HORIBA

INSTRUCTION MANUAL

OM-Series DO Meters

OM-12
OM-14

CODE:04097-7000

WARNING

The DO sensor contains a strong alkaline solution. Should any of this solution come into contact with your clothing or skin, wash it away immediately with plenty of water.

Be especially careful not to allow any of the alkaline liquid in the DO sensor to get in your eyes. If it does come into contact with your eyes, consult a doctor immediately.

HORIBA OM-Series HANDY Dissolved-Oxygen Meter has two models, the basic OM-12 and the more advanced OM-14; this Instruction Manual covers both models.

The OM-12 & OM-14 models are compact enough to be held in one hand while taking measurements. They have a large easy- to-read LCD readout. Measurements are taken simply by immersing the probe right into the water sample. The OM-Series are extremely versatile and sophisticated, yet easy to use. You will find your OM-Series DO Meter a valuable addition to on-site water control operations.

To get the most out of your OM-Series of DO Meter, please read this Instruction Manual carefully before you begin to take measurements.

Note that Horiba cannot be held responsible for any equipment malfunction or failure should the OM-Series of DO Meter be operated incorrectly or in a manner other than specified in this Instruction Manual.

Horiba's aim is to produce the best possible equipment and documentation for our products. We welcome comments, questions, or suggestions for improvement concerning both our products and the accompanying documentation, such as this Instruction Manual.

First edition: January, 1992

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Section 5 Maintenance and Troubleshooting

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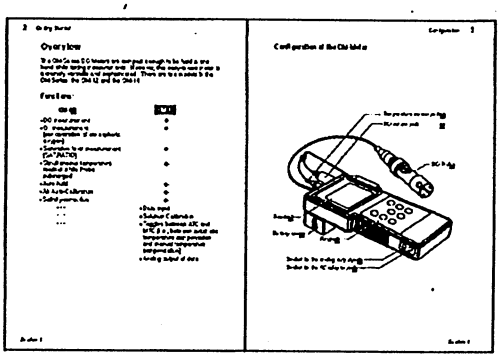
Contents of Tables

Using this Instruction Manual

A single Instruction Manual covers two different models of the OM-Series of dissolved-oxygen meters: the basic OM-12 model and the more sophisticated OM-14. This manual is organized as follows to handle the differences between the two models:

(1) Where the description is identical for both OM-12 and OM-14.

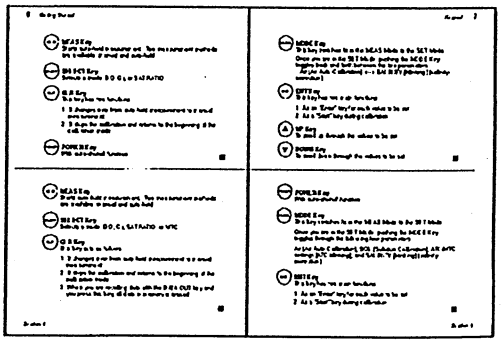


(2) Where the description differs
e.g., the Keypad,
Specifications

Top is OM-12 data; bottom is OM-14 data

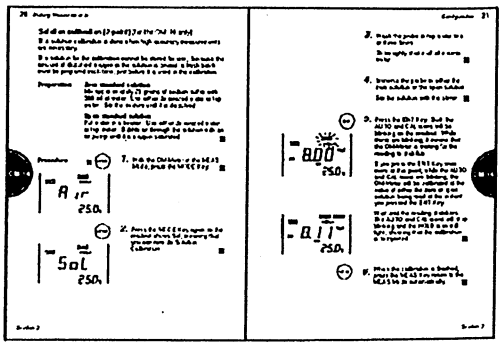
OM-12 →

OM-14 →



(3) For special features found only on the OM-14 model.
e.g., Solution calibration,
Data handling and
calculations

Half-circle on the sides of the pages means the description applies only to OM-14.



Section 1

Getting Started

This section gives an overview of the important components of the OM-Meter. It shows how to interpret the LCD readout and how to use the keypad to operate the various functions of the OM-Meter.

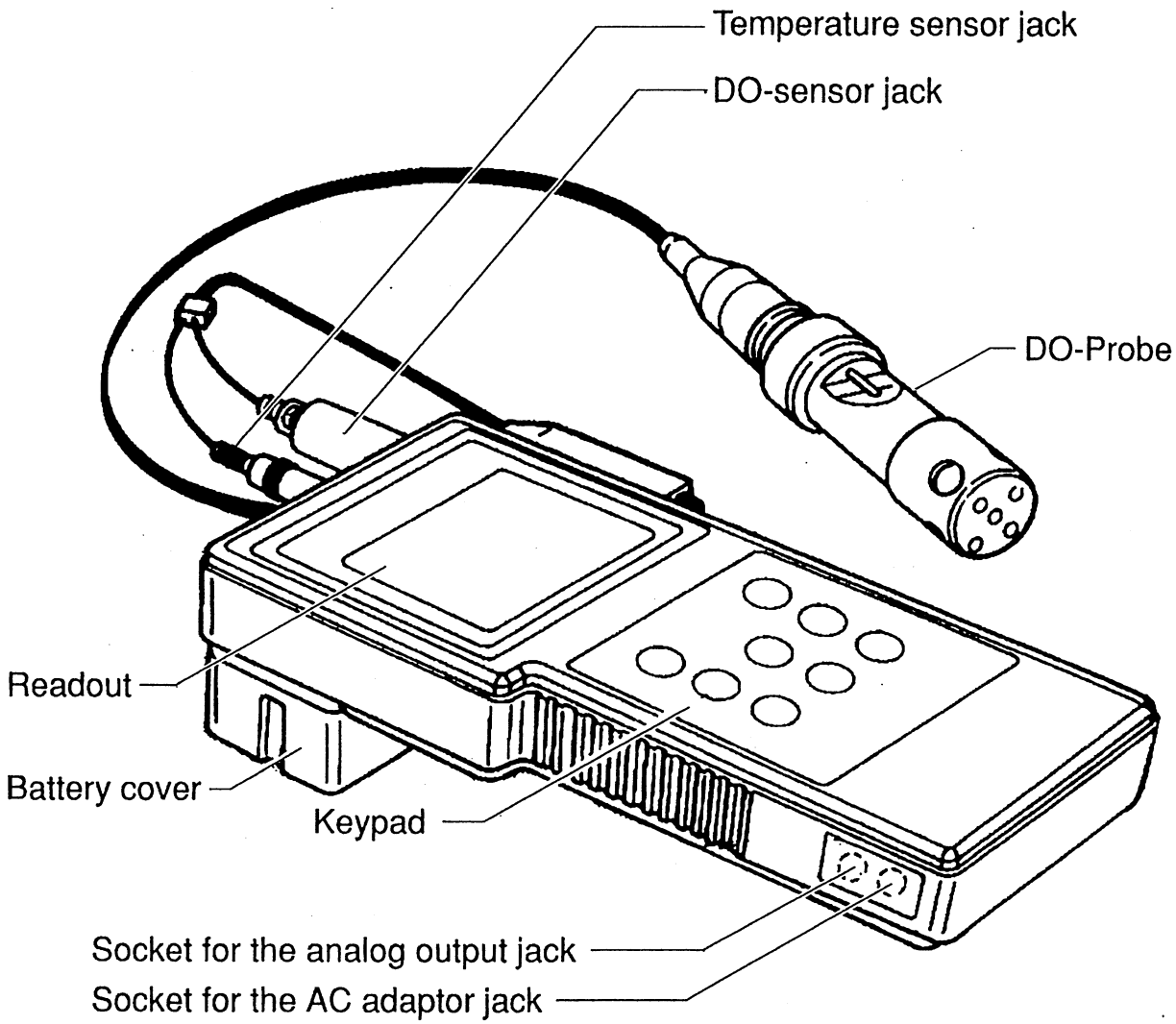
Overview

The OM-Series DO Meters are compact enough to be held in one hand while taking measurements. However, this easy-to-use meter is extremely versatile and sophisticated. There are two models in the OM-Series: the OM-12 and the OM-14.

Functions:

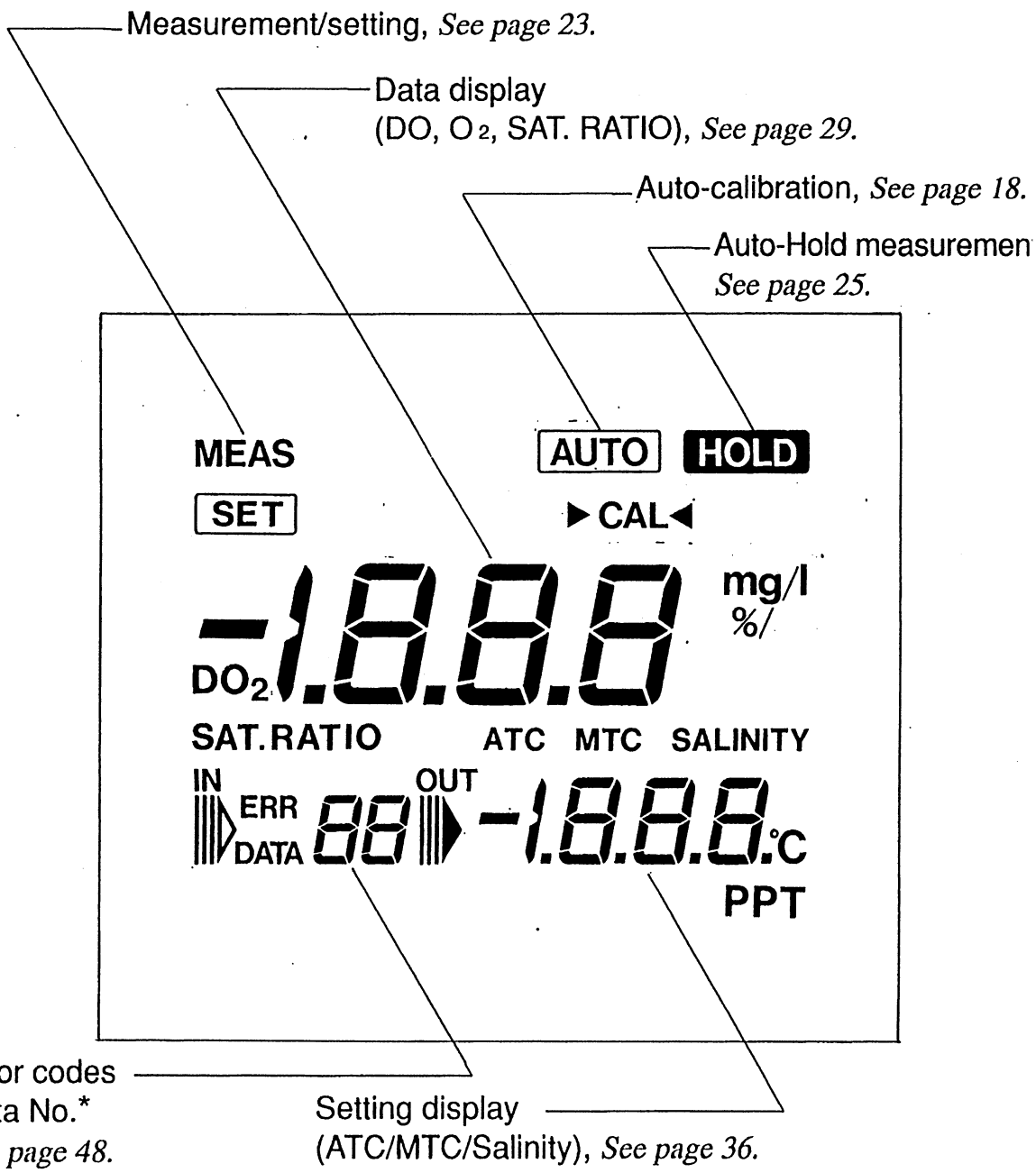
OM-12	OM-14
• DO measurement	←
• O_2 measurement (concentration of atmospheric oxygen)	←
• Saturation level measurement (SAT.RATIO)	←
• Simultaneous temperature readout while Probe submerged	←
• Auto-hold	←
• Air Auto-Calibration	←
• Salinity-correction	←
---	• Data input
---	• Solution Calibration
---	• Toggles between ATC and MTC (i.e., between automatic temperature compensation and manual temperature compensation)
---	• Analog output of data

Configuration of the OM-Meter



The Readout

Basically the OM-Meter readout shows the measured values for DO, O_2, and SAT.RATIO. It also gives you other vital data, including the temperature of the sample solution at the time of measurement and the internal settings of your OM-Meter.

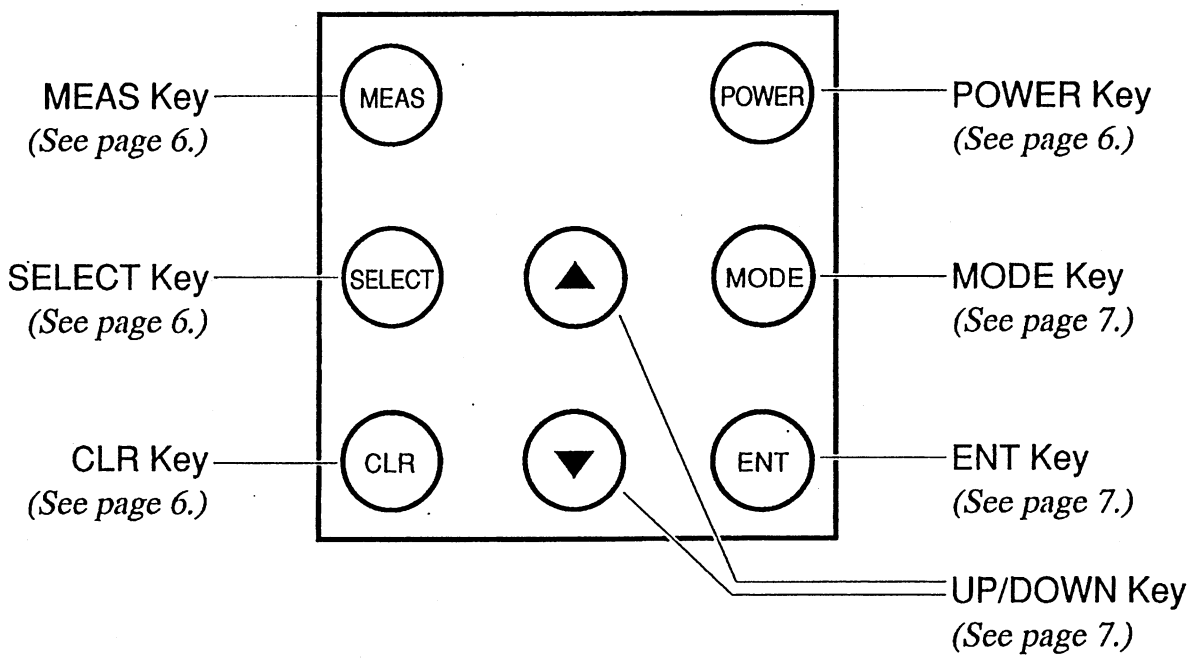


* Data No.: only on the OM-14

The Keypad

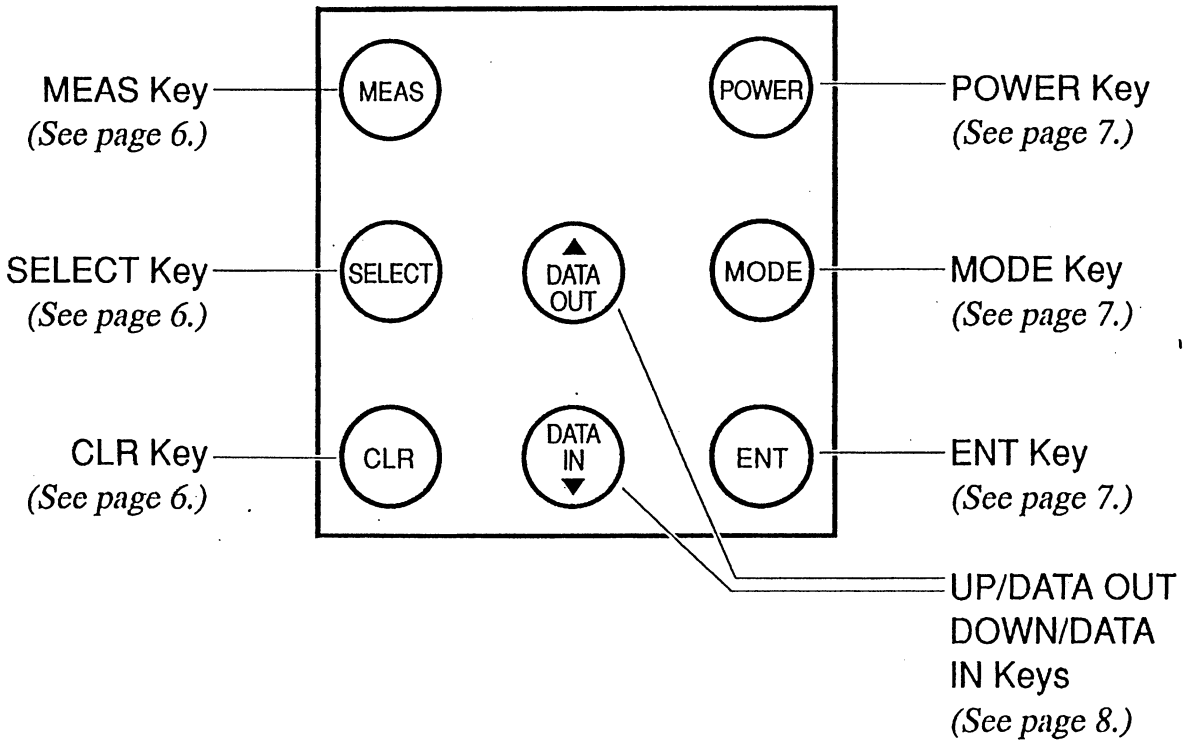
OM-12

The OM-Meter is operated by the keypad on the main unit, which has eight surface-sealed keys, as illustrated.



OM-14

The OM-Meter is operated by the keypad on the main unit, which has eight surface-sealed keys, as illustrated.



MEAS Key
Starts auto-hold measurement. Two measurement methods are available: manual and auto-hold.

SELECT Key
Selects a mode: DO, O_2, or SAT.RATIO.

CLR Key
This key has two functions:

1. It changes over from auto-hold measurement to manual measurement
2. It stops the calibration and returns to the beginning of the calibration mode.

POWER Key
With auto-shutoff function

MEAS Key
Starts auto-hold measurement. Two measurement methods are available: manual and auto-hold.

SELECT Key
Selects a mode: DO, O_2, SAT.RATIO, or MTC

CLR Key
This key acts as follows:

1. It changes over from auto-hold measurement to manual measurement
2. It stops the calibration and returns to the beginning of the calibration mode.
3. When you are recalling data with the DATA OUT key and you press this key, all data in memory is erased.

MODE Key
This key switches from the MEAS Mode to the SET Mode.

Once you are in the SET Mode, pushing the MODE Key toggles back and forth between the two parameters:
Air (Air Auto-Calibration) <--> SALINITY [blinking] (salinity-correction)

ENT Key
This key has two main functions:

1. As an "Enter" key for each value to be set.
2. As a "Start" key during calibration.

UP Key
To scroll up through the values to be set

DOWN Key
To scroll down through the values to be set

POWER Key
With auto-shutoff function

MODE Key
This key switches from the MEAS Mode to the SET Mode.

Once you are in the SET Mode, pushing the MODE Key toggles through the following four parameters:

Air (Air Auto-Calibration), SOL (Solution Calibration), ATC/MTC settings [ATC blinking], and SALINITY [blinking] (salinity-correction)

ENT Key
This key has two main functions:

1. As an "Enter" key for each value to be set.
2. As a "Start" key during calibration.

UP/DATA OUT Key
This key has two functions:

1. In the MEAS Mode it scrolls through the data sets stored in memory so you can select the data you want to recall.
2. In the SET Mode it scrolls up through the values to be set.

DOWN/DATA IN Key
This key has two functions:

1. In the MEAS Mode it scrolls through the data-set Nos. 1-10, allowing you to input a maximum of ten data sets into memory.
2. In the SET Mode it scrolls down through the values to be set.

Section 2

Setting up the OM-Meter

The OM-Meter is shipped with a DO-probe using a delicate sensor membrane, and with the battery removed. This section covers how to insert the sensor in the DO probe and how to insert the battery. It also covers how to use the AC adaptor.

Inserting the Sensor Module in the Probe

Field-use probes

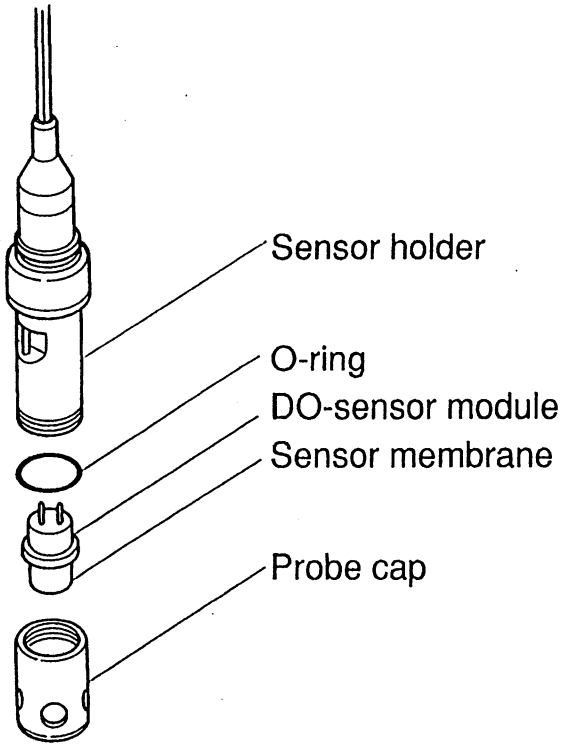
1. Unscrew the probe cap.
2. Remove the sensor from storage socket and insert it, with the O-ring, into the sensor holder as shown. Note that the two terminals on the sensor are of different thickness; be sure to insert them into the proper holes in the sensor holder.

Caution

Be very careful not to rupture the delicate sensor membrane.

It is recommended that you save the storage socket for the sensor for when you wish to store it for long periods of time.

3. Finally screw the probe cap back on tightly.



Lab-use probe

1. Slide the probe adaptor onto the probe body. This probe adaptor is designed to be used with a BOD bottle (biochemical oxygen demand) or with a triangular flask for storing the probe.
2. Remove the sensor from storage socket. Screw the sensor, with the O-ring, tightly into the probe body as shown.

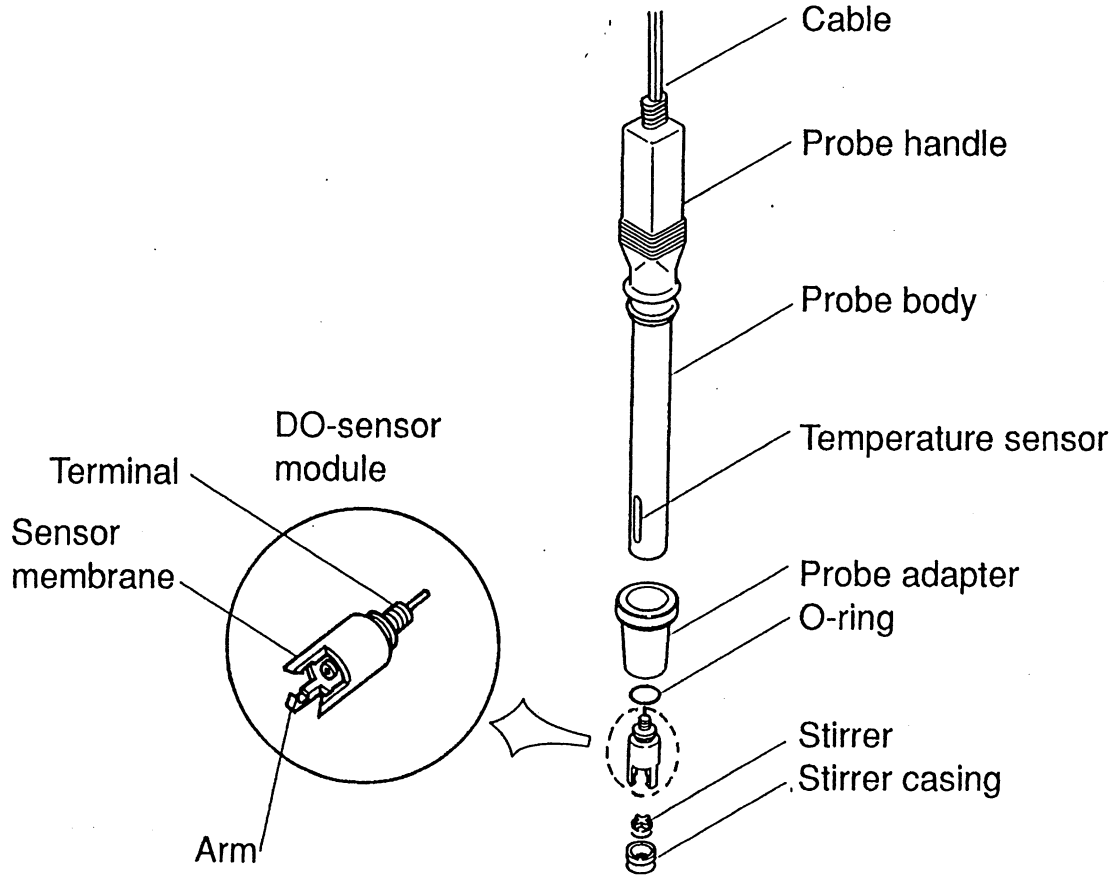
   Note that the two terminals on the sensor are of different thickness; be sure to insert them into the proper holes in the sensor holder.

Caution

Be very careful not to rupture the delicate sensor membrane.

It is recommended that you save the storage socket for the sensor for when you wish to store it for long periods of time.

3. Place the white-colored stirrer on the stirrer casing and click th casing (with stirrer) into the three prongs on the sensor as sho



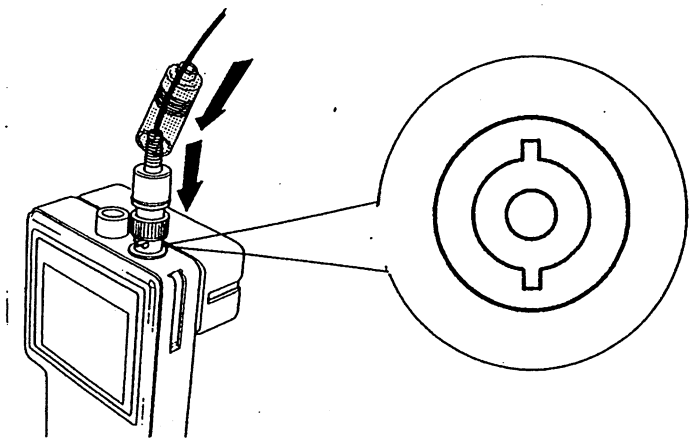
Connecting the Probe to the Main Unit

The probe should be connected to the main unit as show in the following steps.

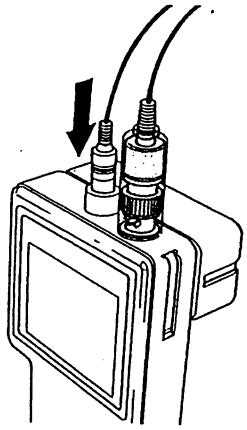
Caution

Be careful never to let the probe jacks or the sockets on the main unit get wet. Never touch the electrical connections of the jack or socket with dirty fingers.

DO-Sensor jack

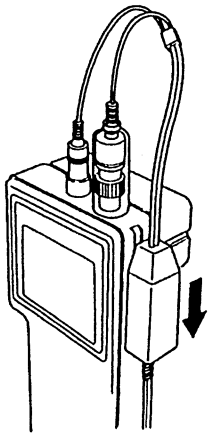


Temperature sensor jack

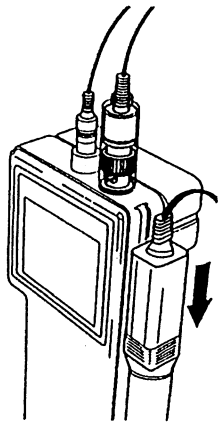


- **How to use the cable clamp**

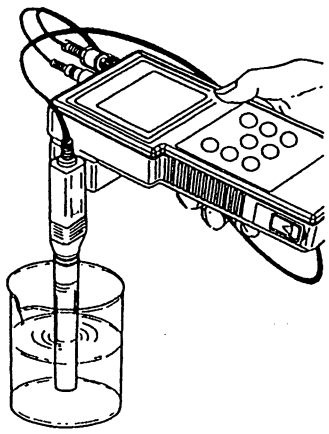
Field-use probe



Lab-use probe



For storage



For measurement

Inserting the Battery

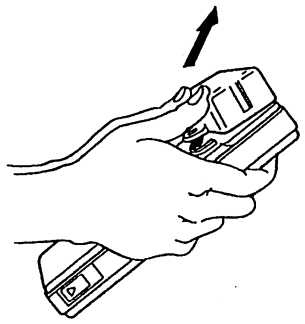
If the readout shows the message ERR 5, it means that the battery is defective or exhausted and should be replaced.

The battery may be inserted by loosening the setscrew on the battery cover and pulling up the cover as shown.

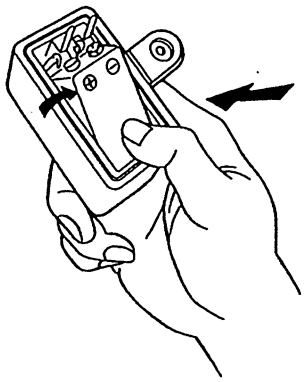
If you are replacing the battery and already have data stored in the OM-Meter memory that you wish to save, be sure to turn OFF the POWER Key before you remove tha old battery.

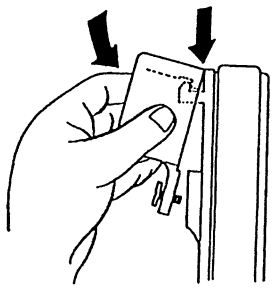
This will assure that data stored in memory will be maintained by the internal backup battery.

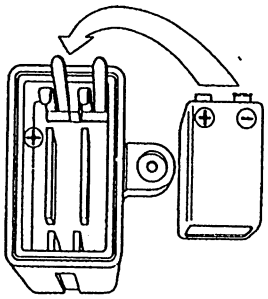
Push up the cover.



Press down the lower part of the battery.



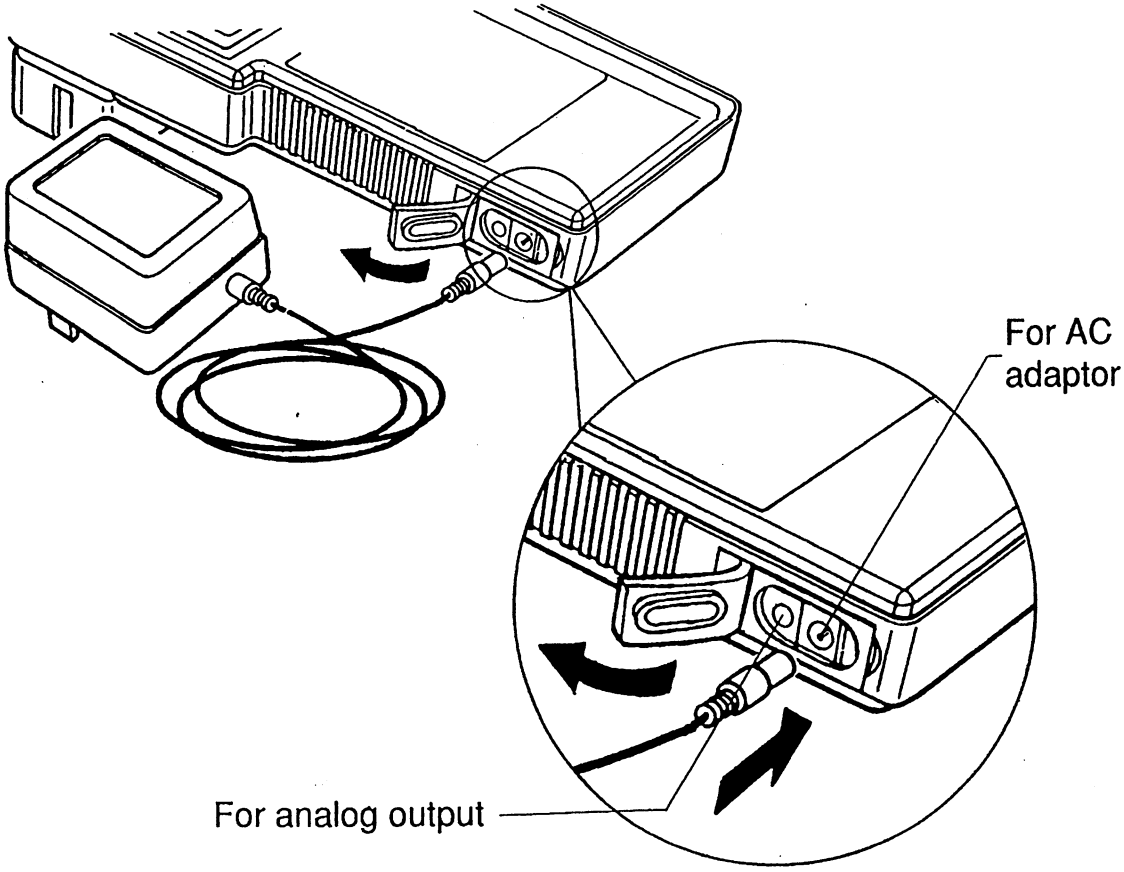




Make sure that the plus and minus poles of the battery match the terminals correctly.

Using the AC Adaptor

You can run your OM-Meter from a standard AC electrical outlet using the optional AC adaptor.



Caution

Note that you should only use the Model AC-10 adaptor; if you use an incorrect AC adaptor you run the risk of damaging your OM-Meter.

When you have been using your OM-Meter with the AC adaptor and are finished with your measurements, be sure to turn OFF the main unit's POWER Key before you disconnect the AC adaptor. If you disconnect the AC adaptor with the OM-Meter still running, this may cause the OM-Meter to malfunction.

After you have switched off the OM-Meter, first remove the prongs of the AC adaptor from the wall plug, then pull out the AC adaptor jack from the OM-Meter main unit.

Section 3

Making Measurements

Making a measurement with the OM-Meter is extremely simple. Just turn on the power and place the probe in the sample solution you wish to measure. The OM-Meter can measure dissolved oxygen (DO), the concentration of oxygen in the atmosphere (O_2), and the oxygen saturation ratio (SAT.RATIO). The results of your measure- ments are shown instantly on the LCD readout. This section shows you how to make measurements and how to calibrate the DO-Probe. Frequent calibration is the key to accurate measurements.

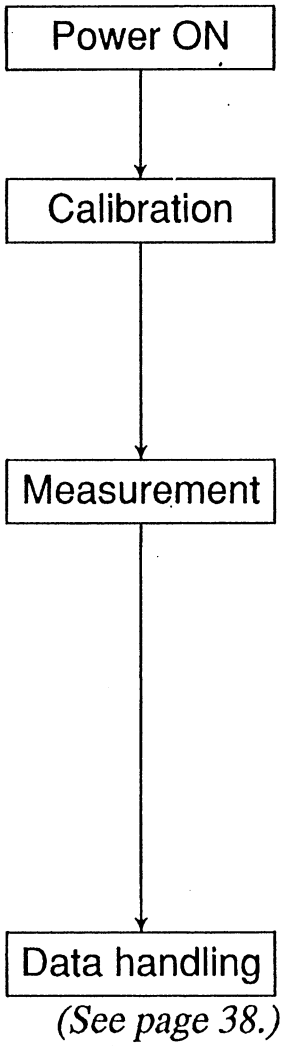
Also explained here are fresh-water measurements, sea-water measurements, selecting the parameter to measured, what to do when you are finished measuring, and important points to remember when you are making DO measurements.

Measurement Flow

Making a measurement with the OM-Meter is extremely simple.

Just turn on the power. Then gently lower the probe in the sample solution you wish to measure.

Basically, that's all there is to it: just turn on the OM-Meter and put the probe into the sample. Of course, your OM-Meter can do many sophisticated things with the sample data, and for best results you should be careful about calibrating the unit and maintaining it in good condition. This is explained below and in the next section.



(See page 38.)

- Initial readout
  (See page 17.)

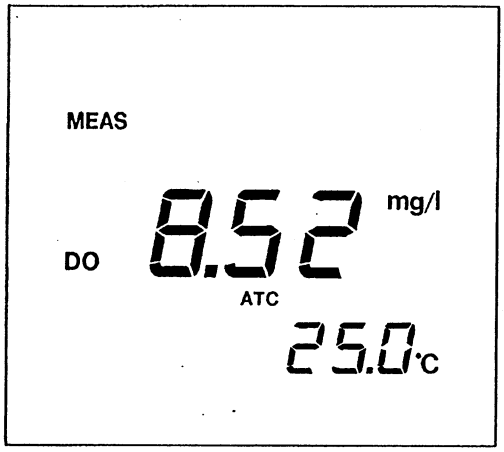
- Atmospheric air calibration (1 point)
  (See page 18.)
- Solution calibration (2 points)
  (See page 20.)

- Manual measurement/auto-hold measurement
  (See page 25.)
- Setting the fresh water or salt water measurements
  (See page 27.)
- Specifying what to measure
  (See page 29.)

Power ON

Initial readout

When you first turn the power on, the OM-Meter will be in the Manual MEAS Mode and the readout will look like this.



The readout will show the last parameters that were active when the previous measurement was made, *i.e.*, DO and ATC (automatic temperature compensation), as illustrated here.

Even after you have turned the power off, the OM-Meter will retain in memory the latest parameters and calibrations you have set.

Calibration

The key to accurate measurements is cleanliness and frequent calibration of the OM-Meter. It is essential to clean the sensor module thoroughly after each measurement, and it is recommended that you re-calibrate it as frequently as possible.

Note: In general re-calibration at least once a week is recommended. For best results where high accuracy is needed, you should re-calibrate it daily or before each measurement.

Atmospheric air calibration (1-point) *

This simple calibration procedure is done with the probe exposed to atmospheric air. The procedure is as follows:

Notes:

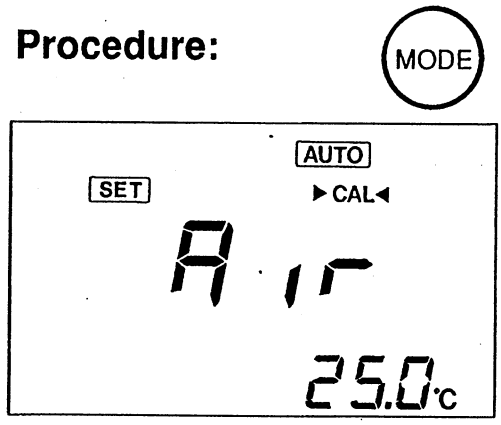
- Carry out the calibration in a location protected from strong drafts and breezes, severe changes in temperature, rain squalls, or the effects of air-conditioning and heating equipment. All of the above can adversely affect the calibration of the OM-Meter, ultimately resulting in poor measurements readouts.

- Never touch the sensor holder portion of the probe with your fingers either during the calibration process or immediately before or after the process; body heat will affect the results.

* Solution calibration (2 points) is also available: See page 20. (OM-14 only)

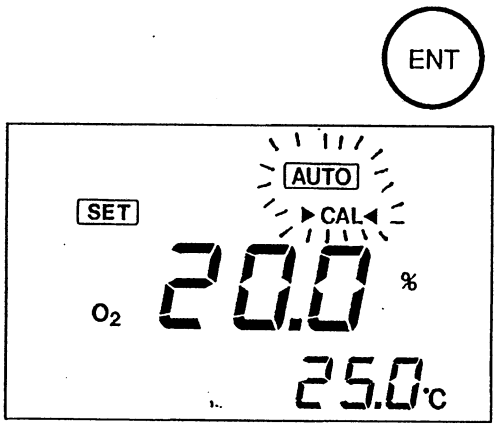
Preparation: First, the DO-Probe must be completely dry. If you have just washed the probe, shake off excess water and let it dry for 24 hours before carrying out this atmospheric calibration procedure. When the probe is dry, expose it to the air.

Procedure:



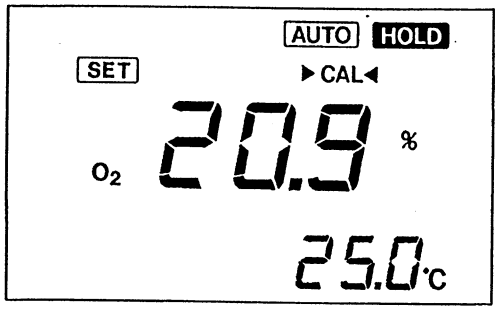
1. With the OM-Meter in the MEAS Mode, press the MODE Key.

The readout will show Air, meaning that you can now do the atmospheric calibration.



2. Press the ENT Key. Both the AUTO and CAL icons will be blinking on the readout. While these are blinking, it means that the OM-Meter is waiting for the reading to stabilize.

If you press the ENT Key once more at this point, while the AUTO and CAL icons are blinking, the OM-Meter will be calibrated at the value being read at the instant you pressed the ENT Key.



Wait until the reading stabilizes. The AUTO and CAL icons will stop blinking and the HOLD icon will light, showing that the calibration is completed. When the calibration is finished, the OM-Meter will automatically return to the MEAS Mode.

Solution calibration (2-point) (for the OM-14 only)

This solution calibration is done when high-accuracy measurements are necessary.

The solution for the calibration cannot be stored for use; because the amount of dissolved oxygen in the solution is crucial, a fresh batch must be prepared each time, just before it is used in the calibration.

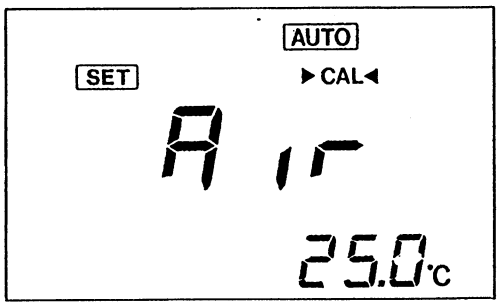
Preparation:

Zero standard solution
Mix approximately 25 grams of sodium sulfite with 500 ml of water. Use either de-ionized water or tap water. Stir the mixture until it is dissolved.

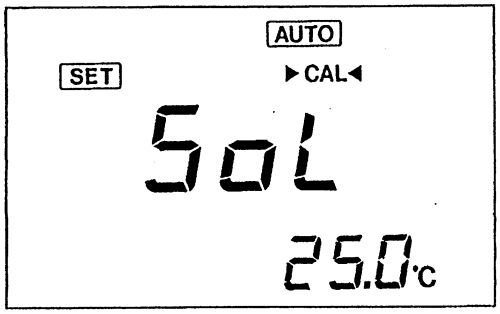
Span standard solution
Put water in a beaker. Use either de-ionized water or tap water. Bubble air through the solution with an air pump until it is oxygen saturated.

OM-14

Procedure:



1. With the OM-Meter in the MEAS Mode, press the MODE Key.



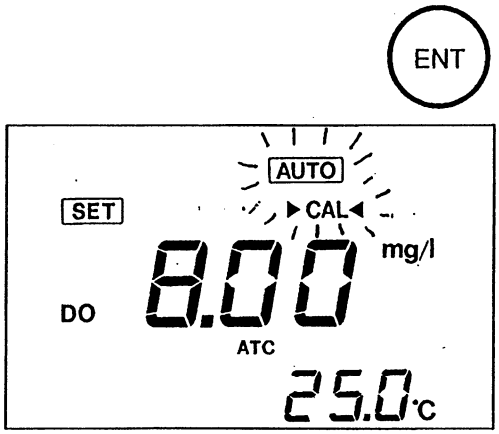
2. Press the MODE Key again so the readout shows Sol, meaning that you can now do Solution Calibration.

3. Wash the probe in tap water two or three times.

Thoroughly shake off all excess water.

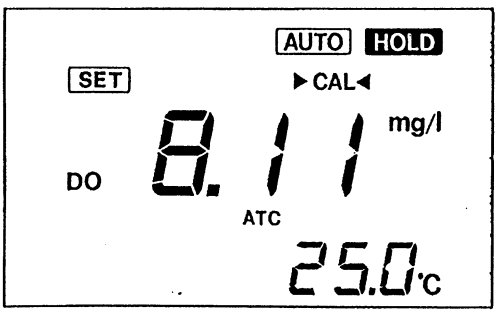
4. Immerse the probe in either the zero solution or the span solution.

Stir the solution with the stirrer.



5. Press the ENT Key. Both the AUTO and CAL icons will be blinking on the readout. While these are blinking, it means that the OM-Meter is waiting for the reading to stabilize.

If you press the ENT Key once more at this point, while the AUTO and CAL icons are blinking, the OM-Meter will be calibrated at the value of either the zero or span solution being read at the instant you pressed the ENT Key.



Wait until the reading stabilizes. The AUTO and CAL icons will stop blinking and the HOLD icon will light, showing that the calibration is completed.

6. When the calibration is finished, press the MEAS Key return to the MEAS Mode automatically.

Table 1 Amounts of saturated dissolved oxygen in water at various temperatures (1°C increment), Salinity = 0.0 PPT

Temperature	DO	Temperature	DO
0 °C	14.16 mg/*l*	21 °C	8.68 mg/*l*
1	13.77	22	8.53
2	13.40	23	8.39
3	13.04	24	8.25
4	12.70	25	8.11
5	12.37	26	7.99
6	12.06	27	7.87
7	11.75	28	7.75
8	11.47	29	7.64
9	11.19	30	7.53
10	10.92	31	7.42
11	10.67	32	7.32
12	10.43	33	7.22
13	10.20	34	7.13
14	9.97	35	7.04
15	9.76	36	6.94
16	9.56	37	6.86
17	9.37	38	6.76
18	9.18	39	6.68
19	9.01	40	6.59
20	8.84		

Measurement

Using the OM-Meter to make a measurement is simple. Just turn on the power, and then lower the probe into the sample solution. When it senses a stable value, this is shown on the readout. Both manual measurement and auto-hold measurement are available, in addition to the method that corrects for the salinity concentration of the sample solution (see page 27).

Important points when making DO measurements

Warning

The DO sensor contains a strong alkaline solution. Should any of this solution come get on your clothing or skin, wash it away immediately with plenty of water.

Be especially careful not to allow any of the liquid in the DO sensor to get in your eyes.

Caution

The Dissolved-Oxygen (DO) sensor has a delicate membrane that can easily be ruptured. Never drop or throw the probe into the sample solution. Always gently lower the probe into the sample.

Never place the probe in a liquid that is below 0℃ or greater than 40℃.

The DO-Sensor detects oxygen that diffuses through its oxygen-permeable membrane. In principle, the rate of detection will be influenced by several factors, including 1) the surface condition of the membrane, 2) the speed at which the probe moves through the sample solution, and 3) the temperature of the sample solution. Therefore, to ensure reliable results, the following points should be kept in mind:

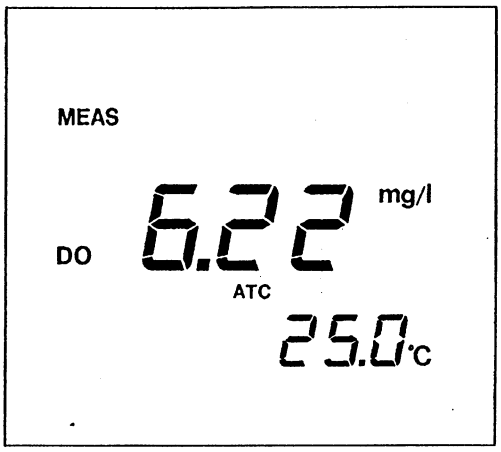
1. *Make sure the temperature-sensor portion of the probe is completely immersed in the sample solution.*
2. *The temperature of the probe should be the same as the temperature of the sample solution.*
3. *Make sure the membrane on the sensor is not soiled or contaminated in any way.*
4. *There should be no air bubbles at the surface of the membrane.*
5. *Be sure to wash the probe thoroughly each time before you use it to measure a new sample.*

When you are using the Lab-use probe, swish the probe lightly around in the solution to assure an even flow of sample solution to the DO-Sensor membrane. When you are using the Field-use probe, hold the probe by the cable and slowly move it up and down to circulate the sample solution through it to get a uniform reading. (Move it 1 foot (30 cm) per sec.) Then wait for the readout to stabilize while doing this.

Manual measurements

Manual measurement refers to the state the OM-Meter is in when you first turn on the power. Here the readout shows continuously changing values of parameters of the sample solution as they change in real time.

When you abort the Auto-Hold measurement feature, you return to the initial manual measurement state.



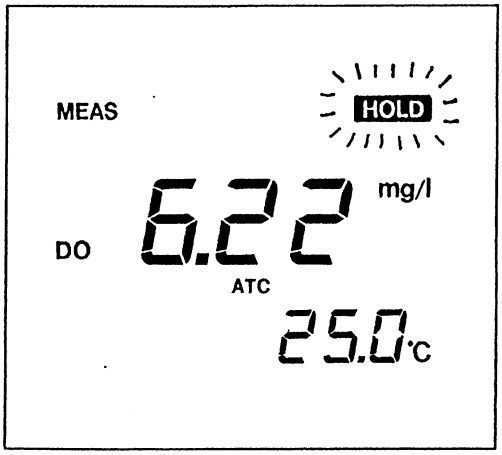
Readout during manual measurements

Auto-Hold measurements

In this state the OM-Meter automatically determines when the parameters of the sample solution have stabilized and then locks onto and "holds" that value for the readout.

MEAS

With the OM-Meter in the MEAS Mode, place the probe into the sample solution. Press the MEAS Key to activate the Auto-Hold feature. You will see the HOLD icon blinking in the upper right-hand corner of the readout.

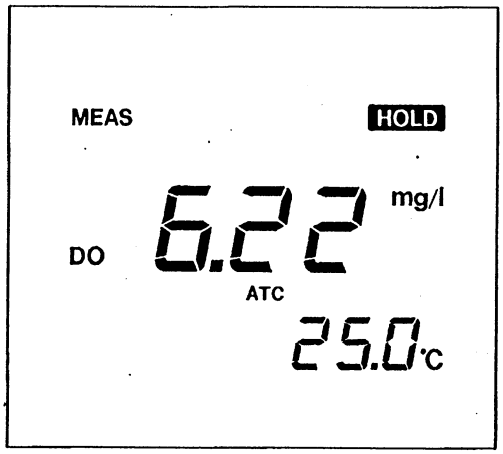


Readout during Auto-Hold measurement

CLR

To terminate the Auto-Hold feature, press the CLR Key, this will return the OM-Meter to the initial manual measurement state.

When the values have stabilized, the Meter will beep once, and the HOLD icon will stop blinking.



Stabilized value "on hold" for readout

MEAS

Once you have gotten a stable readout, you can press the MEAS Key once more to *restart* the Auto-Hold measurement.

CLR

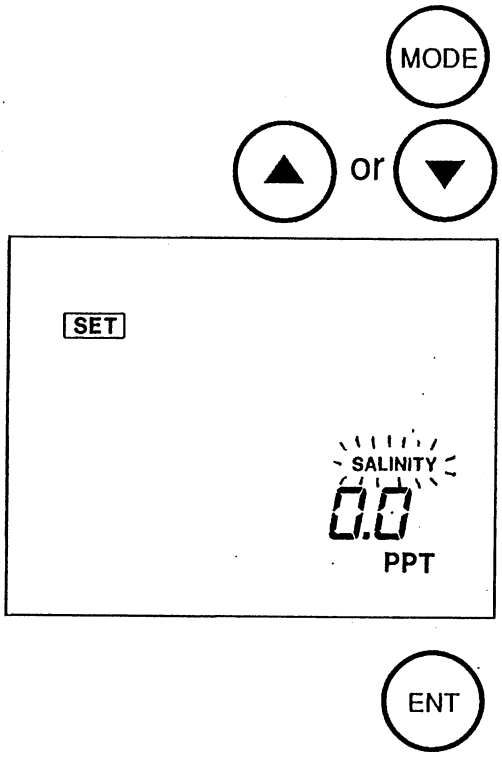
You can repeat this as often as necessary, and at any time you can terminate the Auto-Hold feature by pressing the CLR Key; this will return the OM-Meter to the initial manual measurement state.

If a stable readout is not obtained within 10 seconds after activating the Auto-Hold feature, the OM-Meter will blink an error message on the readout, and the readout will be "hold" at the present measured value.

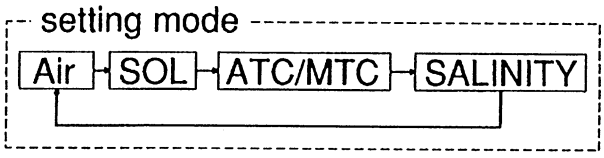
Setting the fresh water or salt water measurements

The OM-Meter can be set to the salinity concentration for either fresh water or salt water when measuring dissolved oxygen.

Setting the fresh water measurement



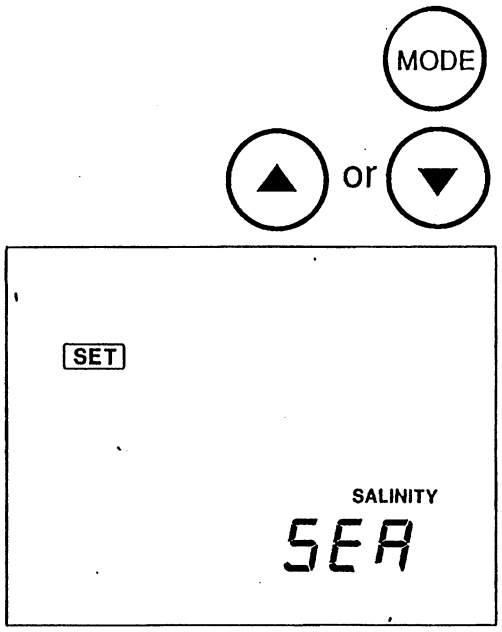
1. With the OM-Meter in the MEAS Mode, press the MODE Key. Keep pressing the the MODE Key until the SALINITY icon appears on the readout.



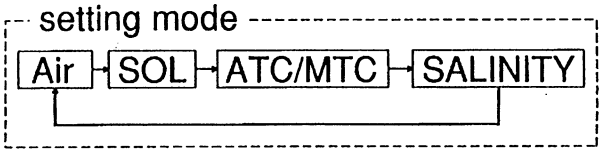
With the SALINITY icon showing, use the UP/DOWN keys to adjust the reading to 0.0 PPT.

2. Press the ENT Key. The readout will remain unchanged for about two seconds while the appropriate internal adjustments are made; then the readout will automatically change to the MEAS Mode.

Setting the salt water measurement



1. Just as you did with the fresh-water setting, first, with the OM-Meter in the MEAS Mode, press the MODE Key. Keep pressing the MODE Key until the SALINITY icon appears on the readout.



There are now two ways to set the OM-Meter for sea-water measurement:

① *If you do not know the salinity concentration* of the sea-water sample you are measuring, you may use the OM-Meter's default setting. With the SALINITY icon showing, use the UP/DOWN keys to adjust the reading so that it shows SEA; the default value for SEA is 35.0 PPT

② *If you know the salinity concentration* of the sample, you may set the concentration to any value between 0.0 PPT and 40.0 PPT. Use the UP/DOWN keys to adjust the reading to the value you want.

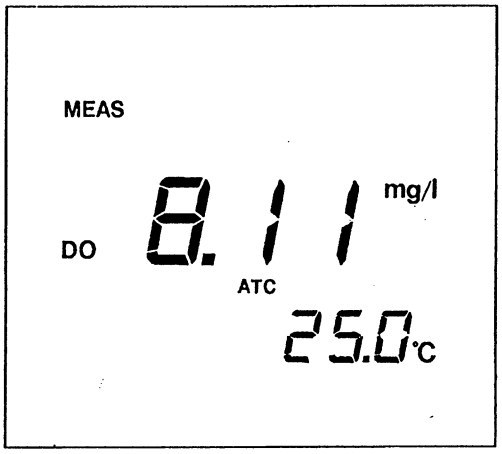
2. When you have set the appropriate salinity concentration value, press the ENT Key. The readout will remain unchanged for about two seconds while the appropriate internal adjustments are made; then the readout will automatically change to the MEAS Mode.

Specifying what to measure

SELECT

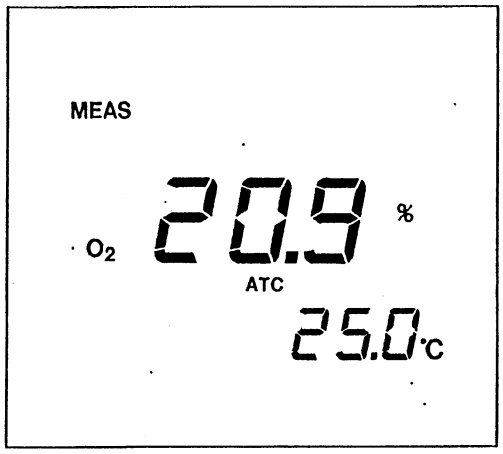
With the OM-Meter in the MEAS Mode you can use the SELECT Key to toggle through the three measurable parameters: DO, O_2, and SAT.RATIO

DO measurement



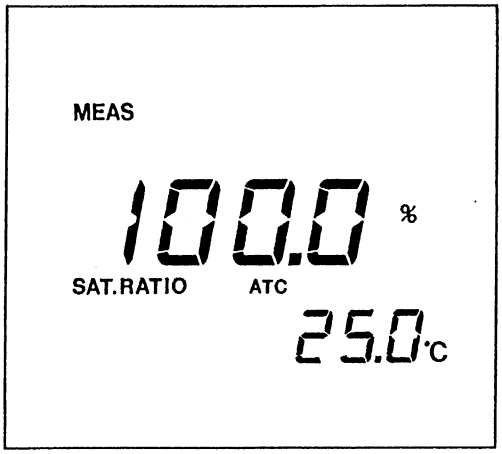
DO measures dissolved oxygen in a liquid sample, in units of mg/l.

O_2 measurement



O_2 measures oxygen in the atmosphere, in %.

SAT. RATIO measurement



SAT.RATIO measures the ratio of dissolved oxygen to saturated oxygen in a liquid sample, in %.

After measurement

Rinse the probe thoroughly to remove all traces of the sample solution. Please refer to the material in Section 5 on "Maintenance and Troubleshooting" for details.

Section 4

Functions

In this section, we look at the various functions incorporated in the OM-Series Meters. Both the OM-12 and the OM-14 automatically detect when the values of the parameters you are measuring have stabilized; and both models allow you to correct for atmospheric pressure, a valuable function when making measurements at high altitudes. In addition with the OM-14, you can (1) toggle between ATC and MTC (i.e., between automatic temperature compensation and manual temperature compensation); (2) store measured results in memory; and (3) output your measured and stored data in analog form to an external device.

The Auto-Stabilize Function

In the MEAS Mode, if you press the MEAS Key, the Meter will start to read the probe's response. If, within a specified amount of time, the OM-Meter sees that the value being measured remains within a certain range, it interprets it as a stable value. This value is "held" on the readout. (For details, see the previous section on "Making Measurements.")

If you are in one of the calibration modes, pressing the ENT Key similarly activates this automatic detection of stabilized values and uses it for calibration purposes.

Types of the auto-stabilize detection

In MEAS Mode and Solution Calibration mode

In the MEAS Mode and the solution calibration, the time limit for the determination of stability is 10 seconds; the permissible range of fluctuation for the various parameters being measured is 10 digits, that is 10 digits/10 sec.*
You can re-set the limit of the range for automatic detection of stabilized values.

In Air Auto-Calibration mode

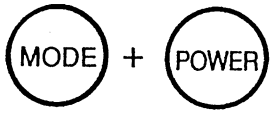
In the Air Auto-Calibration Mode, the time limit for the determination of stability is 30 seconds; the permissible range of fluctuation for the parameter being measured, i.e., O_2, is 2 digits, that is 2 digits/30 sec.*
You cannot re-set the limits of the range for automatic detection of stabilized values.

* Note that in these references to numbers of digits, the decimal point is ignored.

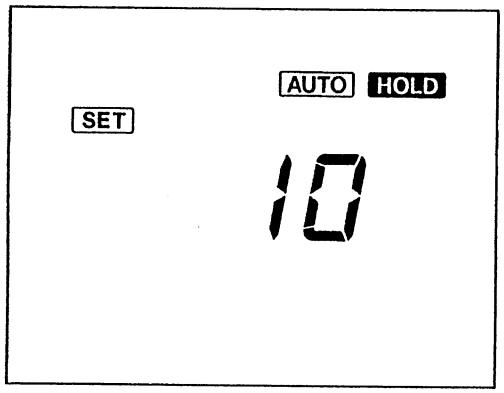
Setting the auto-stabilize detection range

It is possible to re-set the limits of the range for automatic detection of stabilized values in the **MEAS Mode** and the **Solution Calibration Mode**. This is especially useful when you are performing measurements that require greater accuracy than normal. (Note that in the Air Auto-Calibration Mode.)

Procedure



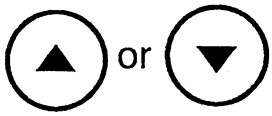
1. First, with the power off, hold down the MODE Key and press the POWER Key.



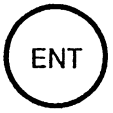
2. Then, press the MODE Key once more. The readout should look as shown here; this value shows the number digits in the range for a time limit of 10 seconds.

The default time value set at the factory is 10 digits in 10 seconds.

Note that you cannot re-set the value for the number of seconds. You can re-set only the value for the number of digits.



3. You can now use the UP/DOWN keys to reset the digits values shown on the readout. You may set any value for the digits between 0 and 100.



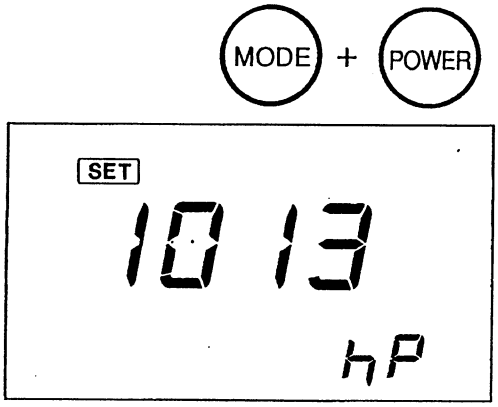
4. Input your final selection by pressing the ENT Key; the readout will remain unchanged for about two seconds while this value is input and the appropriate internal adjustments are made; then the readout will return to the normal initial state, i.e., to the MEAS Mode in manual measurement.

Note that if you set the value to 0 digits, this means a range of zero, which effectively deactivates the Auto-Hold Function, causing the Meter to give all readouts in the manual measurement state.

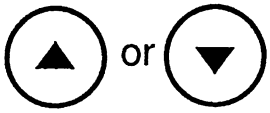
Correcting for atmospheric pressure

When you re-calibrate the OM-Meter, strictly speaking atmospheric pressure should also be a factor included in the re-calibration procedure. At normal atmospheric pressures near sea level, this usually is not a problem, but when the OM-Meter is to be used at high altitudes, it is necessary to make a correction for atmospheric pressure. (For details, refer to in the Appendix on "Correction for atmospheric pressure.")

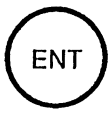
Setting the coefficient for correction



1. First, with the power off, hold down the MODE Key and press the POWER Key. The readout should look as shown here. The values shown on the readout are the coefficients set in the OM-Meter for atmospheric pressure.



2. You can now use the UP/DOWN keys to reset the digits value showing on the readout. You may set any value for the digits between 100 and 1999 hPa.* The default value is 1013 hPa.



3. Input your final selection by pressing the ENT Key; the readout will remain unchanged for about two seconds while this value is input and the appropriate internal adjustments are made; then the readout will return to the normal initial state, i.e., to the MEAS Mode in manual measurement.

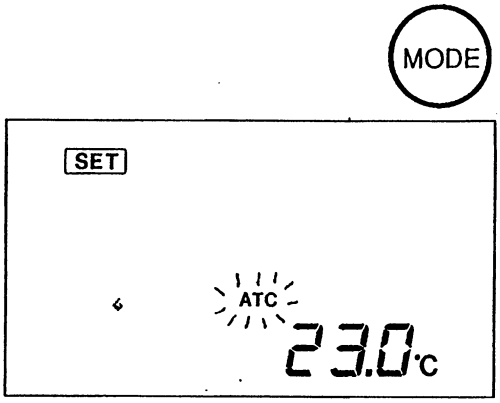
Refer to Table 2 in the Appendix on "Correction for atmospheric pressure," showing the values of atmospheric pressure at various altitudes.

For conversion in mmHg, refer to Table 2, page 56.

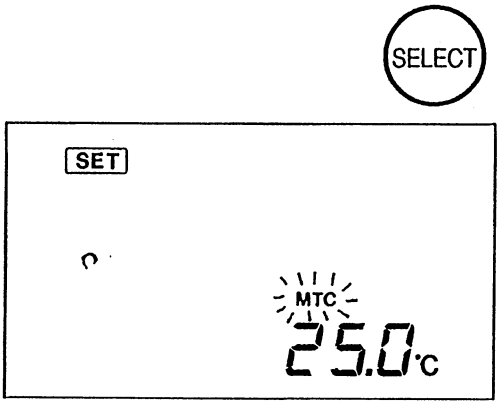
Setting the Manual Temperature Compensation (MTC) (only on the OM-14)

The Model OM-14 allows you to toggle back and forth between ATC & MTC (i.e., between automatic temperature compensation and manual temperature compensation). With MTC you can measure the temperature of the sample solution separately if you wish and then input that temperature value into the OM-14 manually.

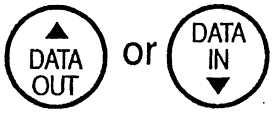
Setting the MTC value



1. From the MEAS Mode, press the MODE Key three times to go the ATC & MTC Settings. Here, either the icon for ATC or MTC will blink.

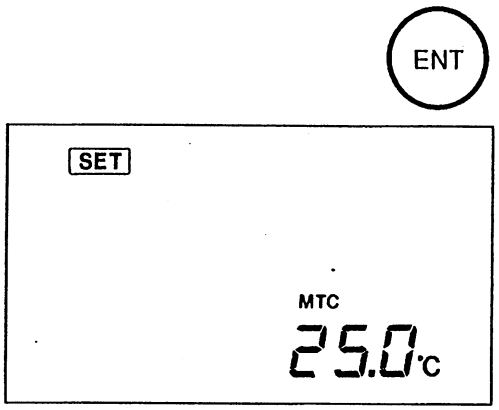


2. You can now use the SELECT Key to toggle back and forth between ATC and MTC. When the MTC icon is blinking, you can re-set the MTC value.



3. You can now use the DATA OUT/DATA IN keys to reset the MTC value showing on the readout. You may set any MTC value between 0.0°C and 50.0°C

OM-14



4. Input your final selection by pressing the ENT Key.

MTC icon is changed from "blinking" to "steady".

The readout will remain unchanged for about two seconds while this value is input and the appropriate internal adjustments are made; then the readout will change to the MEAS Mode in ATC measurement.

To return to the ATC mode from MTC

MODE

5. First use the MODE Key to go to the ATC & MTC Settings mode.

SELECT

6. Then use the SELECT Key to toggle to ATC.

ENT

7. Press the ENT Key. The readout will remain unchanged for about two seconds while the appropriate internal adjustments are made; then the readout will change to the MEAS Mode in ATC measurement.

Even if you have set the Meter to MTC, if you turn off the power, it always returns automatically to the MEAS Mode in ATC measurement.

Data Handling (only on the OM-14)

The Model OM-14 allows you to store data in its memory. You can store up to ten different data sets of values for the four measured parameters (i.e., DO, O_2, SAT.RATIO, and temperature). Stored data sets can be recalled at any time.

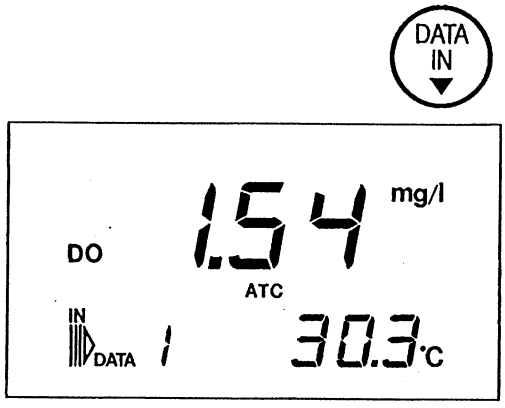
Storing data

Data is input into memory with the DATA IN Key.

Pressing the DATA IN Key causes the values for the four measured parameters (i.e., DO, O_2, SAT.RATIO, and temperature), plus the temperature compensation setting, to be stored in memory. Up to ten data sets may stored in the OM-14 memory.

You cannot input data in the following cases:
1. in the MEAS Mode when the HOLD icon is blinking
2. when there are already ten data sets stored in memory
3. when you are in one of the SET, or calibration, modes

OM-14



1. When the readout shows a set of values you wish to store as data, press the DATA IN Key.

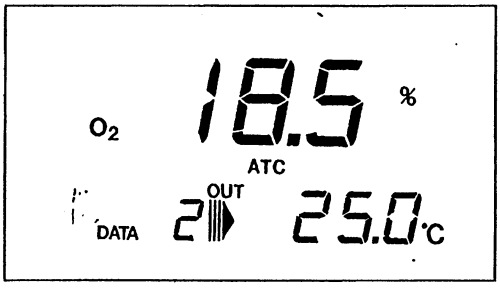
The readout will show the DATA IN icon and the data-set No. to which these values have been assigned. After about 2 seconds, the readout will return to normal.

Recalling data

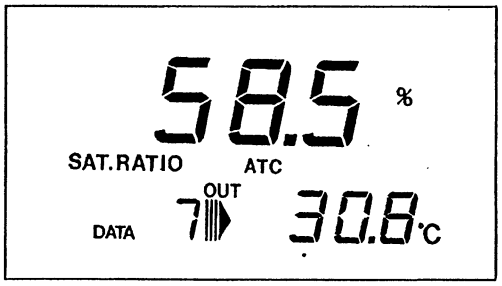
To recall data from memory, use the DATA OUT Key.

Stored data sets can be recalled at any time.

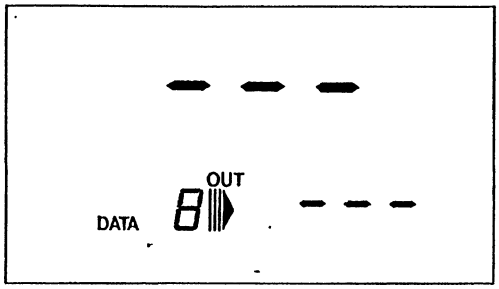
You cannot recall data in the following cases:
1. in the MEAS Mode when the HOLD icon is blinking
2. when you are in one of the SET, or calibration, modes



1. Press the DATA OUT Key. The readout will show the DATA OUT icon, the data-set No., and the values stored in this data set.



2. Pressing the DATA OUT Key again will bring up the values of the next data set onto the readout.



3. When you have reached data-set No. 10, pressing the DATA OUT Key once more will return you to data-set No. 1. If a particular data-set No. has nothing stored in it, the readout will show a series of dashes.

4. To return to the MEAS Mode press the MEAS Key.

Deleting data

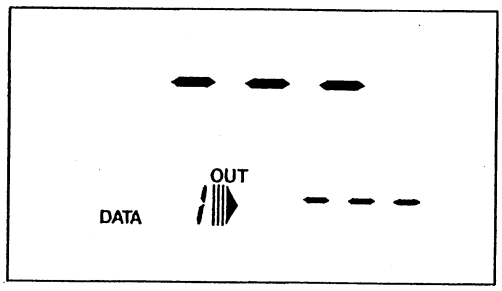
To delete all the data from memory, press the CLR Key while a data set is being recalled on the readout.

Caution

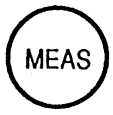
You cannot delete individual Data-Sets. The CLR Key will always erase all data from memory.

1. In MEAS Mode first press the DATA OUT Key to recall a data set.

2. Then press the CLR Key. When the memory has been cleared, the readout will show a series of dashes.



OM-14



3. To return to the MEAS Mode press the MEAS Key.

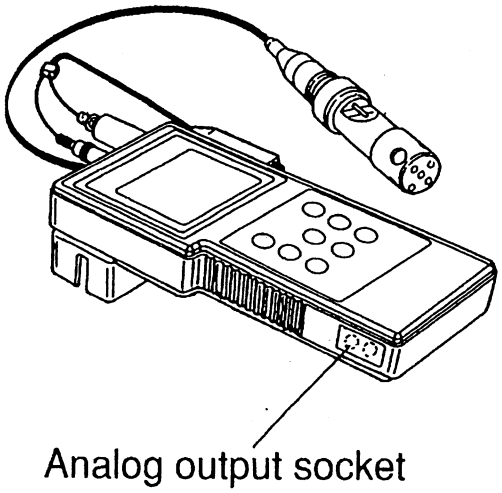
Analog output of data (only on the OM-14)

The OM-Meter produces an analog output signal with a voltage that corresponds to the measured values shown on the readout. The chart below shows the analog output voltage values for the three parameters, DO, O_2, and SAT.RATIO.

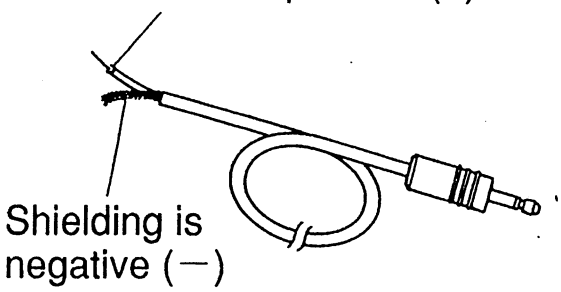
Note that the Auto-Shutoff function is disabled when the output jack is plugged into the analog output socket.

Measurement parameter	Readout range	Analog output range
DO	0.00-19.99 mg/l	0-1 VDC/F.S.
O_2	0.0-50 %	0-0.5 VDC/F.S.
SAT.RATIO	0.0-199.9 %	0-1 VDC/F.S.

Peel back the rubber seal that covers the sockets for the AC adaptor jack and the analog output jack. Plug in the analog output jack. In the MEAS Mode, real-time changes in measurement values will still be output through the analog output socket, even if the readout shows that OM-Meter is in HOLD MEAS Mode. However, when you leave the MEAS Mode to recall a data set to the readout or to put the OM-Meter into one of the SET Modes, the voltage value being output at the analog output socket remains the same as the last value that was output while the Meter was in MEAS Mode.



Analog output socket



Section 5

Maintenance and Troubleshooting

For accurate measurements and prevention of malfunction, routine careful-maintenance of the OM-Meter is important. In particular, failure to maintain the DO-Probe properly can lead to serious trouble or incorrect measurements. The OM-Meter is provided with error-code function for ready detection of potential problems.

Daily Maintenance

Field-use Probes, *Models #5450-20D and #5450-100D*

Cleaning the probe

If the probe membrane gets dirty, clean it with soft tissue paper or gauze. Never apply strong pressure to the membrane.

Caution
Be extremely careful not to damage or tear the membrane.

When you expect that OM-Meter will not be used for measurements for a relatively short period of time:

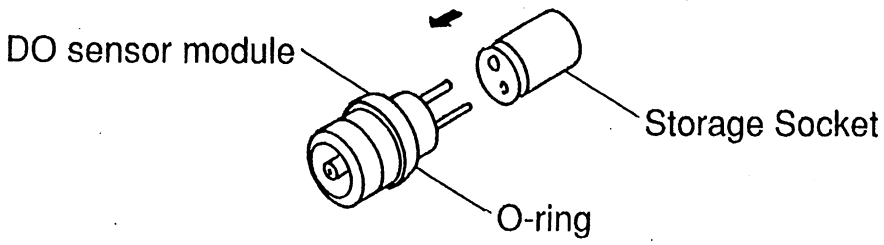
After your last measurement is complete thoroughly wash the probe with tap water and let it dry in the open air.

Keep the probe connected to the main unit.

Note: If you wish to store the probe in tap water, before you use it for the next measurement, be sure to let it dry in the open air for at least two hours or more before recalibrating it.

If you plan not to use your OM-Meter for a long period of time:

1. Disconnect the probe.
2. Carefully wash the probe with de-ionized or distilled water and wipe away any water droplets with soft gauze.
3. Remove the DO sensor from the sensor holder.
4. Re-pack and re-seal the DO sensor in the original storage socket that it came shipped in. After it is sealed, store it in a cool, dark place.

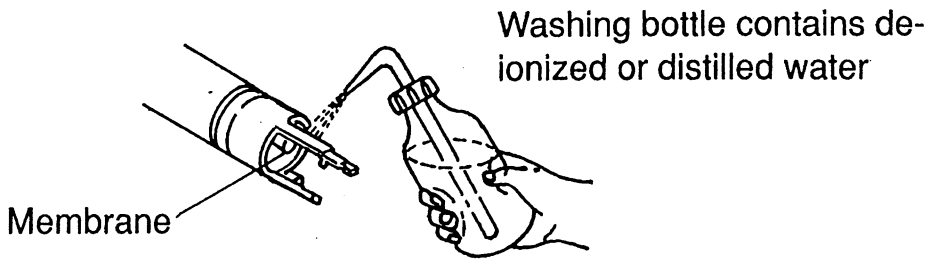


Lab-use Probe, *Model #5420-10D*

Cleaning the probe

A clean probe is essential to accurate measurements. Each time you measure a different sample solution, you should rinse the probe in de-ionized or distilled water and wipe it off with gauze or soft absorbent paper.

Caution
Be especially careful not to damage or tear the probe membrane.



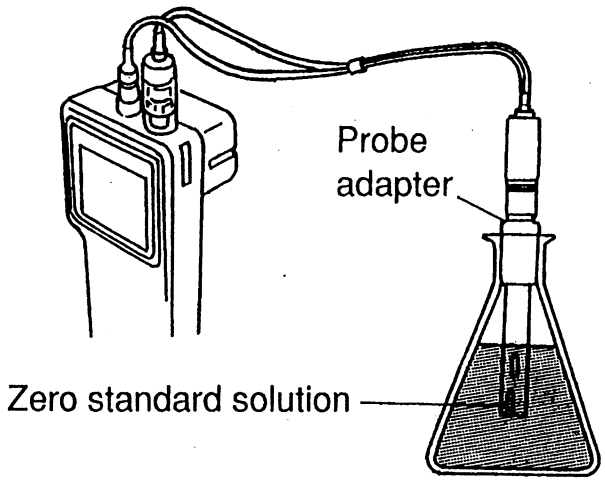
Note: Other than water, use only a neutral detergent to wash the probe. If you do use a detergent, be very careful not to let any of the detergent make contact with the membrane.

Detergent will harm the membrane, causing a slower response.

When the OM-Meter is not to be used for relatively short periods of time:

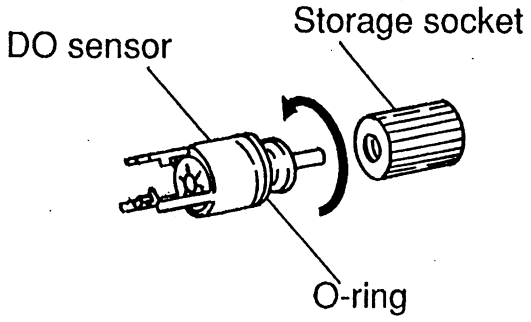
When you have finished with your last measurement, thoroughly wash the probe in de-ionized or distilled water.

Then store the probe in a zero standard solution. To do this, it is convenient use to an Erlenmeyer flask filled with zero standard solution and use the probe adapter to seal the flask tightly as shown.



If you plan not to use your OM-Meter for a long period of time:

1. Disconnect the probe.
2. Carefully wash the probe with de-ionized or distilled water and wipe away any water droplets with soft gauze.
3. Remove the DO sensor from the sensor holder.
4. Re-pack and re-seal the DO sensor in the original storage socket that it came shipped in. After it is sealed, store it in a cool, dark place.



Troubleshooting

No Readout

Is the power ON?	Turn ON the power.
Is the battery bad?	Replace the battery if bad.

Cannot perform Air Auto-Calibration.

Has the readout stabilized?	Leave the probe exposed to open air for at least two hours.
Is there a sudden temperature variation?	Leave the probe exposed to open air for at least two hours.
Is the calibration method correct?	Re-calibrate

Readout is unstable or patchy

Is the membrane damaged?	Replace the DO sensor.
Is the sample solution sufficiently stirred?	Stir more vigorously.
Is the probe dirty?	Clean the probe thoroughly with de-ionized or distilled water.
Is the probe securely connected to the main unit?	Check the probe connection.

Strange values appear on readout.

- 0.00 is shown.
- Value exceeds the OM-Meter's range.
- Readout shows large negative values.
- Readout does not change.
- Readout drifts.

Is the membrane damaged?	Replace the DO sensor.
Is the probe dirty?	Clean the probe thoroughly with de-ionized or distilled water.
Is there water on either the DO sensor or probe jack/socket?	Wipe the jack & socket dry.

Error Message Function

The OM-Meter has an easy-to-understand error message function so you can spot trouble readily. Error codes are displayed on the readout and the unit will beep if an error occurs. (Note that if you press an incorrect sequence of keys, the unit will beep three times to indicate you have pushed the wrong key.)

There are six error codes. If there is an error or malfunction, the upper part of the OM-Meter readout shows the appropriate error code with an abbreviated explanation of the nature of the error.

Details of the error codes are given below in pages 51 through 53.

Error code	Cause	Readout
ERR1	Parameter being measured exceeds the OM-Meter's range.	SCALE OVER
ERR2	The temperature of the sample solution exceeds the OM-Meter's range.	TEMP OVER
ERR3	Poor probe stability.	STABY
ERR4	Poor calibration.	CAL
ERR5	Low battery.	BATTERY
ERR6	Malfunction in main unit.	AMPLIFIER

ERR 1

Parameter being measured exceeds the OM-Meter's range.

DO:	Exceeds 19.99 mg/l
O_2:	Exceeds 50.0%
SAT.RATIO:	Exceeds 199.9%

Either readout blinks or shows oF.

Cause	Corrective Action
• Insufficient sample solution.	• Dilute the solution before carrying out measurement.
• Incorrect calibration.	• Re-calibrate, following the procedure in this Instruction Manual.
• The temperature sensor is not immersed completely in the sample solution.	• Make sure the temperature sensor is immersed in the sample solution.
• The value for manual temperature compensation (MTC) is inappropriate.	• Reset the MTC value.
• The temperature-sensor jack is disconnected.	• Insert the jack correctly.
• The DO-Sensor membrane is damaged.	• Replace the DO-Sensor.
• A measurement was attempted with no DO-Sensor in the probe.	• Replace the probe.
• Insulation failure in probe holder.	• Replace the probe.
• Probable malfunction in main unit.	• Disconnect the probe from the main unit and see whether the error code disappears. If the error code is eliminated and the readout is stable, the main unit is probably functioning properly.

ERR 2

The temperrature of the sample solution exceeds the OM-Meter's range.
I.e., the sample solution is either below 0.0℃ or over 60.0℃

Cause	Corrective Action
• Inappropriate sample solution.	• Check the temperature of the sample solution.
• The probe thermistor is either damaged or short-circuited.	• Replace the probe.
• The probe jack is bad.	• Replace the probe.

ERR 3

Poor probe stability.

Cause	Corrective Action
• Dirty probe.	• Clean the probe.
• The DO-Sensor membrane is damaged.	• Replace the DO sensor.
• Poor contact in probe holder.	• Replace the probe.
• The probe was left in an open state.	• Wait 30-60 minutes until the probe stabilizes.
• Excessive temperrature variations.	• Wait for the temperature of the sample solution to stabilize before measuring.
• Air Auto-Calibration was attempted with the probe either wet or exposed to a breeze.	• Perform the Air Auto-Calibration under correct condition, i.e., when the probe is dry and not exposed to a draft or breeze.
• Sample or standard solution is insufficiently stirred.	• Stir the solution more vigorously.

ERR 4 Poor calibration.

Cause	Corrective Action
• The DO sensor is starting to malfunction.	• Replace the DO sensor.
• Incorrect calibration.	• Re-calibrate, following the procedure in this Instruction Manual.
• The probe is dirty.	• Clean the probe.
• The DO-Sensor membrane is damaged.	• Replace the DO sensor.
• Standard solution is insufficiently stirred.	• Stir more vigorously.

ERR 5 Low battery.

Cause	Corrective Action
• The battery voltage has dropped.	• Replace the battery (standard rectangular 9-V dry cell).

ERR 6 Malfunction in main unit.

Cause	Corrective Action
• Malfunction in main unit IC chip.	• Contact your nearest HORIBA service center or sales office.

Appendix

Reference Materials

The following descriptive information is provided for a better understanding of OM-Meter and its function.

Technical Information

DO (Dissolved Oxygen)

"DO" stands for dissolved oxygen, the concentration of oxygen dissolved in water. It is essential in the oxidation of such typical reducing substances as hydrosulfides, sulfurous acid ions, and ferrous matter, as well as to the cleansing of organic pollution by micro-organisms and to the life of fish and other aquatic organisms such as plankton and seaweed. For this reason, because water in an advanced state of pollution contains a great amount of reducing substances and organic matter the dissolved oxygen is consumed, resulting in a low level of dissolved oxygen. A type of measurement based on this principle, known as the biochemical oxygen demand (BOD test), is used as an indicator of aquatic pollution.

Therefore, since dissolved oxygen is vital to the selfpurification of rivers and seas, as well as to the life of aquatic organisms and fish, measurement of DO is critical in such areas as waste-water treatment, water quality control, the fermentation industry, and in biochemical research.

Measuring principle for Oxygen

Fig. 1 shows the principle of measurement using a DO sensor.

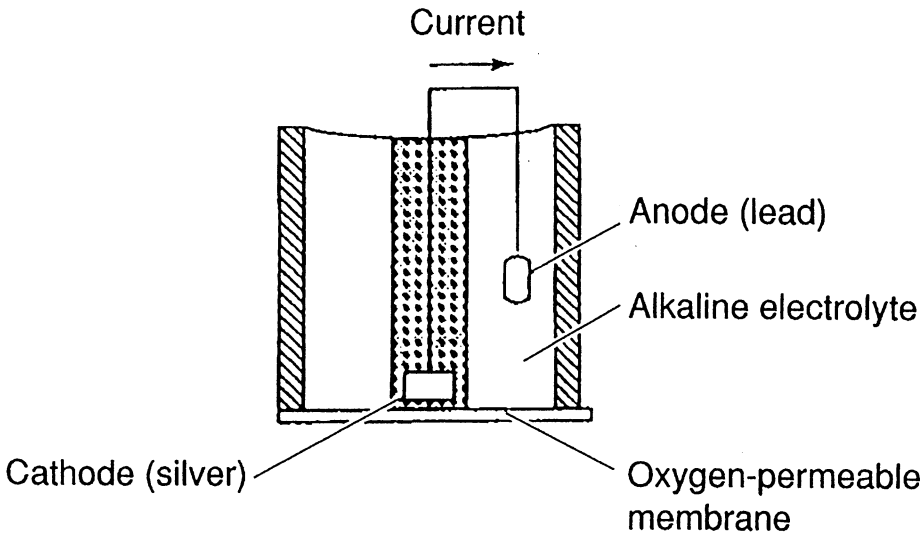


Fig. 1 Principle of DO sensor

A noble metal (silver) is fitted closely to an oxygen-permeable membrane to make the cathode; a base metal (lead) is used as the anode. Both are immersed in an alkaline electrolyte with the anode-to-cathode external circuit complete. Oxygen diffusing through the oxygen-permeable membrane causes a reduction reaction at the cathode; this allows flow of current in the external circuit:

$$O_2 + 2H_2O + 4e^- = 4OH^-$$

At the anode, oxidation reaction occurs as follows:

$$2Pb = 2Pb_2 + 4e^-$$

The current is proportional to the quantity of oxygen diffusing through the oxygen-permeable membrane. Accordingly, measurement of the current makes DO in a sample known.

The DO measuring method based on this principle is called the Galvanic-cell method. This method allows convenient measurement of DO, especially when compared with chemical-analysis methods, which need complicated pretreatment to eliminate the effects of oxidizing or reducing substances.

Atmospheric Oxygen

In the strictest terms, the O_2-measurement mode of a measuring device should measure the partial pressure of oxygen (O_2) in the atmosphere. However, with the OM-Series Meters, as can be determined from the O_2 readout being expressed in percent (%), what is being shown is the volumetric ratio of oxygen in the atmosphere. If this measurement value is obtained under a pressure of one atmosphere (i.e., 1.013 hPa), then the readout will be an accurate assessment of the volumetric ratio. If the actual measurement is a pressure other then one atmosphere, it must be taken into account that the readout value is based on the assumption that the measurement is made at a pressure of one atmosphere (1,013 hPa).

Note that if you are measuring dissolved oxygen and then switch the OM-Meter to the O_2-measurement mode, the value on the readout will have little scientific meaning.

SAT.RATIO

The SAT.RATIO measurement mode on the OM-Meter gives a readout in percent (%) of the ratio of dissolved oxygen to saturated oxygen in the sample solution. Therefore, a SAT.RATIO of 100% means that oxygen is saturated throughout the sample solution.

Let us say, for example, that we measure the dissolved oxygen in a sample solution at 25℃ and at 5℃, and at both temperatures the readout shows a value for dissolved oxygen of 8.11mg/l; in other words the measurement results are the same for dissolved oxygen. However, if we switch to a SAT.RATIO readout, we see that the SAT. RATIO value at 25℃ is 100% while that at 5℃ is only 65.6%, indicating that the sample solution at 5℃ still has room for more oxygen saturation.

Correction for atmospheric pressure

The amount of dissolved oxygen in the sample solution increases in direct proportion to the partial pressure of oxygen in the atmosphere, which, of course, is in contact with the sample solution. Table 3 shows the amounts of saturated dissolved oxygen in water at various temperatures; this shows that a pressure of one atmosphere (i.e., 1,013 hPa), causes 8.11 mg/l of oxygen to be saturated in water at 25 ℃. However, as the height above sea-level increases, the atmospheric pressure decreases, so that, for example, at a great height above sea-level where the atmospheric pressure is only half that at sea-level (i.e., 506.5 hPa) the amount of oxygen saturated in water will only be one-half that at sea-level (i.e., 4.06 mg/l).

Therefore, when the OM-Meter is re-calibrated, strictly speaking the atmospheric pressure should also be a factor included in the re-calibration procedure. At normal atmospheric pressures near sea level, this usually is not a problem, but when the OM-Meter is to be used at high altitudes, it is necessary to make a correction for atmospheric pressure. Both the OM-12 and the OM-14 Models allow you to do this.

Once you have specified a value for atmospheric pressure, this value for atmospheric pressure will automatically be included in the re-calibration when you re-calibrate the Meter. The correction value for atmospheric pressure will be calculated into the re-calibration of the OM-Meter, and when the calibration is completed, this value will be shown: 20.9 x (P/1,013)%. Here, P is the value for atmospheric pressure (in hPa) that you have input into the OM-Meter.

See Table 2 for reference; it shows the values of atmospheric pressure at various heights above sea level. You can refer to these values as a rough guide if you know the altitude at which you are working but not the atmospheric pressure.

Table 2 Altitude vs. atmospheric pressure

Altitude	Atmospheric pressure	
	hPa	mmHg
0	1,013	760
200	990	743
400	966	725
600	943	707
800	921	691
1,000	899	674
1,200	877	658
1,400	856	642
1,600	835	626
1,800	815	611
2,000	795	596
2,200	775	581
2,400	756	567
2,600	738	554
2,800	719	539
3,000	701	526
3,200	683	512
3,400	666	500
3,600	649	487
3,800	633	475
4,000	616	462
4,200	601	451
4,400	585	439
4,600	570	428
4,800	555	416
5,000	540	405

Conversion equation for unit of atomospheric pressure.

$$P \times (\text{mmHg}) = \frac{P_0\ (\text{hPa})}{1.333224}$$

ATC & MTC

The DO-Probes used in the OM-Meters have built-in thermistors that enable them to make temperature measurements and do temperature compensation. These thermistors allow automatic temperature compensation, referred to here as ATC.

The thermistor's accuracy in measuring temperature is ±1℃. For normal measurements in most situations, the accuracy of the OM-Meter operating under this ATC is sufficient. However, should greater accuracy in temperature compensation be necessary, it is possible to use any type of thermometer you wish to measure the temperature of the sample solution independently and then input this value separately into the OM-Meter. This is referred to as Manual Temperature Compensation, or MTC.

DO correction for salinity

When a solution and air are in contact and in complete equilibrium (saturated), DO:C[mg/l] in the solution, and the oxygen partial-pressure:Ps[MPa] in air are in the following relation:

$$C = Ps/H$$

H[MPa/(mg/l)] is referred to as Henry's constant, which depends on the composition of the solution. In general, C becomes smaller as the salinity in the solution increases, since H becomes larger.

A DO sensor is intended to detect Ps in the above expression. Therefore, the DO measurement of an aqueous solution containing salt would be in error if the DO electrode were standardized either on air-saturated pure water or on air. To settle this problem, it is necessary to correct the DO reading based on the salinity of the sample.

Conventional DO meters make this salinity correction by inputting a known salinity value. This poses no problems if the salinity of the sample is known. In practice, however, the salinity of the sample usually not known, unless measured by a device such as the OM Meter. Therefore, until now, DO meters have not been practical, even if they were provided with a salinity-correcting function.

The OM Meter is capable of measuring the salinity of a sample and automatically correcting the DO reading for the amount of salinity measured in the sample.

Table 3 Concentrations of saturated dissolved oxygen in water at various temperatures (0.1℃ increment), Salinity = 0.0 PPT

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0℃	14.16	14.12	14.08	14.04	14.00	13.97	13.93	13.89	13.85	13.81
1	13.77	13.74	13.70	13.66	13.63	13.59	13.55	13.51	13.48	13.44
2	13.40	13.37	13.33	13.30	13.26	13.22	13.19	13.15	13.12	13.08
3	13.04	13.01	12.98	12.94	12.91	12.87	12.84	12.81	12.77	12.74
4	12.70	12.67	12.64	12.60	12.57	12.54	12.51	12.47	12.44	12.41
5	12.37	12.34	12.31	12.28	12.25	12.22	12.18	12.15	12.12	12.09
6	12.06	12.03	12.00	11.97	11.94	11.91	11.88	11.85	11.82	11.79
7	11.75	11.73	11.70	11.67	11.64	11.61	11.58	11.55	11.52	11.50
8	11.47	11.44	11.41	11.38	11.36	11.33	11.30	11.27	11.25	11.22
9	11.19	11.16	11.14	11.11	11.08	11.06	11.03	11.00	10.98	10.95
10	10.92	10.90	10.87	10.85	10.82	10.80	10.77	10.75	10.72	10.70
11	10.67	10.65	10.62	10.60	10.57	10.55	10.53	10.50	10.48	10.45
12	10.43	10.40	10.38	10.36	10.34	10.31	10.29	10.27	10.24	10.22
13	10.20	10.17	10.15	10.13	10.11	10.09	10.06	10.04	10.02	10.00
14	9.97	9.95	9.93	9.91	9.89	9.87	9.85	9.83	9.81	9.78
15	9.76	9.74	9.72	9.70	9.68	9.66	9.64	9.62	9.60	9.58
16	9.56	9.54	9.52	9.50	9.48	9.46	9.45	9.43	9.41	9.39
17	9.37	9.35	9.33	9.31	9.30	9.28	9.26	9.24	9.22	9.20
18	9.18	9.17	9.15	9.13	9.12	9.10	9.08	9.06	9.04	9.03
19	9.01	8.99	8.98	8.96	8.94	8.93	8.91	8.89	8.88	8.86
20	8.84	8.83	8.81	8.79	8.78	8.76	8.75	8.73	8.75	8.70
21	8.68	8.67	8.65	8.64	8.62	8.61	8.59	8.58	8.56	8.55
22	8.53	8.52	8.50	8.49	8.47	8.46	8.44	8.43	8.41	8.40
23	8.39	8.37	8.36	8.34	8.33	8.32	8.30	8.29	8.27	8.26
24	8.25	8.23	8.22	8.21	8.19	8.18	8.17	8.15	8.14	8.13
25	8.11	8.10	8.09	8.07	8.06	8.05	8.04	8.02	8.01	8.00
26	7.99	7.97	7.96	7.95	7.94	7.92	7.91	7.90	7.89	7.88
27	7.87	7.85	7.84	7.83	7.82	7.81	7.79	7.78	7.77	7.76
28	7.75	7.74	7.72	7.71	7.70	7.69	7.68	7.67	7.66	7.65
29	7.64	7.62	7.61	7.60	7.59	7.58	7.57	7.56	7.55	7.54
30	7.53	7.52	7.51	7.50	7.48	7.47	7.46	7.45	7.44	7.43
31	7.42	7.41	7.40	7.39	7.38	7.37	7.36	7.35	7.34	7.33
32	7.32	7.31	7.30	7.29	7.28	7.27	7.26	7.25	7.24	7.23
33	7.22	7.21	7.20	7.20	7.19	7.18	7.17	7.16	7.15	7.14
34	7.13	7.12	7.11	7.10	7.09	7.08	7.07	7.06	7.05	7.05
35	7.04	7.03	7.02	7.01	7.00	6.99	6.98	6.97	6.96	6.95
36	6.94	6.94	6.93	6.92	6.91	6.90	6.89	6.88	6.87	6.86
37	6.86	6.85	6.84	6.83	6.82	6.85	6.80	6.79	6.78	6.77
38	6.76	6.76	6.75	6.74	6.73	6.72	6.71	6.70	6.70	6.69
39	6.68	6.67	6.66	6.65	6.64	6.63	6.63	6.62	6.61	6.60
40	6.59	6.58	6.57	6.56	6.56	6.55	6.54	6.53	6.52	6.51

Table 4 Concentrations of saturated dissolved oxygen (mg/l) in water at various temperatures and salinity concentrations

Tempera-	Salinity (PPT)								
ture	0	5	10	15	20	25	30	35	40
0°C	14.16	13.74	13.32	12.90	12.48	12.06	11.64	11.22	10.80
1	13.77	13.36	12.95	12.55	12.14	11.73	11.32	10.92	10.51
2	13.40	13.00	12.61	12.21	11.82	11.42	11.03	10.63	10.24
3	13.05	12.67	12.28	11.90	11.52	11.13	10.75	10.37	9.98
4	12.70	12.33	11.96	11.58	11.21	10.84	10.47	10.10	9.72
5	12.37	12.01	11.65	11.29	10.93	10.57	10.20	9.84	9.48
6	12.06	11.71	11.36	11.01	10.66	10.31	9.96	9.61	9.26
7	11.76	11.42	11.08	10.74	10.40	10.06	9.72	9.38	9.04
8	11.47	11.14	10.81	10.48	10.15	9.82	9.49	9.16	8.83
9	11.19	10.87	10.55	10.23	9.91	9.59	9.27	8.95	8.63
10	10.92	10.61	10.30	9.99	9.68	9.37	9.05	8.74	8.43
11	10.67	10.37	10.07	9.76	9.46	9.16	8.86	8.56	8.25
12	10.43	10.14	9.84	9.55	9.26	8.96	8.67	8.38	8.08
13	10.20	9.91	9.63	9.34	9.06	8.77	8.49	8.20	7.92
14	9.98	9.70	9.42	9.15	8.87	8.59	8.31	8.04	7.76
15	9.76	9.49	9.22	8.95	8.68	8.41	8.14	7.87	7.60
16	9.56	9.30	9.03	8.77	8.51	8.24	7.98	7.72	7.45
17	9.37	9.11	8.86	8.60	8.34	8.09	7.83	7.57	7.32
18	9.18	8.93	8.68	8.43	8.18	7.93	7.68	7.43	7.18
19	9.01	8.77	8.52	8.28	8.03	7.79	7.54	7.30	7.06
20	8.84	8.60	8.36	8.12	7.88	7.65	7.41	7.17	6.93
21	8.68	8.45	8.21	7.98	7.75	7.51	7.28	7.04	6.81
22	8.53	8.30	8.07	7.84	7.61	7.39	7.16	6.93	6.70
23	8.38	8.16	7.93	7.71	7.48	7.26	7.03	6.81	6.58
24	8.25	8.03	7.81	7.59	7.37	7.15	6.93	6.71	6.49
25	8.11	7.89	7.68	7.46	7.24	7.03	6.81	6.59	6.37
26	7.99	7.78	7.56	7.35	7.14	6.92	6.71	6.49	6.28
27	7.86	7.65	7.44	7.23	7.02	6.81	6.60	6.39	6.17
28	7.75	7.54	7.33	7.13	6.92	6.71	6.50	6.29	6.08
29	7.64	7.43	7.23	7.02	6.82	6.61	6.40	6.20	5.99
30	7.53	7.33	7.12	6.92	6.71	6.51	6.30	6.10	5.90
31	7.42	7.22	7.01	6.81	6.61	6.41	6.20	6.00	5.80
32	7.32	7.12	6.92	6.71	6.51	6.31	6.11	5.91	5.71
33	7.22	7.02	6.82	6.62	6.42	6.21	6.01	5.81	5.61
34	7.13	6.93	6.73	6.53	6.33	6.13	5.92	5.72	5.52
35	7.04	6.84	6.64	6.44	6.24	6.04	5.83	5.63	5.43
36	6.94	6.74	6.54	6.34	6.13	5.93	5.73	5.53	5.33
37	6.86	6.66	6.46	6.25	6.05	5.85	5.65	5.44	5.24
38	6.76	6.56	6.35	6.15	5.95	5.74	5.54	5.34	5.13
39	6.68	6.47	6.27	6.06	5.86	5.65	5.45	5.24	5.04
40	6.59	6.38	6.18	5.97	5.76	5.55	5.35	5.14	4.93

Table 5 Salinity concentration (α) in sea-water at various temperatures

Temperature	Salinity (PPT)								
	0	5	10	15	20	25	30	35	40
0℃	-0.132	3.977	8.021	12.051	16.066	20.079	24.098	28.128	32.177
1	-0.073	4.018	8.045	12.056	16.054	20.050	24.054	28.070	32.103
2	-0.032	4.039	8.047	12.041	16.024	20.005	23.996	27.996	32.014
3	-0.008	4.054	8.034	12.012	15.980	19.948	23.923	27.909	31.912
4	±0.000	4.035	8.007	11.970	15.925	19.878	23.839	27.810	31.799
5	-0.008	4.010	7.966	11.915	15.855	19.796	23.742	27.700	31.674
6	-0.032	3.970	7.911	11.844	15.772	19.699	23.632	27.588	31.539
7	-0.071	3.916	7.843	11.762	15.677	19.591	23.512	27.444	31.392
8	-0.124	3.848	7.762	11.668	15.569	19.472	23.381	27.300	
9	-0.192	3.767	7.667	11.561	15.451	49.340	23.237	27.144	31.067
10	-0.273	3.672	7.561	11.443	15.320	19.199	23.083	26.978	30.888
11	-0.368	3.566	7.442	11.312	15.178	19.045	22.919	26.802	30.701
12	-0.475	3.446	7.311	11.169	15.024	18.880	22.742	26.614	30.503
13	-0.596	3.315	7.168	11.015	14.859	18.704	25.525	26.416	30.295
14	-0.729	3.170	7.013	10.850	14.684	18.518	22.358	26.201	30.078
15	-0.874	3.014	6.846	10.673	14.497	18.324	22.154	25.996	29.822
16	-1.030	2.848	6.669	10.488	14.302	18.118	21.940	25.771	29.618
17	-1.199	2.670	6.482	10.291	14.097	17.903	21.716	25.537	29.375
18	-1.378	2.482	6.286	10.085	13.882	17.679	21.482	25.285	29.124
19	-1.568	2.284	6.078	9.869	13.657	17.444	21.239	25.044	28.865
20	-1.770	2.074	5.860	9.643	13.422	17.202	20.988	24.784	28.597
21	-1.981	1.854	5.632	9.407	13.179	16.952	20.730	24.518	28.321
22	-2.003	1.652	5.396	9.163	12.927	16.691	20.462	24.242	28.032
23	-2.435	1.387	5.150	8.190	12.666	16.423	20.186	23.959	27.747
24	-2.677	1.137	4.894	8.646	12.395	16.145	19.901	23.667	27.448
25	-2.929	0.878	4.628	8.373	12.116	15.859	19.607	23.366	27.141
26	-3.190	0.609	4.333	8.092	11.828	15.564	19.305	23.058	26.826
27	-3.461	0.333	4.070	7.803	11.532	15.261	18.998	22.744	26.505
28	-3.741	0.047	3.777	7.504	11.228	14.925	18.681	22.421	26.177
29	-4.029	-0.248	3.477	7.199	10.916	14.634	18.357	22.091	25.840
30	-4.327	-0.550	3.171	6.885	10.596	14.308	18.026	21.754	25.498
31	-4.637	-0.862	2.853	6.563	10.269	13.976	17.688	21.410	25.149
32	-4.948	-1.181	2.529	6.233	9.934	13.635	17.342	21.059	24.792

Note that in general the concentration of sea-water, ρ , is between 1.000-1.031. Therefore, no matter what the actual value, the first two digits, i.e., 1.0, are always the same. For the sake of convenience, we have represented the concentration here as $\alpha = (\rho - 1) \times 1000$. The values in this table represent this α .

Table 6 Electrical conductivity of sea-water ($mS.cm^{-1}$)

Temperature	Salinity (PPT)								
	0	5	10	15	20	25	30	35	40
0°C	4.8	9.2	13.5	17.6	21.6	25.4	29.3	33.1	
5	5.5	10.7	15.6	20.3	24.8	29.2	33.5	37.8	
10	6.3	12.2	17.8	23.1	28.3	33.2	38.2	43.0	
15	7.1	13.8	20.1	26.1	31.9	37.5	43.1	48.6	
20	7.9	15.4	22.5	29.2	35.7	42.0	48.2	54.3	
25	8.8	17.1	24.9	32.3	39.4	46.4	53.2	60.1	
30	9.7	18.7	27.3	35.4	43.3	51.0	58.5	66.0	

Specifications

OM-12

Measurement method	For dissolved oxygen: membrane-type galvanic cell For temperature: thermistor
Measurable range	Dissolved oxygen: 0-19.99 mg/l Atmospheric oxygen: 0-50.0% SAT.RATIO: 0-199.9%
Temperature range	0-50.0°C
Repeatability of readout	DO, O_2, and SAT.RATIO: ±0.5%, F.S. ±1 digit temperature: ±0.1°C, ±1 digit
Readout	Liquid Crystal Display (LCD); shows DO, O_2, SAT.RATIO, and temperature

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OM-14

Measurement method	For dissolved oxygen: membrane-type galvanic cell For temperature: thermistor
Measurable range	Dissolved oxygen: 0-19.99 mg/l Atmospheric oxygen: 0-50.0% SAT.RATIO: 0-199.9%
Temperature range	0-50.0°C
Repeatability of readout	DO, O_2, and SAT.RATIO: ±0.5%, F.S. ±1 digit temperature: ±0.1°C, ±1 digit
Readout	Liquid Crystal Display (LCD); shows DO, O_2, SAT.RATIO, and temperature
Temperature compensation	ATC & MTC (both automatic & manual temperature compensation): 0-40°C

Temperature compensation	ATC (automatic temperature compensation): 0-40°C
Salinity correction	0-40 PPT, the Meter may be set to measure sea-water
Calibration methods	Air Auto-Calibration
Determination of stability	Automatic detection of stabilized values
Power source	Standard rectangular 9-V dry cell (type 6F22/S-006P); Auto-Shutoff function AC Adaptor (optional)
Operating temperature	0-45°C
Dimensions	197 (H) x 78 (W) x 55 (D) mm
Weight	Approx. 350 g, including battery

Salinity correction	0-40 PPT, the Meter may be set to measure sea-water
Calibration methods	Air Auto-Calibration & Solution Calibration (2-point, zero & span calibration)
Determination of stability	Automatic detection of stabilized values
Analog output	DO: 0-1 VDC/F.S. O_2: 0-0.5 VDC/F.S. SAT.RATIO: 0-1 VDC/F.S.
Data storage	Up to 10 data sets
Power source	Standard rectangular 9-V dry cell (type 6F22/S-006P); Auto-Shutoff function AC Adaptor (optional)
Operating temperature	0-45°C
Dimensions	197 (H) x 78 (W) x 55 (D) mm
Weight	Approx. 350 g, including battery

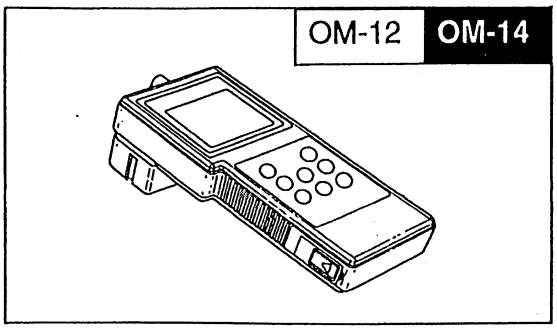
Parts List

Part name	Model No.	Details	Order P/N
DO-Probe	#5450-20D	Field-use with 2-m cable	
DO-Probe	#5450-100D	Field-use with 10-m cable	
DO-Probe	#5420-10D	Includes Lab-use cable	
DO-Sensor	#5401	For Model #5450	9033-0100-00
DO-Sensor	#7541	For Model #5420 DO-Probe	9074-0002-00
Sensor adaptor		For Model #5420 DO-Probe	9074-0003-00
Stirrer set		For Model #5420 DO-Probe, 10-mm diameter, 9-mm high, cross-head type	9074-0004-00
AC adaptor	AC-10	For 220 VAC	
Output cord	---	For analog output of data	9078-0002-00
Carrying case	---	Soft case for main unit	
Stand set	---	For Model #5420 DO-Probe: main unit stand and probe arm	

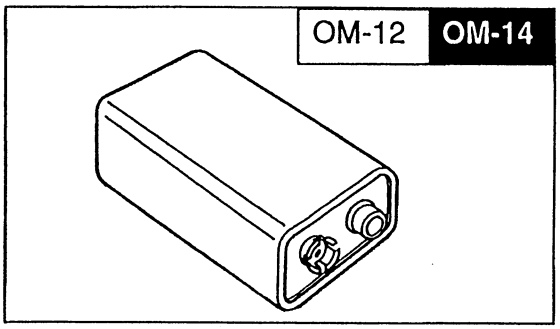
Unpacking your OM-Meter

The following items are included with your OM-Meter. When you unpack the probe and main unit, confirm that all the other accessories are included as well.

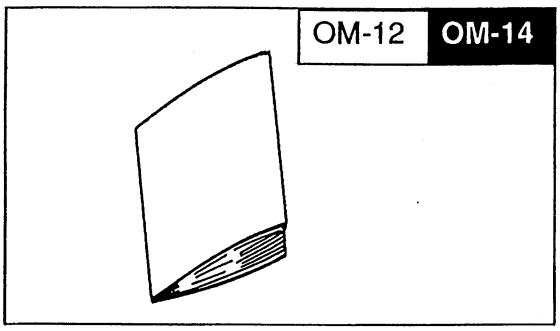
- **Main unit**



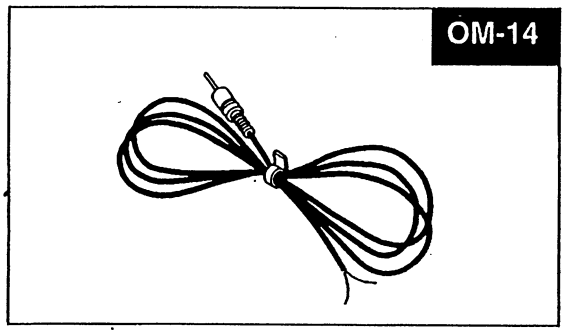
- **9V battery**



- **This Instruction Manual**



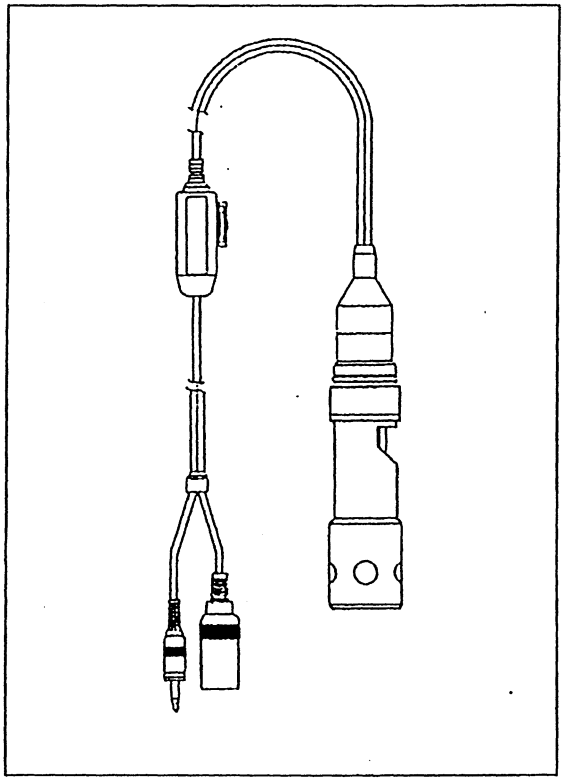
- **2-m output cable** (comes with OM-14 Model only)



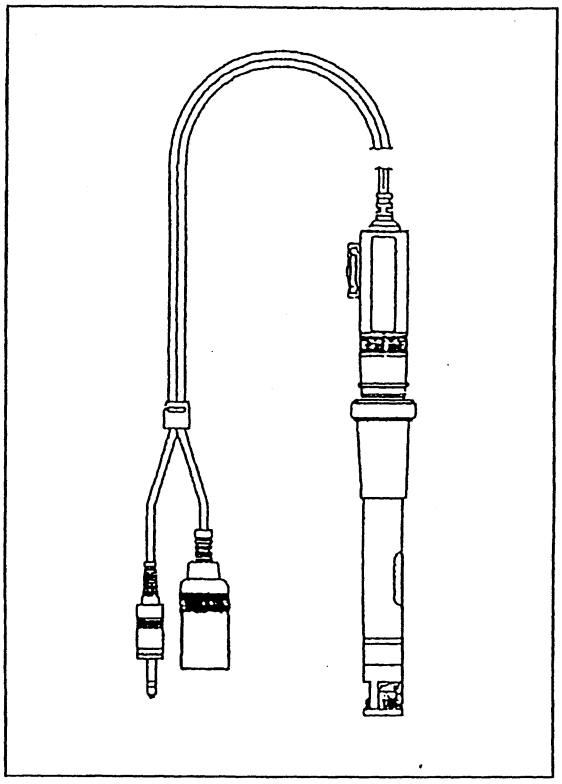
Be sure to select the appropriate DO-Probe for your OM-Meter.

- **DO-Probes (Sold separately)**

Field-use:DO-Probes
Model 5450-20D W/2m-cable
Model 5450-100D W/10m-cable



Lab-use:DO-Probe
Model 5420-10D (Cable length: 1m),



Precaution when using OM-Meter

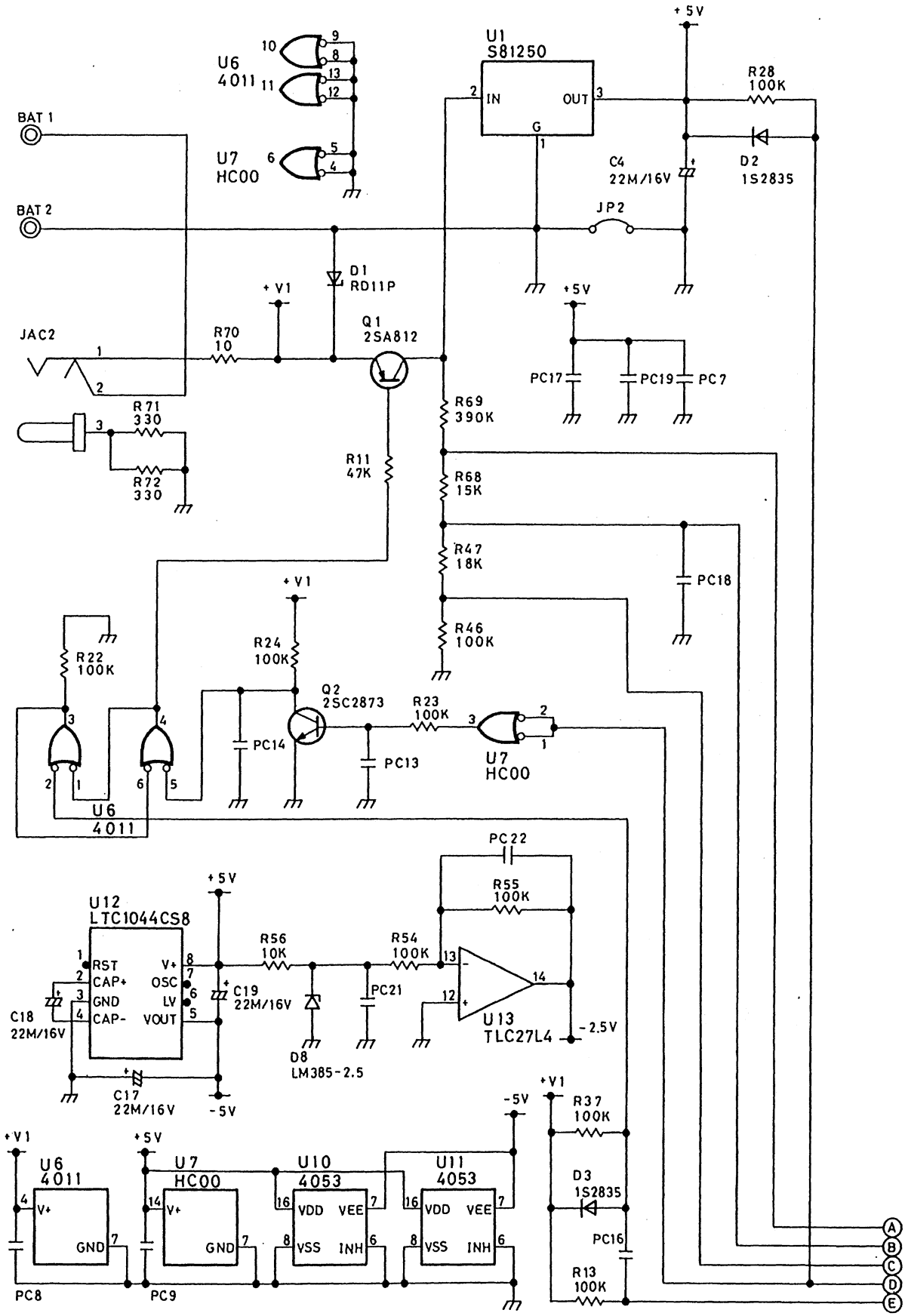
The OM-Meter is carefully designed for trouble-free operation. However, it is sophisticated electronic instrument, and it can be damaged if used carelessly. Please read the following precautions and observe them when using your OM-Meter.

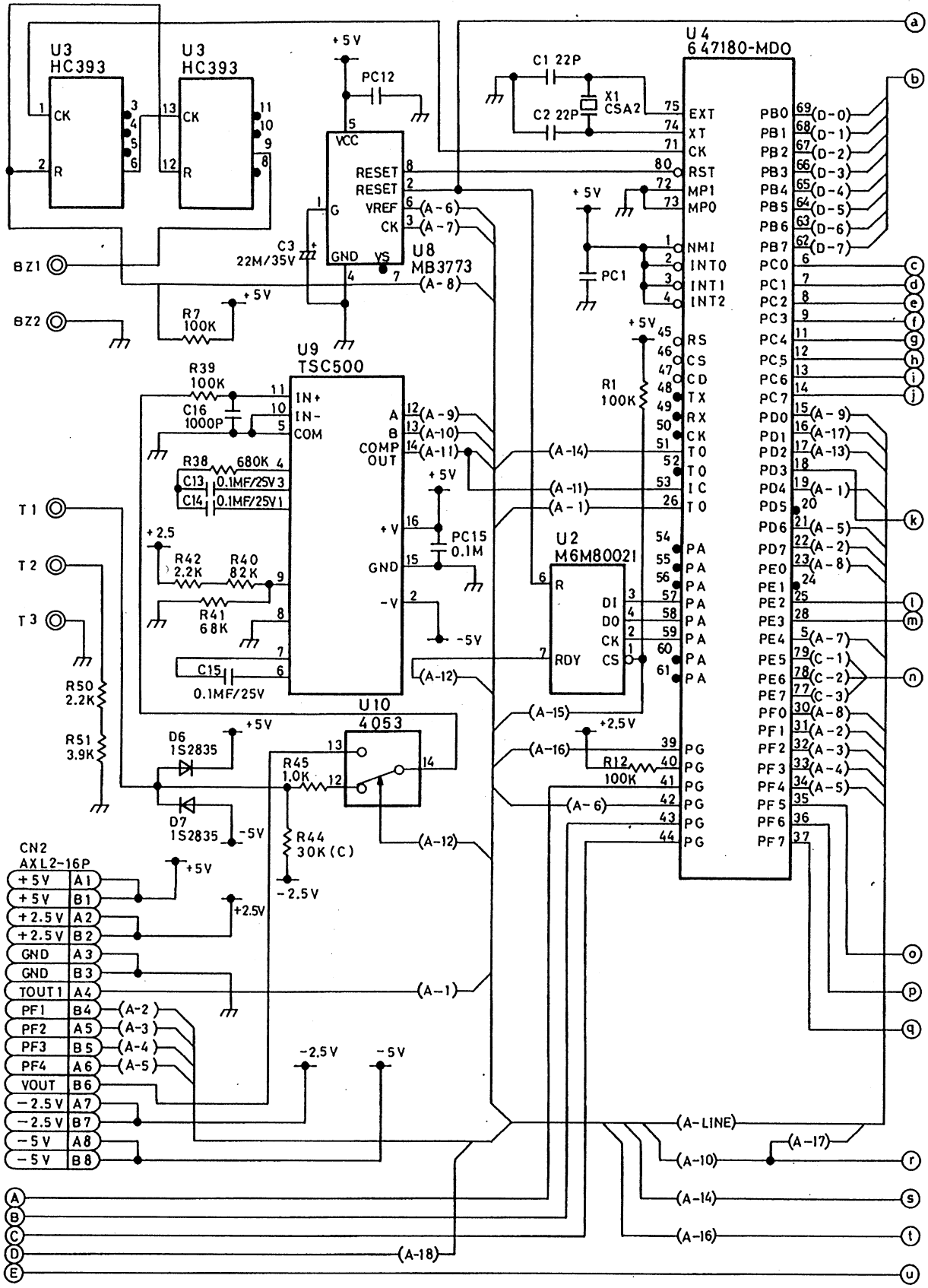
- Be sure never to let your OM-Meter get wet.
- Never let the DO-Sensor jack or the DO-Sensor socket on the main unit get wet. Never touch the electrical connections of the jack or socket with your fingers.
- The DO-Sensor jack and socket require a high degree of electrical insulation. If they get wet or are touched with dirty fingers, at the very least, the insulation characteristics of the connection will be adversely affected.
  This will result in an unsteady readout and errors in measurements. At the worst, the Probe may be irreparably damaged.
- Never immerse the main unit directly in water.

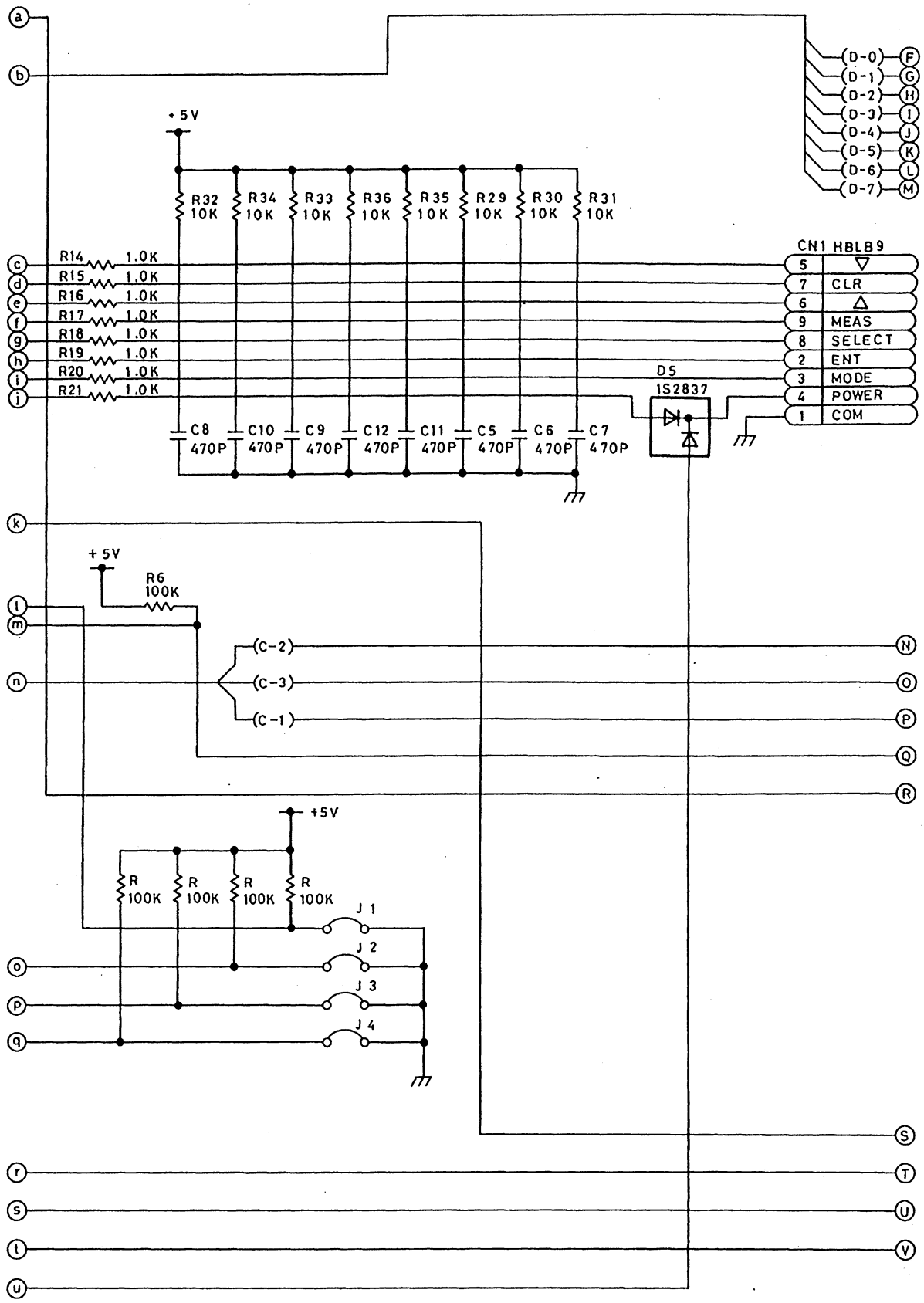
  The main unit is water-resistant and may be safely used in the rain; however, it is not of waterproof construction.
  Immersing the main unit in water or any other liquid can damage the internal electronic circuits.
- Never drop the DO-Probe or the main unit. Never subject either component to sudden impact.
- The keys on the Keypad are designed to be pushed with your fingers. Never push the keys with pointed or metal objects.
- Do not store the OM-Meter where it may be exposed to prolonged direct sunlight.
- The OM-Meter Readout uses a high-quality Liquid-Crystal Display (LCD). If the LCD is exposed to ultraviolet rays for extended periods, the contrast may be reduced.
- Keep the Meter away from dust, high humidity, and vibration.

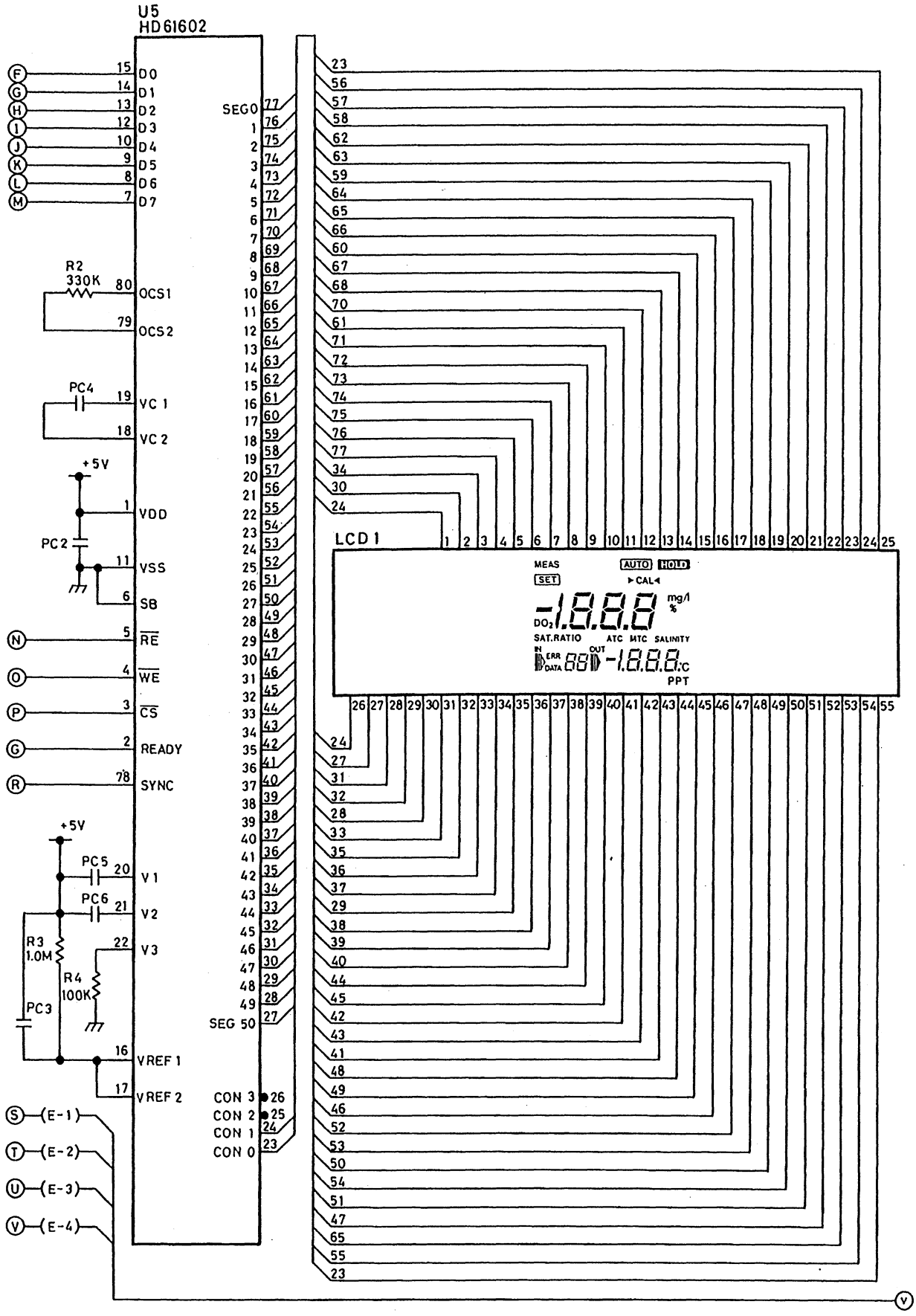
  The OM-Meter is a high-precision device. Storing it where it may be subject to excessive vibration, large amounts of dust, or high humidity may cause a malfunction in the internal circuitry.
- Do not swing or jerk the probe by its cable.
- Do not subject the cable connector to stress by pulling or stretching it.

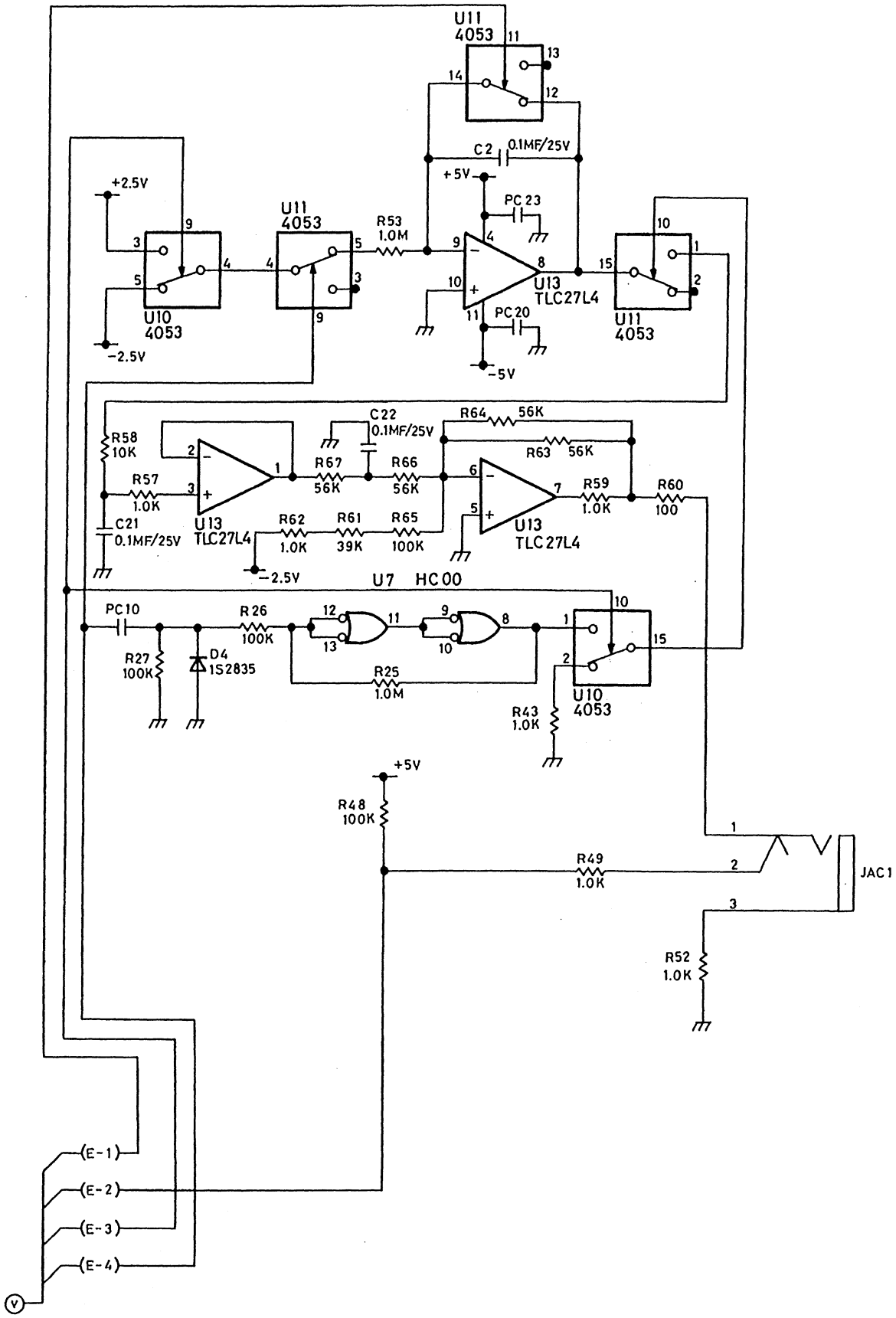
Circuit Diagram



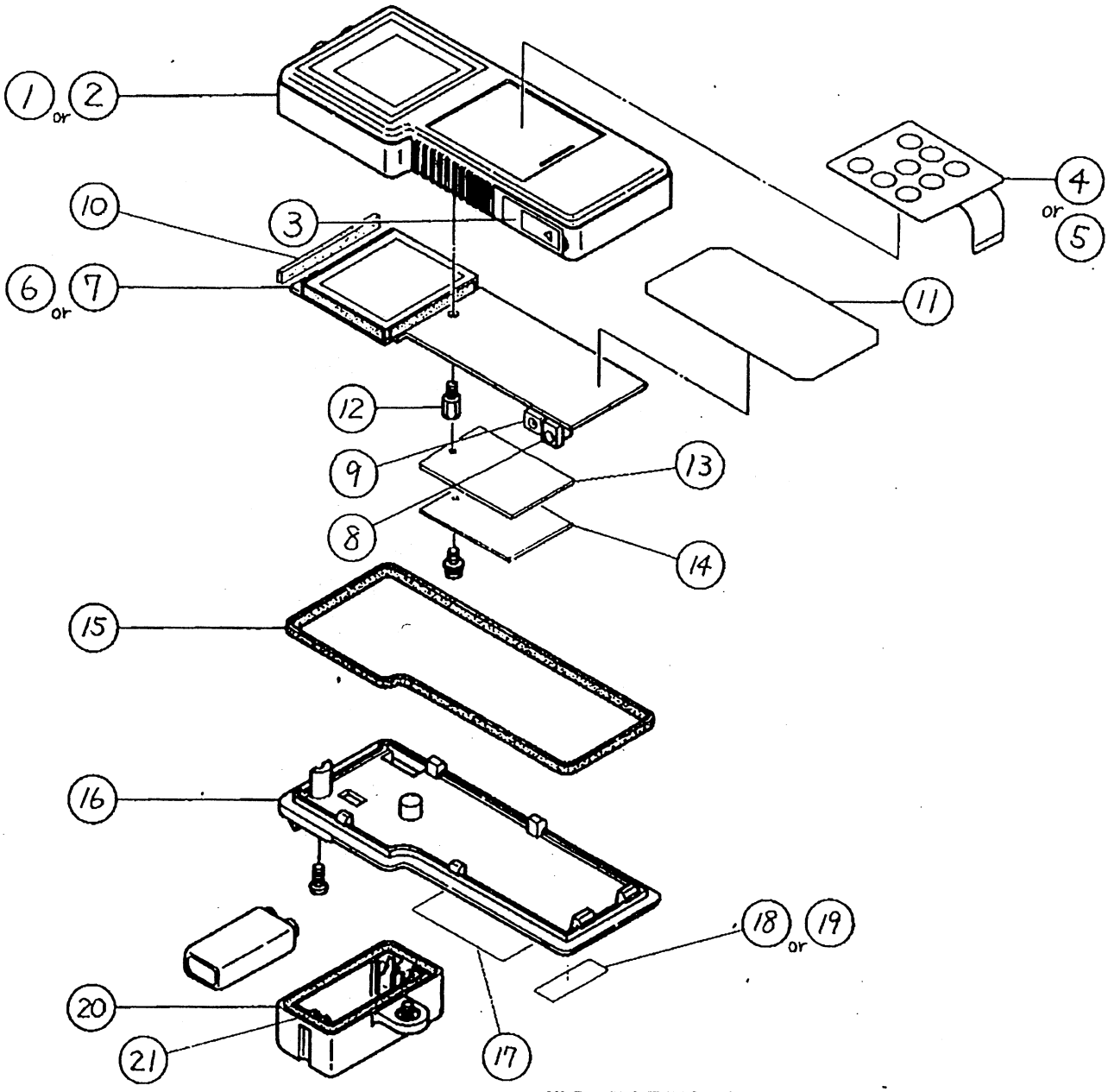

U3
HC393
U3
HC393
U4
64180-MD0
U8
MB3773
U9
TSC500
U10
4053
U2
M6M80021
C1 22P
C2 22P
X1
CSA2
PC12
PC1
PC15
0.1M
C3
22M/35V
R7
100K
R1
100K
R12
100K
R39
100K
C16
1000P
R38
680K
C13
0.1MF/25V
C14
0.1MF/25V
R42
2.2K
R40
82K
R41
68K
C15
0.1MF/25V
R50
2.2K
R51
3.9K
R45
1.0K
R44
30K(C)
D6
1S2835
D7
1S2835
BZ1
BZ2
T1
T2
T3
CN2
AXL2-16P
+5V
+2.5V
-2.5V
-5V
(A-LINE)
(A-18)


(D-0) F
(D-1) G
(D-2) H
(D-3) I
(D-4) J
(D-5) K
(D-6) L
(D-7) M
+5V
R32 10K
R34 10K
R33 10K
R36 10K
R35 10K
R29 10K
R30 10K
R31 10K
R14 1.0K
R15 1.0K
R16 1.0K
R17 1.0K
R18 1.0K
R19 1.0K
R20 1.0K
R21 1.0K
C8 470P
C10 470P
C9 470P
C12 470P
C11 470P
C5 470P
C6 470P
C7 470P
CN1 HBLB9
5
7 CLR
6
9 MEAS
8 SELECT
2 ENT
3 MODE
4 POWER
1 COM
D5
1S2837
+5V
R6 100K
(C-2)
(C-3)
(C-1)
+5V
R 100K
R 100K
R 100K
R 100K
J 1
J 2
J 3
J 4


U5
HD61602
LCD 1
MEAS
SET
AUTO
HOLD
CAL
mg/l
%
SAT.RATIO
ATC MTC SALINITY
PPT
R2
330K
PC4
PC2
PC5
PC6
R3
1.0M
R4
100K
PC3
+5V
DO
D1
D2
D3
D4
D5
D6
D7
OCS1
OCS2
VC 1
VC 2
VDD
VSS
SB
RE
WE
CS
READY
SYNC
V1
V2
V3
VREF 1
VREF 2
SEG0
SEG 50
CON 3
CON 2
CON 1
CON 0
(E-1)
(E-2)
(E-3)
(E-4)


U11
4053
C2
0.1MF/25V
+5V
PC23
+2.5V
U11
4053
R53
1.0M
U10
4053
-2.5V
U13
TLC27L4
PC20
-5V
U11
4053
C22
0.1MF/25V
R64
56K
R63
56K
R58
10K
R57
1.0K
C21
0.1MF/25V
U13
TLC27L4
R67
56K
R66
56K
R62
1.0K
R61
39K
R65
100K
R59
1.0K
R60
100
-2.5V
U7 HC00
PC10
R26
100K
R27
100K
D4
1S2835
R25
1.0M
R43
1.0K
U10
4053
+5V
R48
100K
R49
1.0K
JAC1
R52
1.0K
(E-1)
(E-2)
(E-3)
(E-4)
V

Exploded Views—main unit

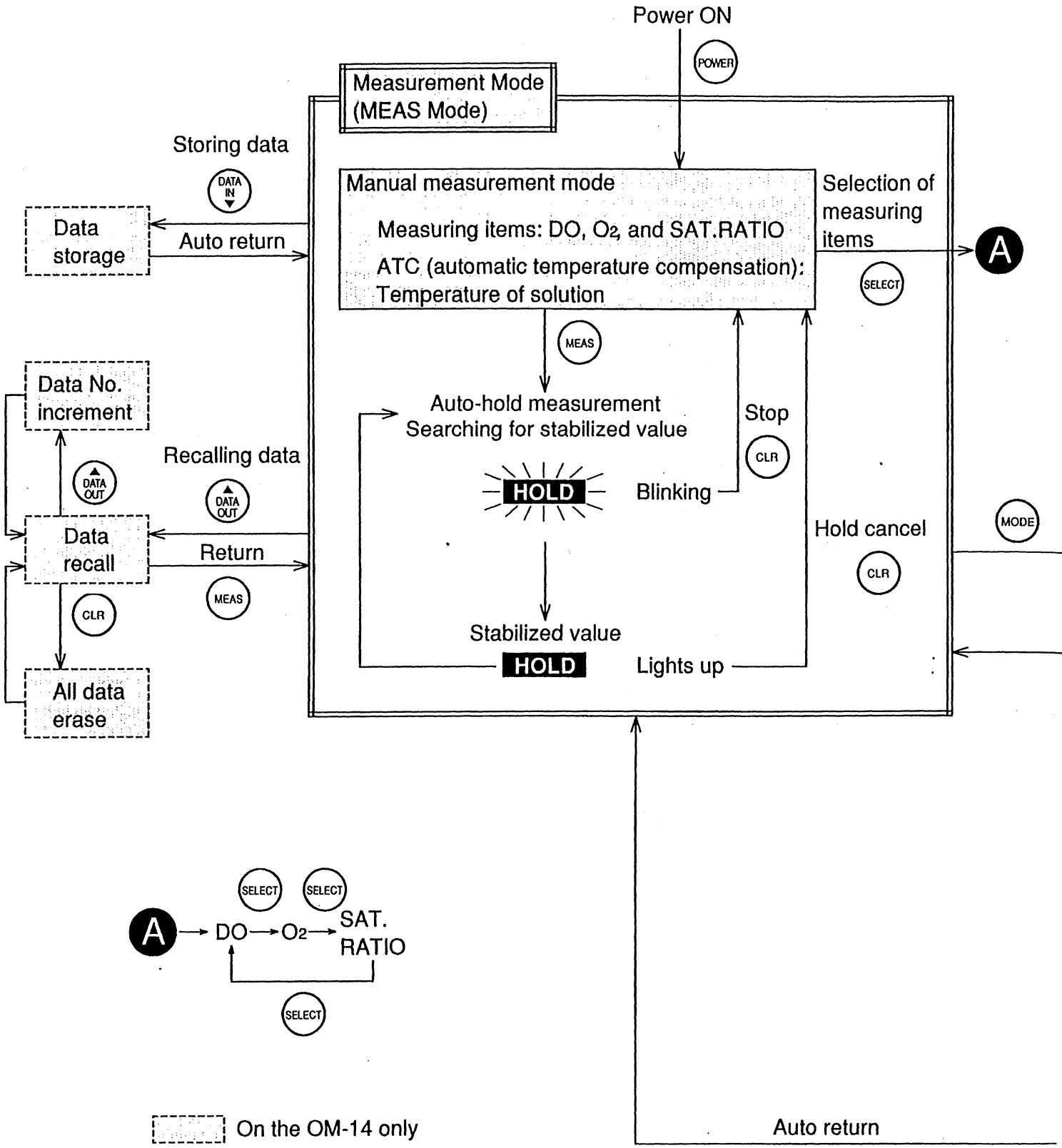


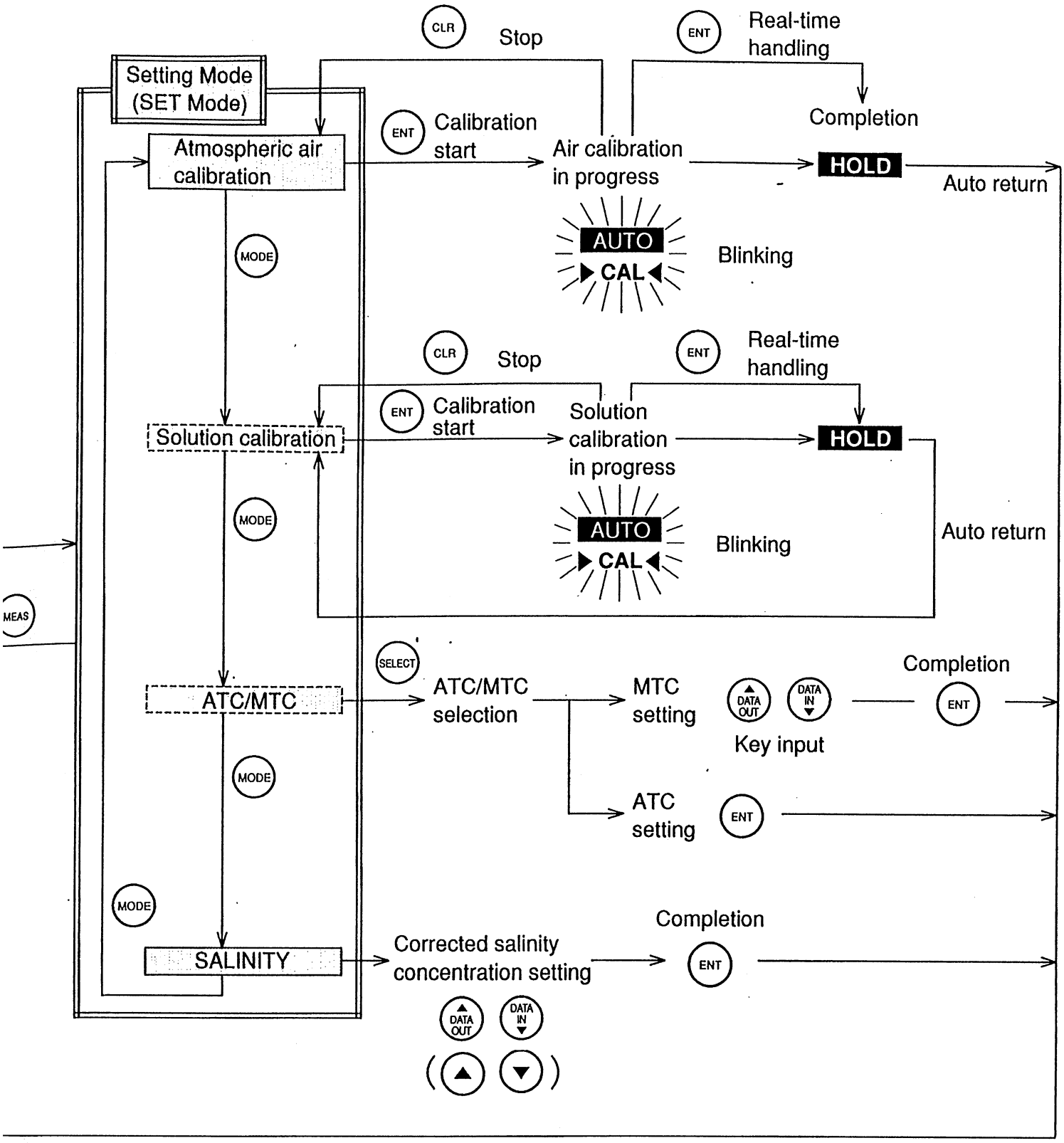
NO.	PARTS NO.	PARTS NAME
1	U800892700	Case assy, top
2	U800892800	Case assy, top
3	H350578-01	Packing, jak
4	H359800-01	Sheet switch
5	H359801-01	Sheet switch
6	U800890600	Main PCB assy
7	U800890700	PCB assy
8	E012208100	Power jak
9	E012208300	Output jak
10	H526160-01	Cushion

NO.	PARTS NO.	PARTS NAME
11	H526346-01	Insulating sheet
12	F022017500	Stay bar
13	U800890800	Pre-amp PCB assy
14	H538876-01	Insulating sheet
15	H525433-01	Case packing
16	H223899-01	Case assy, bottom
17	H353512-01	Rating plate
18	H525382-01	Plate
19	H525383-01	Plate
20	U800733700	Battery case
21	H526789-01	Packing, battery case

Index

Quick Reference for Key Operation




CLR
Stop
ENT
Real-time handling
Setting Mode (SET Mode)
Completion
ENT
Calibration start
Atmospheric air calibration
Air calibration in progress
HOLD
Auto return
AUTO
CAL
Blinking
MODE
CLR
Stop
ENT
Real-time handling
ENT
Calibration start
Solution calibration
Solution calibration in progress
HOLD
MODE
AUTO
CAL
Blinking
Auto return
MEAS
SELECT
Completion
ATC/MTC
ATC/MTC selection
MTC setting
DATA OUT
DATA IN
ENT
Key input
MODE
ATC setting
ENT
MODE
Completion
SALINITY
Corrected salinity concentration setting
ENT
DATA OUT
DATA IN

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