows blinking "C°" or "F°".	Out of order temperature probe.	Replace the temperature probe.
Meter does not work with temperature probe.	Broken temperature probe.	Replace the temperature probe.
Meter fails to calibrate or gives faulty readings.	Broken pH electrode.	Replace the electrode
At startup the meter displays all LCD tags permanently	One of the keys is blocked.	Check the keyboard or contact your dealer
"Er0, Er1, Er2" message at start up.	Internal error.	Contact your dealer or Milwaukee Instruments.

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## **ACCESSORIES**

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<b>MA 9001</b>	pH 1.68 Buffer Solution (230 mL bottle)
<b>MA 9004</b>	pH 4.01 Buffer Solution (230 mL bottle)
<b>MA 9006</b>	pH 6.86 Buffer Solution (230 mL bottle)
<b>MA 9007</b>	pH 7.01 Buffer Solution (230 mL bottle)
<b>MA 9009</b>	pH 9.18 Buffer Solution (230 mL bottle)
<b>MA 9010</b>	pH 10.01 Buffer Solution (230 mL bottle)
<b>MA 9012</b>	Refilling Solution for pH electrode (230 mL bottle)
<b>MA 9015</b>	Storage Solution (230 mL bottle)
<b>MA 9016</b>	Electrode Cleaning Solution (230 mL bottle)
<b>MA 9112</b>	pH 12.45 Buffer Solution (230 mL bottle)
<b>MA 9310</b>	12 VDC Adapter, 220 V
<b>MA 9311</b>	12 VDC Adapter, 110 V
<b>MA 9315</b>	Electrode Holder
<b>MA 917B/1</b>	pH Electrode, glass body, refillable
<b>MA 922B/1</b>	ORP Electrode, glass body, refillable
<b>MA 831R</b>	Temperature Probe
<b>MA 9350</b>	RS232 connection cable (2 meters)

For your Safety don't use or store the instrument in hazardous environments. To avoid damages or burns, do not perform any measurement in microwave ovens.

### **WARRANTY**

This instrument is 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. If during this period the repair or replacement of parts is required, where the damage is not due to negligence or erroneous operation by the user, please return the instrument, electrode and probe to either distributor or our office and the repair will be effected free of charge.

Damage due to accidents, misuse, tampering or lack of prescribed maintenance is not covered by the warranty.

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

# THANK YOU FOR CHOOSING



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