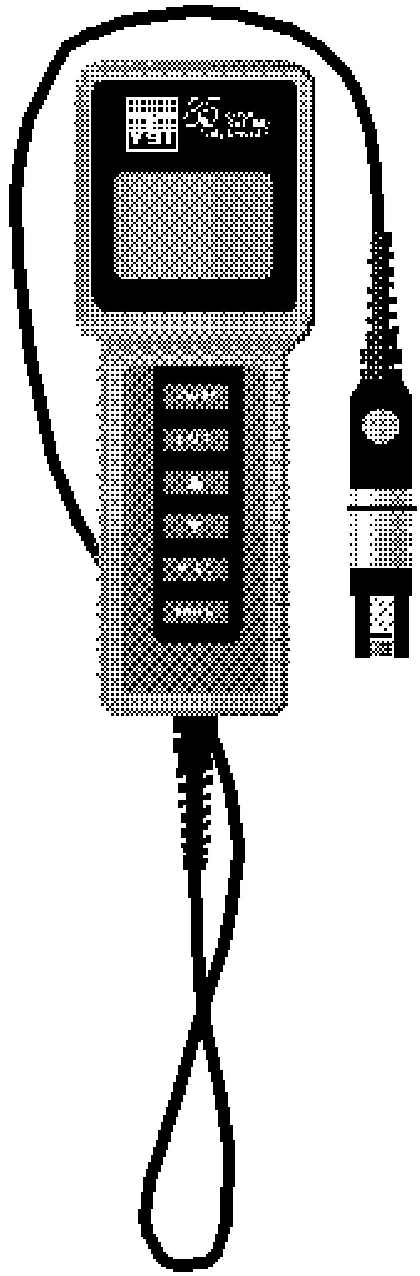
YSI incorporated

YSI Model 85

Handheld Oxygen, Conductivity, Salinity, And Temperature System



Service

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SECTION 1 INTRODUCTION

The YSI Model 85 Handheld Salinity, Conductivity, Dissolved Oxygen & Temperature System is a rugged, microprocessor based, digital meter with an attached YSI combination conductivity and dissolved oxygen probe.

The YSI Model 85 is designed for use in field, lab, and process control applications as well as for environmental, aquaculture, and industrial uses. The Model 85 is available with cable lengths of 10, 25, 50 or 100 feet. The body of the probe has been manufactured with stainless steel to add rugged durability and sinking weight. The probe also utilizes our easy to install cap membranes for measuring dissolved oxygen.

The YSI Model 85 probe is a non-detachable; combination sensor designed specifically for the YSI Model 85 Handheld System. The conductivity portion is a four-electrode cell with a cell constant of 5.0/cm ±4%. The dissolved oxygen portion is a polaragraphic clark type sensor. The Model 85's microprocessor allows the system to be easily calibrated for dissolved oxygen or conductivity with the press of a few buttons. Additionally, the microprocessor performs a self-diagnostic routine each time the instrument is turned on. The self-diagnostic routine provides you with useful information about the conductivity cell constant and function of the instrument circuitry.

The system simultaneously displays temperature (in °C), along with one of the following parameters: dissolved oxygen in either mg/L (milligrams per liter) or % air saturation; conductivity; temperature compensated conductivity; (in µS/cm or mS/cm), and salinity (in parts per thousand {ppt}).

The system requires only a single calibration regardless of which dissolved oxygen display you use. The calibration of conductivity is not required but is available. A single calibration will adjust the instrument, regardless if you are reading conductivity or temperature compensated conductivity. You can switch between all of these parameters with the push of a single key.

Six AA-size alkaline batteries power the instrument. A new set of alkaline batteries will provide approximately 100 hours of continuous operation. When batteries need to be replaced, the LCD will display a **"LO BAT"** message.

1.1 SERVICE PHILOSOPHY

The YSI Model 85 is sold as a complete dissolved oxygen, conductivity and salinity measuring system including an attached probe. Most service issues that occur in dissolved oxygen and conductivity systems are caused by improper maintenance of the probe. For this reason, troubleshooting efforts should be initially directed at determining the condition and functionality of the probe and cable.

In the event that a service problem is isolated to the meter itself, YSI recommends the replacement of the entire defective sub-assembly rather than individual components. To lessen down time, YSI maintains an adequate stock of replacement sub-assemblies.

The recommended method of determining a sub-assemblies condition is by substitution. For example, to test for a defective probe/cable assembly, substitute the assembly with a known good assembly or a decade resistance box. If, after testing, the PCB meets the established specifications, the probe/cable assembly will have to be serviced or replaced.

1.2 SPECIFICATIONS

Operating Environment

Medium: fresh, sea, or polluted water and most other liquid solutions.
Temperature: -5 to +65 °C
Depth: 0 to 10, 0 to 25, 0 to 50, or 0 to 100 feet (depending on cable length)

Storage Temperature: -10 to +50 °C

Material: ABS, Stainless Steel, and other materials

Dimensions:

Height:	9.5 inches	(24.13 cm)
Thickness:	2.2 inches	(5.6 cm)
Width:	3.5 inches max.	(8.89 cm)
Weight:	1.7 pounds (w/ 10' cable)	(.77 kg)
Display:	2.3"W x 1.5"L	(5.8cm W x 3.8cm L)

Power: 9 VDC -6 AA-size Alkaline Batteries (included)
Approximately 100 hours operation from each new set of batteries

Water Tightness: Meets or exceeds IP65 standards

Extensive testing of the YSI Model 85 indicates the following typical performance:

Measurement	Range	Resolution	Accuracy
Conductivity	0 to 499.9 µS/cm	0.1 µS/cm	± .5% FS
	0 to 4999 µS/cm	1.0 µS/cm	± .5% FS
	0 to 49.99 mS/cm	.01 mS/cm	± .5% FS
	0 to 200.0 mS/cm	0.1 mS/cm	± .5% FS
Salinity	0 to 80 ppt	.1 ppt	± 2%, or ± 0.1 ppt
Temperature	-5 to +65 °C	0.1 °C	± 0.1 °C (±1 lsd)
Dissolved Oxygen	0 to 200 % Air Sat.	0.1% Air Saturation	± 2% Air Saturation
	0 to 20 mg/L	0.01 mg/L	± 0.3 mg/L

Adjustable Conductivity Reference Temperature: 15°C to 25°C

Adjustable Temperature Compensation Factor for Conductivity: 0% to 4%

Temperature Compensation: Automatic

Range: User selected or Autoranging for Conductivity

SECTION 2 PRINCIPLES OF OPERATION

The dissolved oxygen sensor utilizes an oxygen permeable membrane that covers an electrolytic cell consisting of a gold cathode and a porous silver anode. This membrane acts as a diffusion barrier and an isolation barrier preventing fouling of the cathode surface by impurities in the environment. Upon entering the cell through the membrane, oxygen is reduced at an applied potential of -0.8 V referenced to the silver electrode. The reduction current at the cathode is directly proportional to the partial pressure of oxygen in liquid (expressed as %-air saturation) which is proportional to the concentration of dissolved oxygen (in mg/L) at a particular temperature. Thus the same partial pressure of oxygen (% air-saturation) in liquid gives different concentrations of dissolved oxygen (mg/L) at different temperatures because of the different solubility's of oxygen at different temperatures.

The conductivity cell utilizes four pure nickel electrodes for the measurement of solution conductance. Two of the electrodes are current driven, and two are used to measure the voltage drop. The measured voltage drop is then converted into a conductance value in milli-Siemens (millimhos). To convert this value to a conductivity (specific conductance) value in milli-Siemens per cm (mS/cm), the conductance is multiplied by the cell constant that has units of reciprocal cm (cm^{-1}). The cell constant for the Model 85 conductivity cell is 5.0/cm $\pm$ 4%. For most applications, the cell constant is automatically determined (or confirmed) with each deployment of the system when the calibration procedure is followed. Solutions with conductivity's of 1.00, 10.0, 50.0, and 100.0 mS/cm, which have been prepared in accordance with recommendation 56-1981 of the Organization International De Metrologie Legale (OIML) are available from YSI. The instrument output is in µS/cm or mS/cm for both conductivity and specific conductance. The multiplication of cell constant times conductance is carried out automatically by the software.

TEMPERATURES EFFECT ON CONDUCTIVITY

The conductivity of solutions of ionic species is highly dependent on temperature, varying as much as 3% for each change of one degree Celsius (temperature coefficient = 3%/C). In addition, the temperature coefficient itself varies with the nature of the ionic species present.

Because the exact composition of a natural media is usually not known, it is best to report conductivity at a particular temperature, e.g. 20.2 mS/cm at 14 C. However, in many cases, it is also useful to compensate for the temperature dependence in order to determine at a glance if gross changes are occurring in the ionic content of the medium over time. For this reason, the Model 85 software also allows the user to output conductivity data in either raw or temperature compensated form. If "Conductivity" is selected, values of conductivity that are **NOT** compensated for temperature are output to the display. If "Specific Conductance" is selected, the Model 85 uses the temperature and raw conductivity values associated with each determination to generate a specific conductance value compensated to a user selected reference temperature (see Section 3.3, Advanced Setup) between 15 C and 25 C. Additionally the user can select any temperature coefficient from 0% to 4% (see Section 3.3, Advanced Setup).
Using the Model 85 default reference temperature and temperature coefficient (25 C and 1.91%), the calculation is carried out as in equation (1) below:

$$\text{Specific Conductance (25 C)} = \frac{\text{Conductivity}}{1 + TC * (T - 25)}$$

As noted above, unless the solution being measured consists of pure KCl in water, this temperature compensated value will be somewhat inaccurate, but the equation with a value of TC = 0.0191 will provide a close approximation for solutions of many common salts such as NaCl and NH_4Cl and for seawater.

Salinity is determined automatically from the Model 85 conductivity readings according to algorithms found in *Standard Methods for the Examination of Water and Wastewater (ed. 1989).* The use of the "Practical Salinity Scale" results in values that are unitless, since the measurements are carried out in reference to the conductivity of standard seawater at 15 C. However, the unitless salinity values are very close to those determined by the previously-used method where the mass of dissolved salts in a given mass of water (parts per thousand) was reported. Hence, the designation "ppt" is reported by the instrument to provide a more conventional output.

For further information on conductivity and the above standard information, refer to the ASTM document, Standard Methods of Test for Electrical Conductivity of Water and Industrial Wastewater, ASTM Designation D1125-82, and OIML Recommendation Number 56. ASTM symbols for conductivity, cell constant, and path lengths differ from those preferred in the general literature and also from those used in this manual.

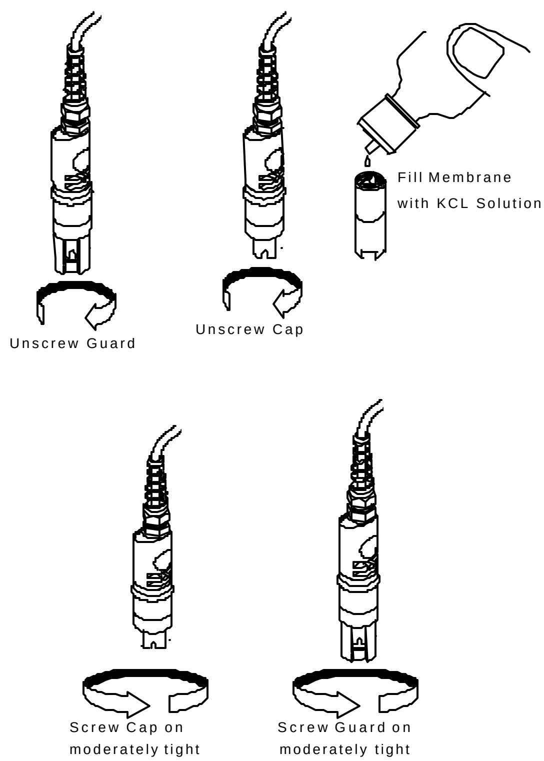
SECTION 3 SYSTEM SETUP AND OPERATION

3.1 PREPARING THE DO PROBE

DISSOLVED OXYGEN PROBE PREPARATION

Follow the instructions below to install fresh KCl solution and a new membrane cap.

1. Unscrew the probe sensor guard.
2. Remove the old membrane cap.
3. Thoroughly rinse the sensor tip with distilled water.
4. Inspect the gold electrode and silver electrodes. If resurfacing is required, refer to Section 4.2, Probe Maintenance.
5. Prepare the electrolyte according to the directions on the KCl solution bottle.
6. Hold the membrane cap and fill it at least 1/2 full with the electrolyte solution.
7. Screw the membrane cap onto the probe moderately tight. A small amount of electrolyte should overflow.

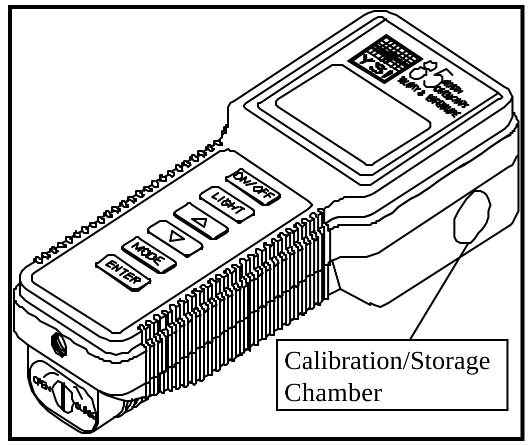


3.2 SYSTEM CALIBRATION

CALIBRATION OF DISSOLVED OXYGEN

To accurately calibrate the YSI Model 85 you will need to know the approximate altitude of the region in which you plan to take your dissolved oxygen measurements.

1. Ensure that the sponge inside the instrument's calibration chamber is wet. Insert the probe into the calibration chamber.



2. Turn the instrument on by pressing the **ON/OFF** button on the front of the instrument. Press the **MODE** button until the dissolved oxygen is displayed in mg/L or %. Wait for the dissolved oxygen and temperature readings to stabilize (usually 15 minutes is required).

3. Use two fingers to press and release the **UP ARROW** and **DOWN ARROW** buttons at the same time once.

4. The LCD will prompt you to enter the local altitude in hundreds of feet. Use the arrow keys to increase or decrease the altitude. When the proper altitude appears on the LCD, press the **ENTER** button once.

EXAMPLE: Entering the number 12 here indicates 1200 feet.

5. The Model 85 should now display **CAL** in the lower left of the display, the calibration should be displayed in the lower right of the display and the actual % should be on the main display. Press the **ENTER** button and the display should read **SAVE** then should return to the Normal Operation Mode.

Each time the Model 85 is turned off, it may be necessary to re-calibrate before taking measurements. All calibrations should be completed at a temperature which is as close as possible to the sample temperature. Dissolved oxygen readings are only as good as the calibration.

CALIBRATION OF CONDUCTIVITY

IMPORTANT: System calibration is rarely required because the YSI Model 85 conductivity cell is typically very stable. However, after service, it is wise to check the system calibration and make adjustments when necessary.

Prior to calibration, it is important to remember the following:

- Always use clean, properly stored, NIST traceable calibration solutions (see *Accessories and Replacement Parts*) and a clean calibration container.
- Rinse the probe with distilled water (and wipe dry) between changes of calibration solutions.
- When placed in solution, allow the probe time to stabilize with regard to temperature (approximately 60 seconds) and gently agitate the probe to remove any air bubbles.
- To minimize error, perform sensor calibration at a temperature as close to 25^{o}C as possible.

To perform an accurate calibration of the YSI Model 85:

1. Clean the probe thoroughly (see *Probe Maintenance*)
2. Place at least 3-4 inches of solution in a clean glass beaker. Select a calibration solution which is most similar to the sample being measured
    - For sea water choose a 50mS/cm conductivity standard (YSI Item #3169)
    - For fresh water choose a 1mS/cm conductivity standard (YSI Item #3167)
    - For brackish water choose a 10mS/cm conductivity standard (YSI Catalog # 3168)
3. Turn the instrument on. Use the **MODE** button to advance the instrument to display conductivity
4. Insert the probe into the beaker deep enough to cover the entire probe. Do not rest the probe on the bottom of the container -- suspend it above the bottom at least 1/4 inch.
5. Allow at least 60 seconds for the temperature reading to become stable
6. Move the probe vigorously from side to side to dislodge any air bubbles from the electrodes
7. Press and release the **UP ARROW** and **DOWN ARROW** buttons at the same time. The CAL symbol will appear at the bottom left of the display to indicate that the instrument is now in Calibration mode.
8. Use the up or down arrow key to adjust the reading on the display until it matches the value of the calibration solution you are using. Once the display reads the exact value of the calibration solution being used (the instrument will make the appropriate compensation for temperature variation from 25° C) press the **ENTER** button once. The word "**SAVE"** will flash across the display for a second indicating that the calibration has been accepted.

Note: The YSI Model 85 is designed to retain its last conductivity calibration permanently. Therefore, there is no need to calibrate the instrument after battery changes or power down.

3.3 ADVANCED CONDUCTIVITY SETUP

The default reference temperature and temperature coefficient setting of the Model 85 are appropriate for the vast majority of measurement applications. However, it is important that the service technician understand that the user may have modified these settings and will affect temperature compensated measurements.

IMPORTANT: There is never a need to enter Advanced Setup Mode unless there is a need for a change in the reference temperature and or the temperature coefficient. Therefore, unless you are certain that an application requires a change to one or both of these criteria, do not modify the default reference temperature (25°C) or the default temperature coefficient (1.91%).

CHANGING THE TEMPERATURE COEFFICIENT

1. Turn the instrument on, and wait for it to complete its self test procedure
2. Use the **MODE** button to advance the instrument to display conductivity.
3. Press and release the **DOWN ARROW** and the **MODE** buttons at the same time. The CAL symbol will appear at the bottom left of the display
4. The large portion of the display will show 1.91 % (or a value set previously using Advanced Setup)
5. Use the **Up** or **Down** arrow keys to change the value to the desired new temperature coefficient
6. Press the **ENTER** button. The word "SAVE" will flash across the display for a second to indicate that your change has been accepted
7. Press the **MODE** button to return to normal operation; the CAL symbol will disappear from the display.

CHANGING THE REFERENCE TEMPERATURE

1. Turn the instrument on, and wait for it to complete its self test procedure
2. Use the **MODE** button to advance the instrument to display conductivity.
3. Press and release the **DOWN ARROW** and the **MODE** button at the same time.
4. The CAL symbol will appear at the bottom left of the display
5. The large portion of the display will show 1.91 % (or a value set previously using Advanced Setup)
6. Press and release the **MODE** button; the large portion of the display will show **25.0C** (or a value set previously using the Advanced Setup)
7. Use the **UP** or **Down** arrow keys to change the value to the desired new reference temperature (any value between 15°C and 25°C is acceptable)
8. Press the **ENTER** button. The word "SAVE" will flash across the display for a second to indicate that your change has been accepted
9. The instrument will automatically return to normal operation mode.

CHANGING FROM AUTORANGING TO MANUAL RANGING

If your application is easier to perform using a manual range that you select, the YSI Model 85 allows you to turn off the default autoranging feature. While you are making conductivity or temperature compensated conductivity measurements simply press and release the **UP ARROW** button. Each additional press of the **UP ARROW** button will cycle the Model 85 to a different manual range until you return again to autoranging. Five pushes of the **UP ARROW** button will cycle the Model 85 through the four manual ranges and return the instrument to autoranging.

NOTE: You may see an error message in some manual ranges if the manual range selected is not adequate for the sample you are measuring. If this happens, simply press and release the **UP ARROW** button again until a range is selected which is suitable for your sample. If you get lost and don't know if you're in a manual range or autoranging, simply turn the instrument off and back on. Also note that the conductivity units will flash while you are in manual range. The instrument will always default to autoranging when first turned on.

The four ranges of the YSI Model 85 are:

Range 1	Range 2	Range 3	Range 4
0 to 499.9 µS/cm	0 to 4999 µS/cm	0 to 49.99 mS/cm	0 to 200.0 mS/cm

3.4 MAKING MEASUREMENTS

TURNING THE INSTRUMENT ON

Once the batteries are installed correctly, turn the instrument face up and press the **ON/OFF** button. The instrument will activate all segments of the display for a few seconds, which will be followed by a self-test procedure that will last for several more seconds. During this power on self-test sequence, the instrument's microprocessor is verifying that the instrument is working properly. The Model 85 will display the cell constant of the conductivity probe when the self-test is complete. If the instrument were to detect an internal problem, the display would show a continuous error message on the display. You can discover the meaning of these error messages by referring to Section 4.5, Troubleshooting.

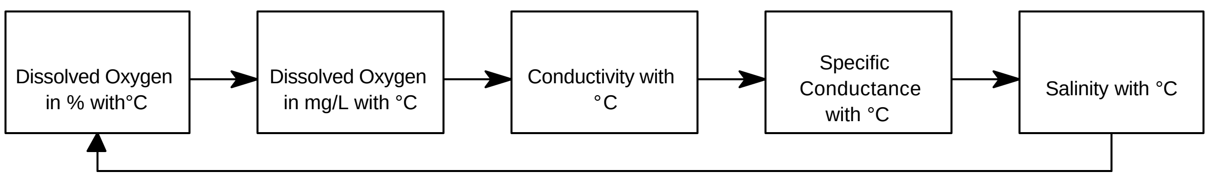
THE MEASUREMENT MODES OF THE MODEL 85

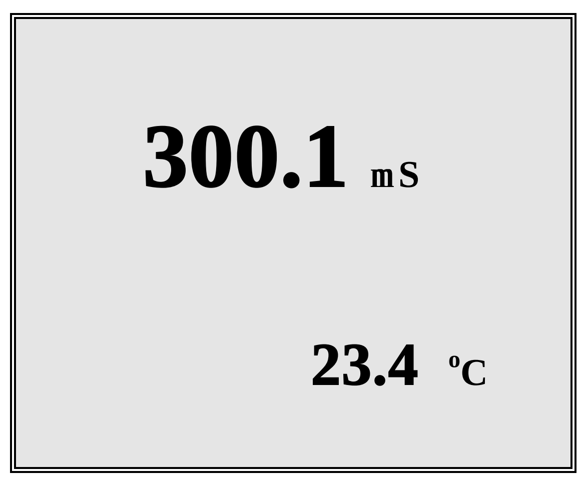
The Model 85 is designed to provide six distinct measurements:

- **Dissolved Oxygen %** -- A measurement of oxygen in percent of saturation.
- **Dissolved Oxygen mg/L** -- A measurement of oxygen in mg/L
- **Conductivity** -- A measurement of the conductive material in the liquid sample without regard to temperature
- **Specific Conductance** -- Also known as temperature compensated conductivity which automatically adjusts the reading to a calculated value which would have been read if the sample had been at 25° C (or some other reference temperature which you choose). See *Advanced Setup*.
- **Temperature** -- which is always displayed.
- **Salinity** -- A calculation done by the instrument electronics, based upon the conductivity and temperature readings.

NOTE: When you turn the Model 85 off, it will "remember" which mode you used last and will return to that mode the next time the instrument is turned on.

To choose one of the measurement modes above (temperature is always displayed) simply press and release the **MODE** button. Carefully observe the small legends at the far right side of the LCD.





If the instrument is reading **Specific Conductance** the large numbers on the display will be followed by either a **μS** or an **mS.** Additionally the small portion of the display will show the **° C** flashing on and off.

If the instrument is reading **Conductivity** (not temperature compensated) the large numbers on the display will be followed by either a **μS** or an **mS.** Additionally the small portion of the display will show the **° C** **NOT** flashing.

If the instrument is reading **Dissolved Oxygen** the large numbers on either a mg/L or % will follow the display. It is important to remember that the dissolved oxygen probe is stirring dependent. This is due to the consumption of oxygen at the sensor tip during measurement. When taking dissolved oxygen measurements the probe must be moved through the sample at a rate of 1 foot per second to provide adequate stirring.

If the instrument is reading **Salinity** the large numbers on the display will be followed by a **ppt.**

AUTORANGING & RANGE SEARCHING

The YSI Model 85 is an autoranging instrument. This means that regardless of the conductivity or salinity of the solution (within the specifications of the instrument) all you need to do to get the most accurate reading is to put the probe in the sample.

When you first place the Model 85 probe into a sample or calibration solution, and again when you first remove the probe the instrument will go into a range search mode that may take as long as 5 seconds. During some range searches the instrument display will flash **rANG** to indicate its movement from one range to another. The length of the range search depends on the number of ranges that must be searched in order to find the correct range for the sample. During the range search, the instrument will appear to freeze on a given reading for a few seconds then, once the range is located, will pinpoint the exact reading on the display. The display may also switch to **00.0** for a second or two during a range search before it selects the proper range.

THE BACKLIGHT

At times it may be necessary to take measurements with the Model 85 in dark or poorly lit areas. To help in this situation, the Model 85 comes equipped with a backlight that will illuminate the display so that it can be easily read. To activate the backlight, press and hold the **LIGHT** button. The display will remain lit as long as the button is depressed. When you let it up, the light goes out to preserve battery life.

3.5 SAVING & RECALLING DATA

The Model 85 is equipped with a non-volatile memory that is capable of storing up to 50 different sets of readings. Non-volatile memory will retain data even if power is lost. The Model 85 will also assign a site identity number to each set of readings to allow easy review of the data.

SAVING DATA TO MEMORY

1. While any parameter is displayed on the screen depress the **ENTER** button and hold for approximately 2 seconds. The meter will flash **SAVE** on the display along with the current site identity being used.

2. When all 50 sites are full the display will flash **FULL** on the screen. This message will remain on the screen (even after power down) until a button is pushed.

Once you have acknowledged the memory is full, any subsequent saved data will begin overwriting existing data starting with site #1.

RECALLING STORED DATA

1. To put the Model 85 into the **RECALL** mode depress the **MODE** button repeatedly until **rcl** is displayed on the screen along with the site ID number in the lower right corner (See figure 1).

2. Depress the **ENTER** button to review the last set of data that was saved. The Model 85 will display the dissolved oxygen in % saturation and temperature. Another press of the **ENTER** button will display the dissolved oxygen in mg/L and the temperature.

Depress the **ENTER** button again and again to review the conductivity, specific conductivity and salinity readings. All of which are displayed with the temperature.

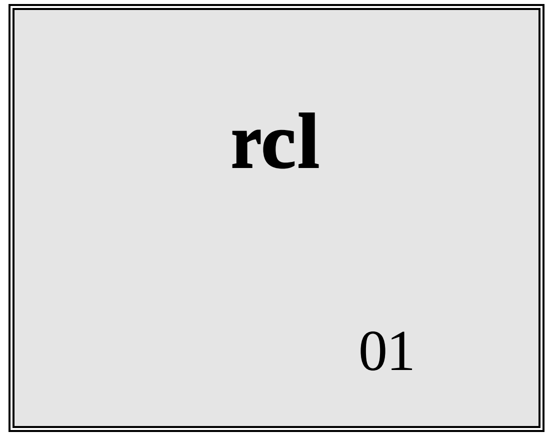


Figure 1

3. Depress the **UP ARROW** button to increment through the saved sets of data.

4. Depress the **DOWN ARROW** button to decrement through the saved sets of data.

NOTE: The Model 85 will recall data as a list. When the **UP ARROW** is depressed the Model 85 will display the Site ID# for the previously recorded date. For example: If you are reviewing Site ID# 5 and the **UP ARROW** is depressed the Model 85 will display Site ID# 4. If you are reviewing Site ID# 5 and Site ID# 5 was the last set of data stored the **DOWN ARROW** button will display Site ID# 1.

Here is an example of the Model 85 memory.
Site ID #1
Site ID #2
Site ID #3 ← If the **UP ARROW** button was pressed the Model 85 would display Site ID #2
Site ID #4
Site ID #5

ERASING STORED DATA

1. To erase the data that is stored into the Model 85's memory, depress the **MODE** button repeatedly until the Model 85 displays **ErAS** on the screen (See figure 2).

2. Depress and hold the **DOWN ARROW** and **ENTER** buttons simultaneously for approximately 5 seconds.

3. The Model 85 flashing DONE on the display for 1 to 2 seconds indicates successful erasure. The instrument will automatically change to normal operation after completion.

IMPORTANT: Data in all 50 site ID's will be erased completely and will be lost forever. Do not use the erase function until all recorded data has been transcribed to an archive outside the Model 85.

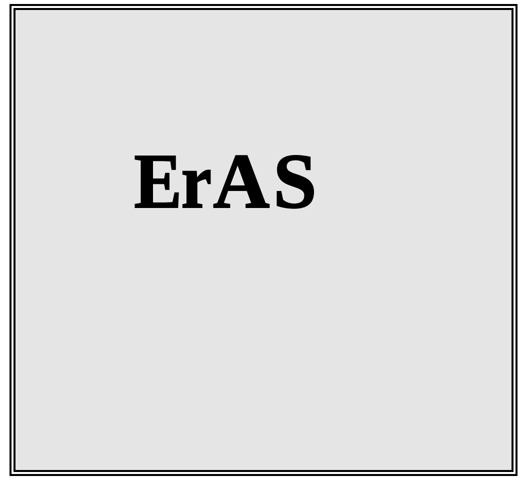


Figure 2

SECTION 4 TROUBLESHOOTING AND MAINTENANCE

4.1 DISCUSSION OF MEASUREMENT ERRORS

DISSOLVED OXYGEN MEASUREMENT ERRORS

There are three basic types of error. Type 1 errors are related to limitations of instrument design and tolerances of instrument components. These are chiefly the meter linearity and the resistor tolerances. Type 2 errors are due to basic probe accuracy tolerances, chiefly background signal, probe linearity, and variations in membrane temperature coefficient. Type 3 errors are related to the operator's ability to determine the conditions at the time of calibration. If calibration is performed against more accurately known conditions, type 3 errors are appropriately reduced.

The sample calculations that follow are for a near extreme set of conditions.

TYPE 1 ERRORS

A. Meter linearity error: ±1% of full scale reading, or ±0.15 mg/l

B. Component and circuitry error: ±0.05 mg/l

TYPE 2 ERRORS

A. Temperature compensation for membrane temperature coefficient: ±0.03 mg/l

B. Temperature measurement errors: A maximum ±0.2^{o}C probe error is equal to ±0.14 mg/l

TYPE 3 ERRORS

A. Altitude:

A 1000-foot change in altitude is equal to an error of approximately 3% at the 10 mg/l level.

B. Humidity:

Errors occur if calibration is performed at less than 100% humidity. The error varies with the temperature as follows:

TEMPERATURE	ERROR
0^{o}C	0.02 mg/l
10^{o}C	0.05 mg/l
20^{o}C	0.12 mg/l
30^{o}C	0.27 mg/l
40^{o}C	0.68 mg/l

APPROXIMATING THE ERROR

It is unlikely that the actual error in any measurement will be the maximum possible error. A better error approximation is obtained using a root mean squared (r.m.s.) calculation:

$$\text{r.m.s. Error} = \pm[1a^2 + 1b^2 + 2a^2 + 2b^2 + 3a^2 + 3b^2]^{1/2} \text{ mg/l}$$

CONDUCTIVITY MEASUREMENT ERRORS

System accuracy for conductivity measurements is equal to the sum of the errors contributed by the environment and the various components of the measurement setup. These include:

- Instrument accuracy
- Cell-constant error
- Solution temperature offset
- Cell contamination (including air bubbles)
- Electrical noise
- Galvanic effects

Only the first three are of major concern for typical measurements, although the user should also be careful to see that cells are clean and maintained in good condition at all times.

Instrument Accuracy = ± .5% maximum
The accuracy specified for the range being used is the worst case instrument error.

Cell-Constant Error = ± .5% maximum
Although YSI cells are warranted to be accurate to within one percent, you should still determine the exact cell constant of your particular cell. Contamination or physical damage to the cell can alter the cell constant. Performing a calibration will eliminate any error that might arise because of cell constant change.

YSI cells are calibrated to within one percent of the stated cell constant at a single point. We consider these products to be usefully linear over most instrument ranges. The cell constant can be calibrated to ±0.35% accuracy with YSI conductivity calibrator solutions.

Temperature Error = ± 1% maximum
The solution temperature error is the product of the temperature coefficient and the temperature offset from 25 C, expressed as a percentage of the reading that would have been obtained at 25 C. The error is not necessarily a linear function of temperature. The statement of error is derived from a 25 C temperature offset and a 3%/ C temperature coefficient.

Total Error

Considering only the above three factors, system accuracy under worst case conditions will be ±2%, although the actual error will be considerably less if recommended and properly calibrated cells and instrument ranges are used. Additional errors, which can essentially be eliminated with proper handling, are described below.

Cell Contamination

This error is usually due to contamination of the solution being measured, which occurs when solution is carried-over from the last solution measured. Thus, the instrument might be correctly reporting the conductivity seen, but the reading does not accurately represent the value of the bulk solution. Errors will be most serious when low conductivity solutions are contaminated by carry-over from high conductivity solutions, and can then be of an order of magnitude or more.

Follow the cleaning instructions carefully before attempting low conductivity measurements with a cell of unknown history or one that has been previously used in higher value solutions.

An entirely different form of contamination sometimes occurs due to a buildup of foreign material directly on cell electrodes. While rare, such deposits have, on occasion, markedly reduced the effectiveness of the electrodes. The result is an erroneously low conductance reading.

Electrical-Noise Errors

Electrical noise can be a problem in any measurement range, but will contribute the most error and be the most difficult to eliminate when operating in the lowest ranges. The noise may be either line-conducted or radiated or both, and may require, grounding, shielding, or both.

Galvanic and Miscellaneous Effects

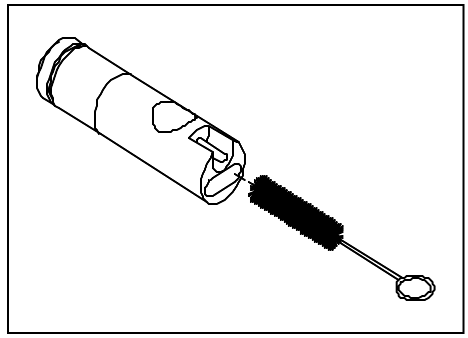
In addition to the error sources described above, there is another class of contributors that can be ignored for all but the most meticulous of laboratory measurements. These errors are always small and are generally completely masked by the error budget for cell-constant calibration, instrument accuracy, etc. Examples range from parasitic reactances associated with the solution container and its proximity to external objects to the minor galvanic effects resulting from oxide formation or deposition on electrodes. Only trial and error in the actual measurement environment can be suggested as an approach to reduce such errors. If the reading does not change as the setup is adjusted, errors due to such factors can be considered too small to see.

4.2 PROBE MAINTENANCE

CONDUCTIVITY CELL CLEANING AND STORAGE

The single most important requirement for accurate and reproducible results in conductivity measurement is a clean cell. A dirty cell will change the conductivity of a solution by contaminating it. When in use, the cell should be rinsed with clean water after each use.

To clean the conductivity cell:



1. Dip the cell in cleaning solution and agitate for two to three minutes. Any one of the foaming acid tile cleaners, such as Dow Chemical Bathroom Cleaner, will clean the cell adequately. When a stronger cleaning preparation is required, use a solution of 1:1 isopropyl alcohol and 10N HCl. Remove the cell from the cleaning solution.

2. Use the nylon brush (supplied) to dislodge any contaminants from inside the electrode chamber.

3. Repeat steps one and two until the cell is completely clean. Rinse the cell thoroughly in deionized, or clean tap water.

4. Store the conductivity cell in the meter storage chamber.

OXYGEN PROBE MAINTENANCE AND STORAGE

Membrane life depends on usage. Membranes will last a long time if installed properly and treated with care. Erratic readings can be a result of loose, wrinkled, damaged, or fouled membranes, or from large (more than 1/8" diameter) bubbles in the electrolyte reservoir. If erratic readings or evidence of membrane damage occurs, you should replace the membrane and the KCl solution. The average replacement interval is two to four weeks.

Precautions

If the membrane is coated with oxygen consuming (e.g. bacteria) or oxygen evolving organisms (e.g. algae), erroneous readings may occur.

Chlorine, sulfur dioxide, nitric oxide, and nitrous oxide can affect readings by behaving like oxygen at the probe. If you suspect erroneous readings, it may be necessary to determine if these gases are the cause.

Avoid any environment that contains substances that may attack the probe materials. Some of these substances are concentrated acids, caustics, and strong solvents. The probe materials that come in contact with the sample include FEP Teflon, stainless steel, epoxy, polyetherimide and the polyurethane cable covering.

Maintenance

Probes that have been exposed to hydrogen sulfide or sulfur dioxide for extended periods may cease operating in a normal mode. Output current will decrease and may become unstable. Visual symptoms include blackening of the silver anode and/or discoloration of the gold cathode.

Electrode Cleaning

Model 85 dissolved oxygen probes should be cleaned only when erratic readings occur or after about every 500 hours of use (two months). Each cleaning removes material and reduces the life of the probe, so excessive cleaning should be avoided.

Gold Cathode

For correct probe operation, the gold cathode must be textured properly. It can become tarnished or plated with silver after extended use. Using the adhesive backed sanding disc provided in the 5906 Membrane Kit can clean the gold cathode. Stick the disc to a small flat object, like a bottle cap, then sand the gold with a twisting motion about 3 times or until all silver deposits are removed and the gold appears to have a matte finish. If the cathode remains tarnished, return the probe for service.

Silver Anode

It is normal for a dark layer of silver chloride to cover the silver anode. After prolonged use it may become necessary to clean the anode. Soak the probe in a 14% ammonium hydroxide solution for 2 to 3 minutes or overnight in a 3% ammonium hydroxide solution. Rinse with deionized water, recharge with electrolyte, and install a new membrane.

4.3 SYSTEM FUNCTIONALITY TEST

OXYGEN

Functionality of the Model 85's oxygen system can easily be tested using the following procedure.

1. If necessary, service the probe's electrodes. Follow the instructions in the *Maintenance Section*.
2. Install a fresh membrane and KCl solution.
3. Place the probe in its calibration chamber.
4. Turn the system on and allow it to stabilize for 30 minutes.
5. Calibrate the system as described in the *Calibration Section* of this manual.
6. With the probe in the calibration chamber, check the displayed reading for stability. Erratic or drifting readings indicates a possible problem. See the ***Troubleshooting Section*** for help.
7. Place the probe in a zero oxygen environment. The display should decrease rapidly and reach 0 ±2.0% in 5 minutes or less.

Note: A zero oxygen environment can be obtain by taking a reading in pure nitrogen gas, in a sodium sulfite solution, or in a BOD bottle filled with 350 ml of distilled water in which 3 to 7 grams of active dry yeast has been dissolved and allowed to consume the oxygen (about 5 minutes).

CONDUCTIVITY

Functionality of the Model's 85 conductivity system can be tested using the following procedure:

1. If necessary, service the probe's electrodes. See Section 4, Troubleshooting and Maintenance.
2. Verify that the Temperature Coefficient and Reference Temperature are properly set.
3. Use clean, properly stored, NIST traceable, calibration solutions to very the accuracy of the system. See Section 3.2, System Calibration for procedures.

TEMPERATURE

Compare the 85's measured temperature value to that of a known traceable temperature standard.

4.4 TEST PROCEDURES

As stated in the Section 1.1, Service Philosophy of this manual, the best way to troubleshoot the Model 85 is by substitution. Below are procedures to test the accuracy and function of the instrument's circuits and probe. If any section of the tests fail the board assembly or probe will have to be repaired or replaced. When disassembled, connecting a jumper wire to the DGNG pin of JP3 and momentarily touching the desired pin or pins can simulate the instrument's keypad functions.

CONDUCTIVITY AND TEMPERATURE CIRCUIT TEST

1. Disassemble the instrument case by referring to Section 5.1, Disassembly Procedures section of this manual.
2. Once the 85 probe is unplugged from PCB connector JP1, connect a decade resistance box in its place. Reference Figure 1 and Figure 2.
3. Use either a second decade resistance box or a 10K-ohm resistor to substitute for the thermistor, RT1 and RT2. This resistance must be substituted or an error we displayed on the LCD.
4. Using Section 3.2, System Calibration procedure **(start at step 7),** calibrate to **450.0 mS** using inputs of 11.11 KΩ at R1 and 10.00 KΩ at R2.

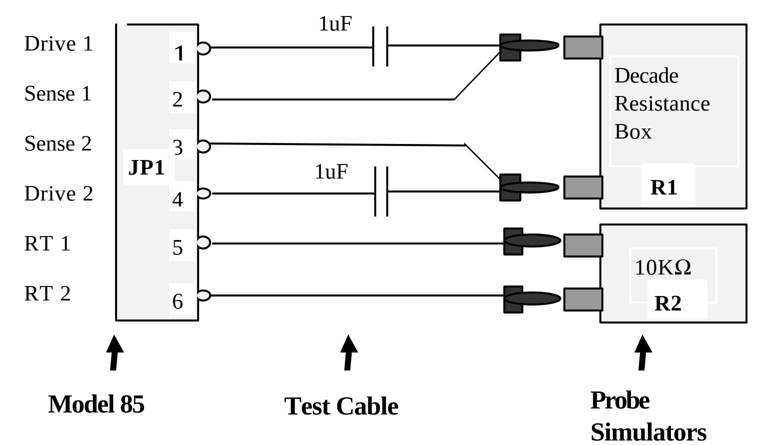


Figure 1

5. Use the charts below to test the instrument's accuracy. Also, check the cell constant by cycling the instrument on an off. It should fall between K = 4.90 and 5.10. In chart 1, the tolerance column reflects the accuracy of the decade resistance box.

Conductivity Test (Chart 1)

R1 Resistance	R2 Resistance	Decade Tolerance	Nominal Reading	Acceptable Reading
33.330 Ω	10.00 KΩ ±.1%	0.5%	150.0 mS	147.2 to 152.8 mS
111.10 Ω	10.00 KΩ ±.1%	0.2%	45.00 mS	44.37 to 45.65 mS
1111.0 Ω	10.00 KΩ ±.1%	0.1%	4.500 mS	4442 to 4560 µS
11.11 KΩ	10.00 KΩ ±.1%	0.1%	450.0 µS	450.0 µS

Note: After the above procedure is used it will be necessary to recalibrate the system. See *System Calibration*.

Temperature Test (Chart 2)

R2 Resistance	Nominal Reading	Acceptable Reading
32.66 KΩ ± .1%	0.0 °C	0.0 ± .1 °C
19.90 KΩ ± .1%	10.0 °C	10.0 ± .1 °C
10.00 KΩ ± .1%	25.0 °C	25.0 ± .1 °C
5329 Ω ± .1%	40.0 °C	40.0 ± .1 °C
1752 Ω ± .1%	70.0 °C	70.0 ± .1 °C

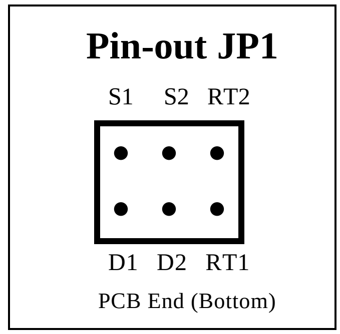


Figure 2

DISSOLVED OXYGEN CIRCUIT TEST

Perform this test using a YSI 16423 Oxygen Test Box or by inputting the resistance values in column 2. To begin the test, input the resistance value in Row #1, or set the test box to A-2, and calibrate the 100.0 %. If using the resistances from column 2, maintain the temperature at 10.0 °C (from Chart 2, above).

Input to connector J6, Pins 1 &2			
Set 16423 Test Box to:	**Resistor input:**	**Display Reading (% Mode)**	**Display Reading (Mg/L Mode)**
A-2	88.2k Ω ±0.1%	100.0 ±0.1%	11.28 ±0.02 Mg/L
B-2	111.42k Ω ±0.1%	79.1 ±0.2%	8.92 ±0.02 Mg/L
C-2	250.0k Ω ±0.1%	35.3 ±0.2%	3.97 ±0.02 Mg/L
D-2	Infinity	0.0 +1.0%	0.00 ±0.1 Mg/L

PROBE LEAKAGE TEST

Electrical leakage between the probe's electrodes can cause system failures. Remove the probe's oxygen membrane and rinse the electrodes with distilled water. In addition, it may be necessary to clean the conductivity electrodes as described in Section 4, Troubleshooting and Maintenance *of* this manual. Then, thoroughly dry the sensor end, inside and outside, and with compressed air or a soft towel before testing. **Caution: The probe must be clean and dry to perform this test. External contamination of the probe may give a false defective indication.**

Model 85 Probe Wiring Chart	
Probe Wire Color	Electrode or Thermistor
Green	S1 Sense
Red	D1 Drive
White	D2 Drive
Black	S2 Sense
Blue	Thermistor
Brown	Thermistor
Orange	Anode
Shielded White	Cathode
Shield (Drain)	No connection

Use the probe wiring chart to confirm that the resistance between all of the electrodes (**except when measuring between the two thermistor leads**) is greater than 200 megaohms. Continuity less than 200 megaohm indicates an internal electrical short which will require probe replacement.

4.5 TROUBLESHOOTING

SYMPTOM	POSSIBLE CAUSE	ACTION
1. Instrument will not turn on	A. Low battery voltage B. Batteries installed wrong C. Power supply circuit defect	A. Replace batteries B. Check battery polarity C. Troubleshoot circuit-Replace PC board
2. Instrument will not calibrate (Dissolved Oxygen)	A. Membrane is fouled or damaged B. Probe anode is fouled or dark C. Probe cathode is tarnished D. Circuit or probe failure	A. Replace membrane & KCl B. Clean anode C. Clean cathode D. Replace defective assembly
3. Instrument will not calibrate (Conductivity)	A. Cell is contaminated	A. See “Maintenance” Chapter
4. Instrument "locks up"	A. Instrument has rec'd a shock B. Batteries are low or damaged C. Defective main PC board	A & B. Remove battery lid, wait 15 seconds for reset, replace lid C. Replace main PC board
5. Instrument readings are inaccurate (Dissolved Oxygen)	A. Cal altitude is incorrect B. Probe not in 100% O_2 saturated air during Cal procedure C. Membrane fouled or damaged D. Probe anode is fouled or dark E. Probe cathode is tarnished F. System requires service	A. Recalibrate w/correct value B. Moisten sponge & place in Cal chamber w/ probe & Recal C. Replace membrane D. Clean anode E. Clean cathode F. Return system for service
6. Instrument readings are inaccurate (Conductivity)	A. Calibration is required B. Cell is contaminated C. Tempco is set incorrectly D. Reference temperature incorrect E. Readings are or are not temperature compensated	A. See “Calibration” Chapter B. See “Maintenance” Chapter C. See “Advanced Setup” Chapter D. See “Advanced Setup” Chapter E. See “Making Measurements” Chapter
7. LCD displays "LO BAT"	A. Batteries are defective or have been installed incorrectly. B. Defective main or display PCB	A. Replace batteries B. Replace PCB
8. Main Display reads “OVEr” (Secondary display reads “ovr”) (Secondary display readn “udr”)	A. Conductivity reading is >200 mS B. Temperature reading is >95°C C. Temperature reading is <-5°C D. Salinity reading is >80 ppt E. User cell constant cal K is >5.25 F. DO temperature is >46°C G. DO % saturation is >200% H. DO concentration is >20 mg/L	In all cases, check calibration values and procedures; check advanced setup settings. If each of these is set correctly, see the Test chapter to determine if problem is circuit or probe related.
9. Main display reads “Undr”	A. User cell constant cal K is <4.8	A. Recalibrate instrument using known good conductivity standard. B. Follow cell cleaning procedure in the Maintenance chapter.
10. Main display reads “rErr”	A. Reading exceeds user selected manual range.	A. Use the mode key to select a higher or lower manual range, or set system to autoranging.
11. Main display reads “PErr”	A. User cell constant cal K is 0.0 B. Incorrect sequence of keystrokes.	A. See “Advanced Setup” chapter. B. Refer to manual section for step by

SYMPTOM	POSSIBLE CAUSE	ACTION
		step instruction for the function you are attempting.
12. Main display reads “LErr”	A. In temperature compensated conductivity mode; temperature exceeds the values computed using user defined temperature coefficient and/or reference temperature. B. In cell constant cal mode, temperature exceeds the values computed using user defined temperature coefficient and/or reference temperature.	A. & B. Adjust user defined tempco or reference temperature.
13. Main display reads “Err” (Secondary display reads “ra”)	A. System has failed its RAM test check procedure.	A. Turn instrument OFF and back ON again. B. Replace main PCB
14. Main display reads “Err” (Secondary display reads “ro”)	A. System has failed its ROM test check procedure.	A.Turn instrument OFF and back ON again. B. Replace Main PCB
15. Secondary display reads “rEr”	A. Temperature jumper is set to °F and reading is >199.9°F but <203°F.	A. Troubleshoot temperature circuit. Defective main PCB or probe
16. Main display reads “FAIL” (Secondary display reads “eep”)	A. EEPROM has failed to respond in time.	A. Reset by removing batteries and retry. Replace main PCB.
17. Readings on main display don’t change	A. Meter is in recall mode.	A. Press **MODE** button to return to Normal Operation

SECTION 5 SERVICE

5.1 DISASSEMBLY PROCEDURES

Refer to the Assembly drawing on the next page before attempting to disassemble the meter case. Follow these steps to disassemble the meter case:

STEP 1 -- Place the instrument face down on a flat cloth-covered surface. Use a Phillips screwdriver to completely remove the screw located at the bottom of the hand strap.

STEP 2 -- Using a standard screwdriver or a small coin, loosen the battery lid screw and remove the battery lid and all six AA-size batteries.

STEP 3 -- With the instrument face down on the flat, cloth-covered surface, place two fingers into the battery chamber and your other hand over the cable strain-relief. Pull straight up on the battery chamber to separate the case halves. Unplug the power connector from the PC Board.

> **NOTE:** Because the Model 85 is water tight, the case halves will be relatively difficult to separate.

STEP 4 -- The main PC Board is held in place by a single Phillips screw located in the center of the board. Remove the screw, and gently pull the PC Board away from the front case.

> **NOTE:** The leads on the cable that connect to the main PC Board are quite short. Be careful not to damage the terminal connectors when you pull the PC Board away from the front case.

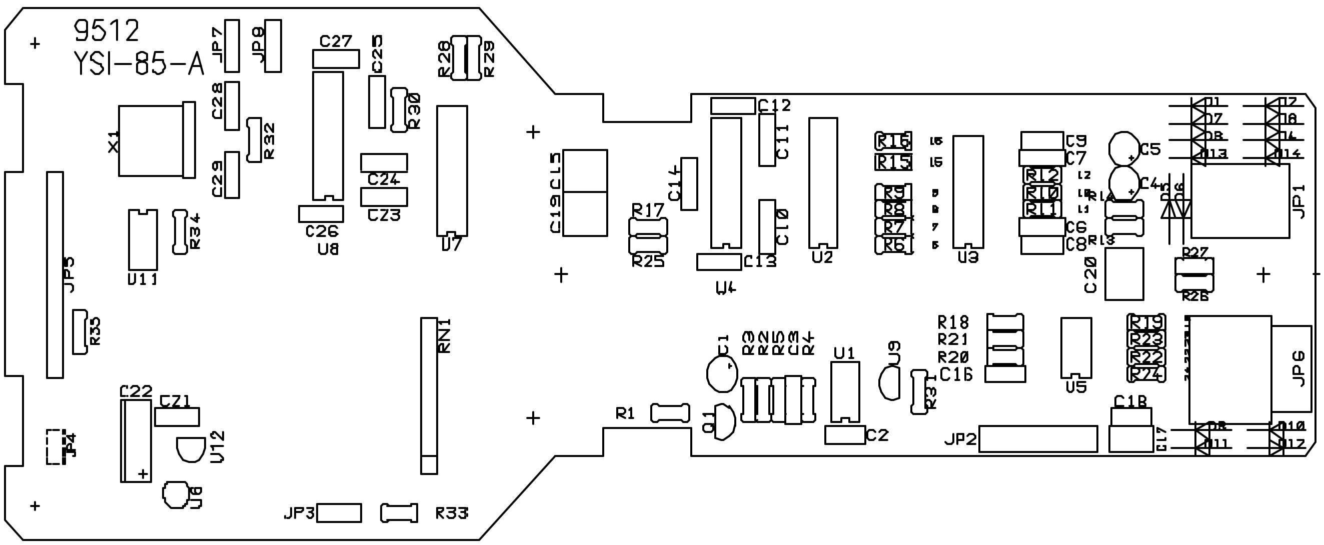
STEP 5 -- Carefully slide the probe cable terminal connector out of its mating connector. Make note of the wire color configuration so that the connectors can be correctly re-installed later.

STEP 6 -- To separate the probe cable from the front case, unscrew the outer portion of the strain relief (that portion which does not make contact with the front case). Slide the spiral portion of the strain relief down the cable toward the probe. Next, unscrew the remaining portion of the strain relief from the front case.

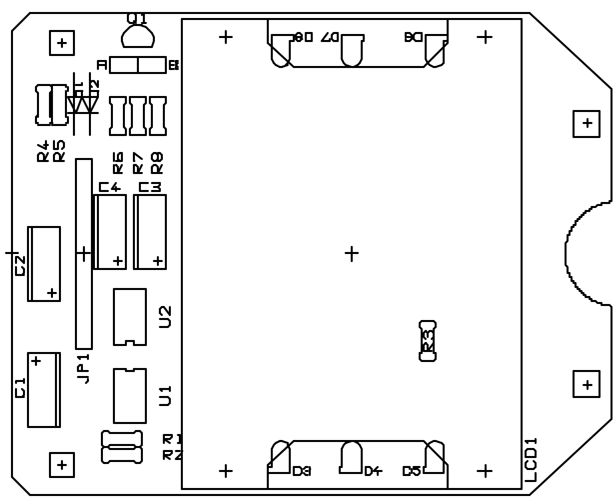
STEP 7 -- To separate the LCD from the main PC Board, squeeze the four plastic offset spacers and slide the LCD PC board away from the main board one corner at a time. Next, remove the four small Phillips screws from the back of the LCD and remove the LCD from its clear plastic frame.

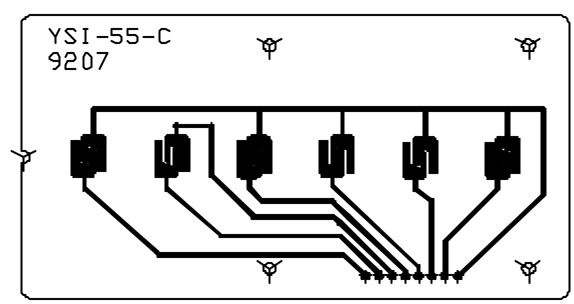
STEP 8 -- To remove the keypad from the front case, use a small Phillips screwdriver to remove the screws from the keypad's metal backplate; then lift the keypad away from the front case.

5.2 PCB ASSEMBLY DRAWINGS



(PCB-A) Main Board – (Non CE Units)





(PCB-B)Display Board

(PCB-C)Keypad Board

5.3 PCB COMPONENTS

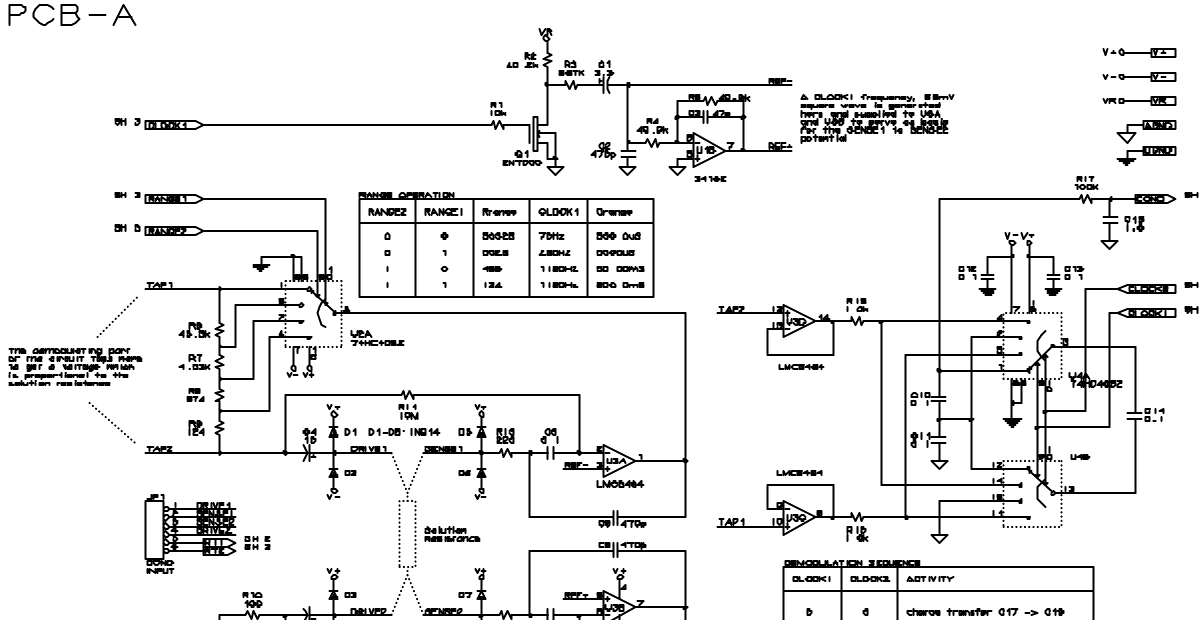
Circuit Symbol	Description	Qty
YSI-85-A	BOARD. MAIN BARE	1
JP1	CONN. 6 PIN. RT. ANGLE	1
JP2	CONN. 8 PIN. WAFER	1
JP3,JP7,JP8	CONN. 3 PIN. WAFER	3
JP4	CONN. 2 PIN. MALE. POL	1
JP5	CONN. 12 PIN. WAFER	1
JP6	CONN. 5 PIN. RT. ANGLE	1
R1,R21,R22	RES. 10K, 1%, 1/4W	3
R2,R31	RES. 40.2K, 1%, 1/4W	2
R3(25PPM)	RES. 887K, 1%, 1/4W	1
R4,R5(25PPM)	RES. 49.9K, 1%, 1/4W	2
R6	RES. 45.3K, 1%, 1/4W	1
R7	RES. 4.53K, 1%, 1/4W	1
R8	RES. 374, 1%, 1/4W	1
R9	RES. 124, 1%, 1/4W	1
R10	RES. 100,5%, 1/4W	1
R11,R12,R32	RES. 10M, 5%, 1/4W	3
R13,R14	RES. 220, 5%, 1/4W	2
R15,R16,R20,R24	RES. 1K, 5%, 1/4W	4
R17,R19,R25	RES. 100K, 1%, 1/4W	3
R18	RES. 54.9K, 1%, 1/4W	1
R23	RES. 15.8K, 1%, 1/4W	1
R26(15PPM)	RES. 6.81K, 0.1%, 1/4W	1
R27,R29,R34,R35	RES. 100K, 1%, 1/4W	4
R28	RES. 909K, 1%, 1/4W	1
R30	RES. 365K, 1%, 1/4W	1
R33	RES. 15K, 1%, 1/4W	1
RN1	RES. SIP. 100K	1
C1	CAPR. TANT. 3.3uF,25V	1
C2,C8,C9	CAPR. CER. 470pF	3
C3	CAPR. CER. 47pF	1
C4,C5	CAPR. TANT. 10uF, 16V	2
C6,C7,C10-C14,C21,C23-C27	CAPR. MPE. 0.1uF,63V	13
C15,C19,C20	CAPR. MPE. 1uF,63V	3
C16,C18	CAPR. CER. 100pF	2
C17	CAPR. MPE. 0.33uF, 63V	1
C22	CAPR. ELE. 2.2uF, 16V	1

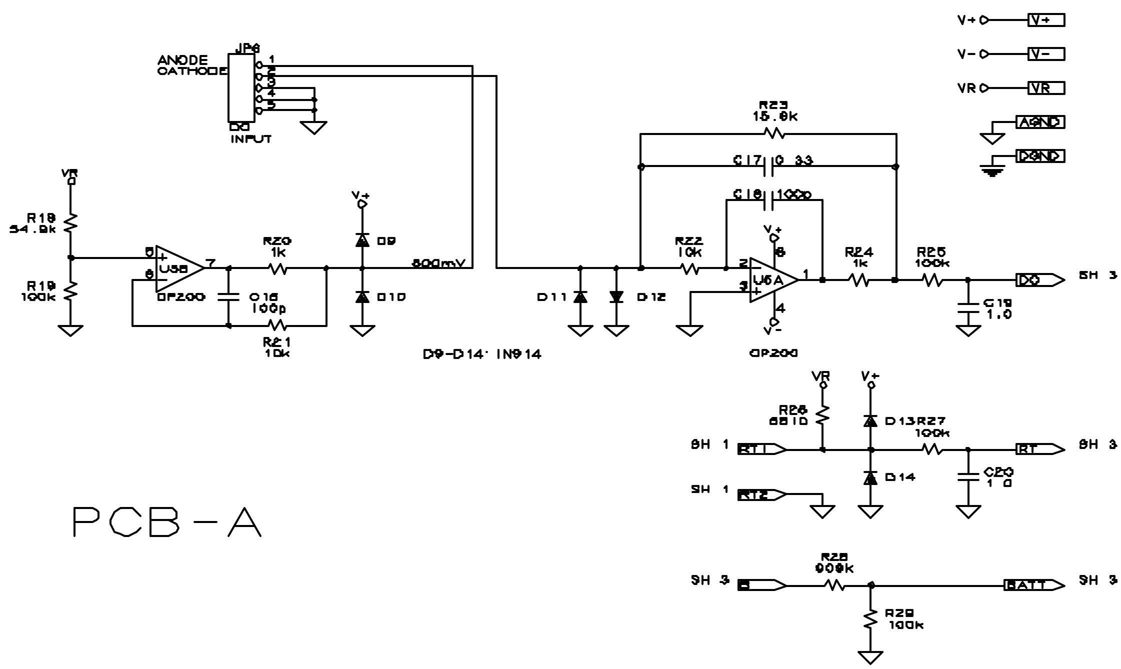
Circuit Symbol	Description	Qty
C28, C29	CAPR. CER. 20pF	2
D1-D14	DIODE. 1N4148	14
U1	I.C. MOTOR. MC34182P	1
U2, U4	I.C., M74HC4052B	2
U3	I.C. NATL. LMC6484IN	1
U5	I.C. PMI OP290GP	1
U6	I.C. ,TC55RP5002EZB	1
U7	I.C. . MC14052BCP	1
U8	I.C. TLDN. TC500CPE	1
U9	I.C. HARR. L8069	1
U10	I.C. MC68HC711E9CFN2	1
U11	I.C. ATMEL. AT24C16PC	1
U12 (if need)	I.C. SEIKO. 8054ALR	1
Q1	FET. 2N7000	1
X1	CRYSTAL 4.00 MHz	1
JP1	CONN. 12 PIN	1
LCD1	LCD DISPLAY	1
U1	I.C. HARRS 7663SCPA	1
U2	I.C. TLDN TC7662ACPA	1
U3	I.C. HD61603	1
D1,D2	DIODE IN4148	2
D3-D8	LED LAMP, HLMP-1540	6
C1	CAPR. ELE. 2.2uF, 16V	1
C2,C3,C4	CAPR. ELE. 10uF, 16V	3
R1	RES. 750K, 1%, 1/4W	1
R2	RES. 261K, 1%, 1/4W	1
R3	RES. 357K, 1%, 1/4W	1
R4	RES. 15K, 5%, 1/4W	1
R5	RES, 100K, 5%, 1/4W	1
R6	RES. 82, 5%, 1/4W	1
R7	RES. 15, 5%, 1/4W	1
R8	RES. 100, 5%, 1/4W	1
Q1	TRSTR. MPSA06, PNP	1
--------	MINI JUMPER. DS-001	2
--------	IC SOCKET. 52P OLCC	1

5.4 SCHEMATIC DIAGRAMS

Schematic diagrams are representative of actual circuits.

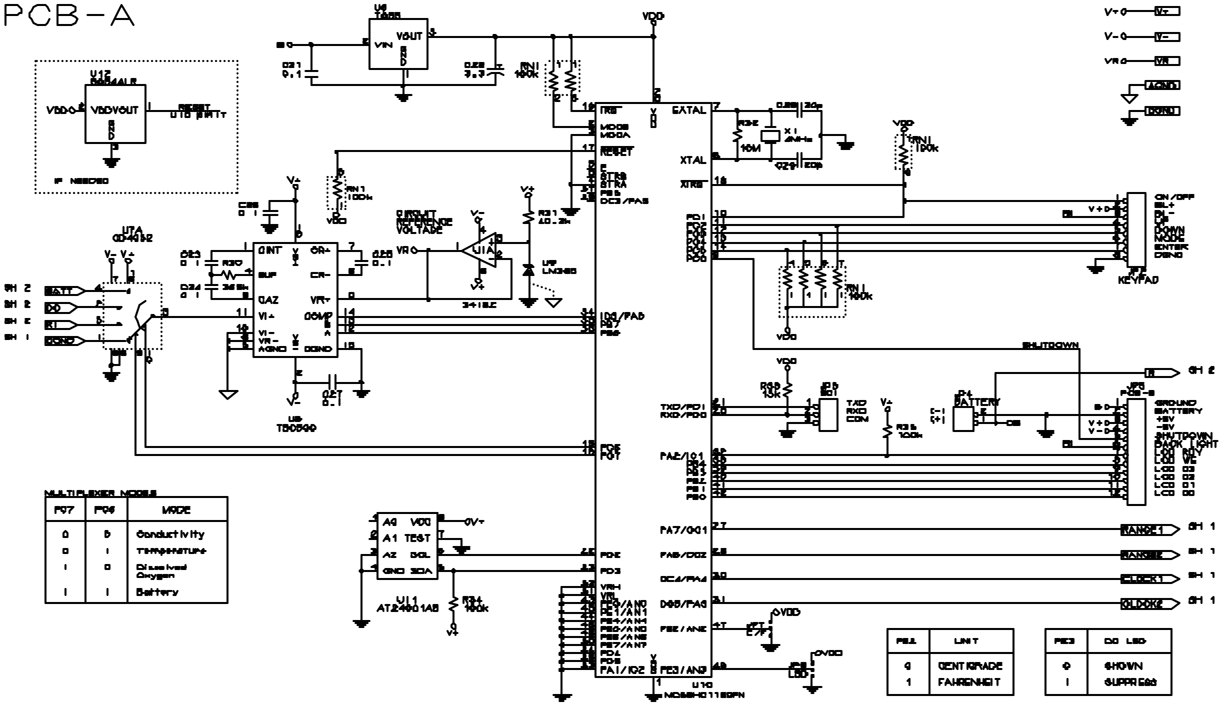
PCB-A



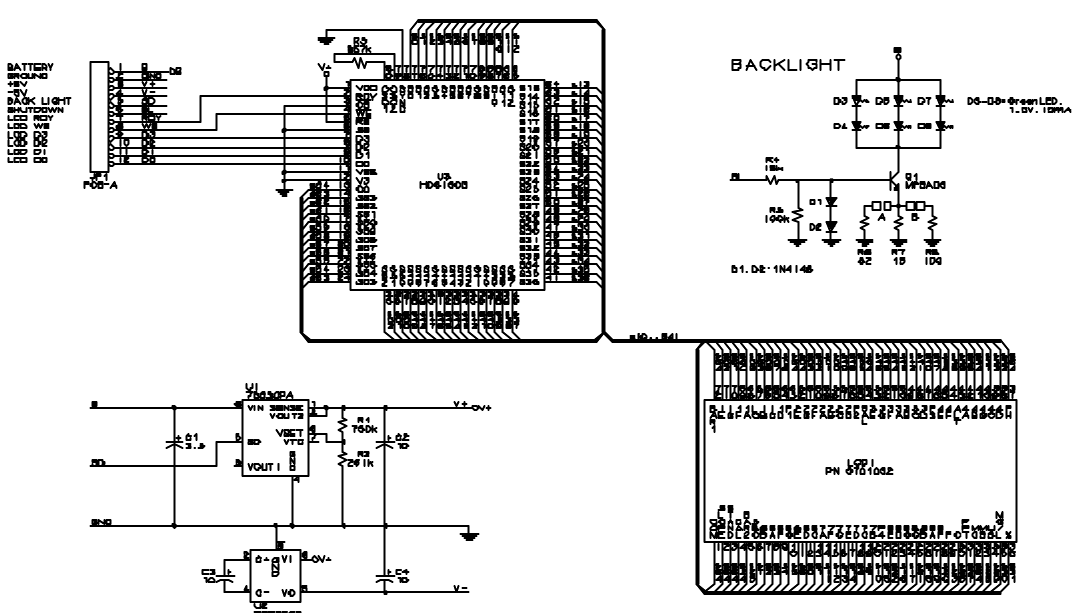


PCB-A

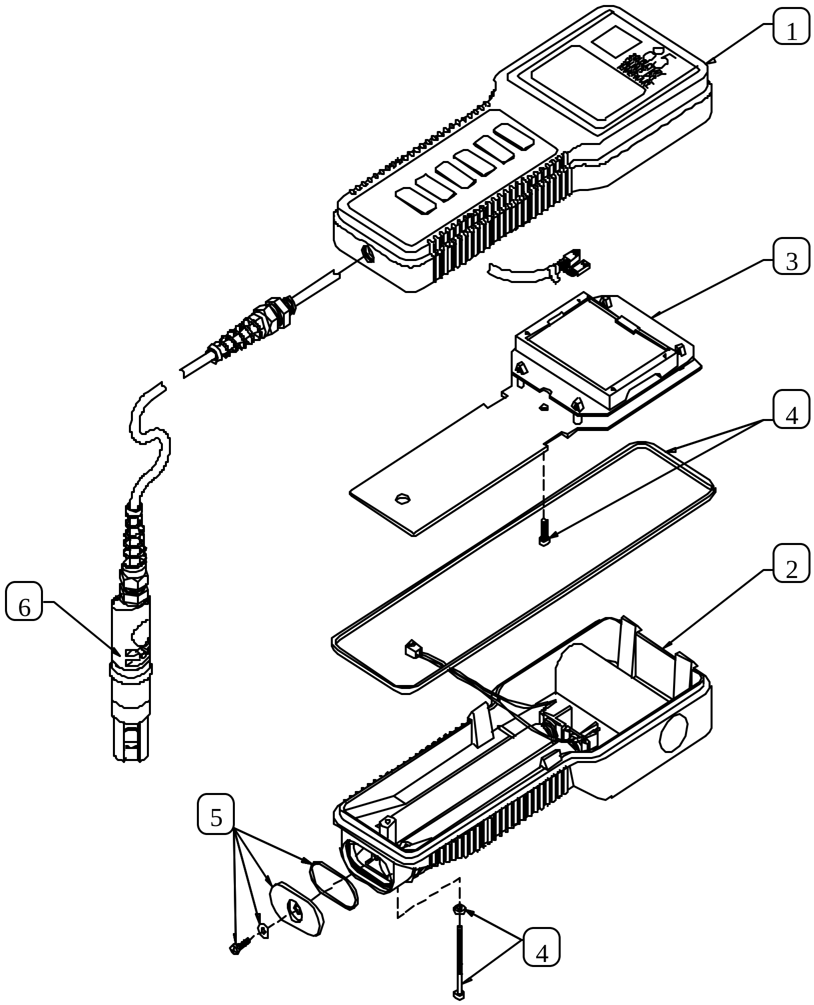
PCB-A



PCB-B



5.5 EXPLODED VIEW



Bubble Number	YSI Order Number	Description
1	038501	Front Case Assy, W/Keypad
2	055242	Rear Case Assy
3	038502	Board Assy, Main, Non CE
3	030156	Board Assy, Main, CE w/ Display
3	030898	Board Assy, Display, CE
4	055204	Kit, Case Hardware
5	055244	Kit, Battery Hardware
6	118510	Probe & Cable Assy, 10 feet
6	118522	Probe & Cable Assy, 25 feet
6	118527	Probe & Cable Assy, 50 feet
6	118519	Probe & Cable Assy, 100 feet

SECTION 6 WARRANTY AND REPAIR

YSI Model 85 Handheld Meters are warranted for two years from date of purchase by the end user against defects in materials and workmanship. YSI Model 85 probes and cables are warranted for one year from date of purchase by the end user against defects in material and workmanship. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, write or call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period or at least 90 days from date of repair or replacement.

Limitation of Warranty

This Warranty does not apply to any YSI product damage or failure caused by (i) failure to install, operate or use the product in accordance with YSI's written instructions, (ii) abuse or misuse of the product, (iii) failure to maintain the product in accordance with YSI's written instructions or standard industry procedure, (iv) any improper repairs to the product, (v) use by you of defective or improper components or parts in servicing or repairing the product, or (vi) modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI's LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT; INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.

AUTHORIZED U.S. SERVICE CENTERS

NORTH REGION / EAST REGION

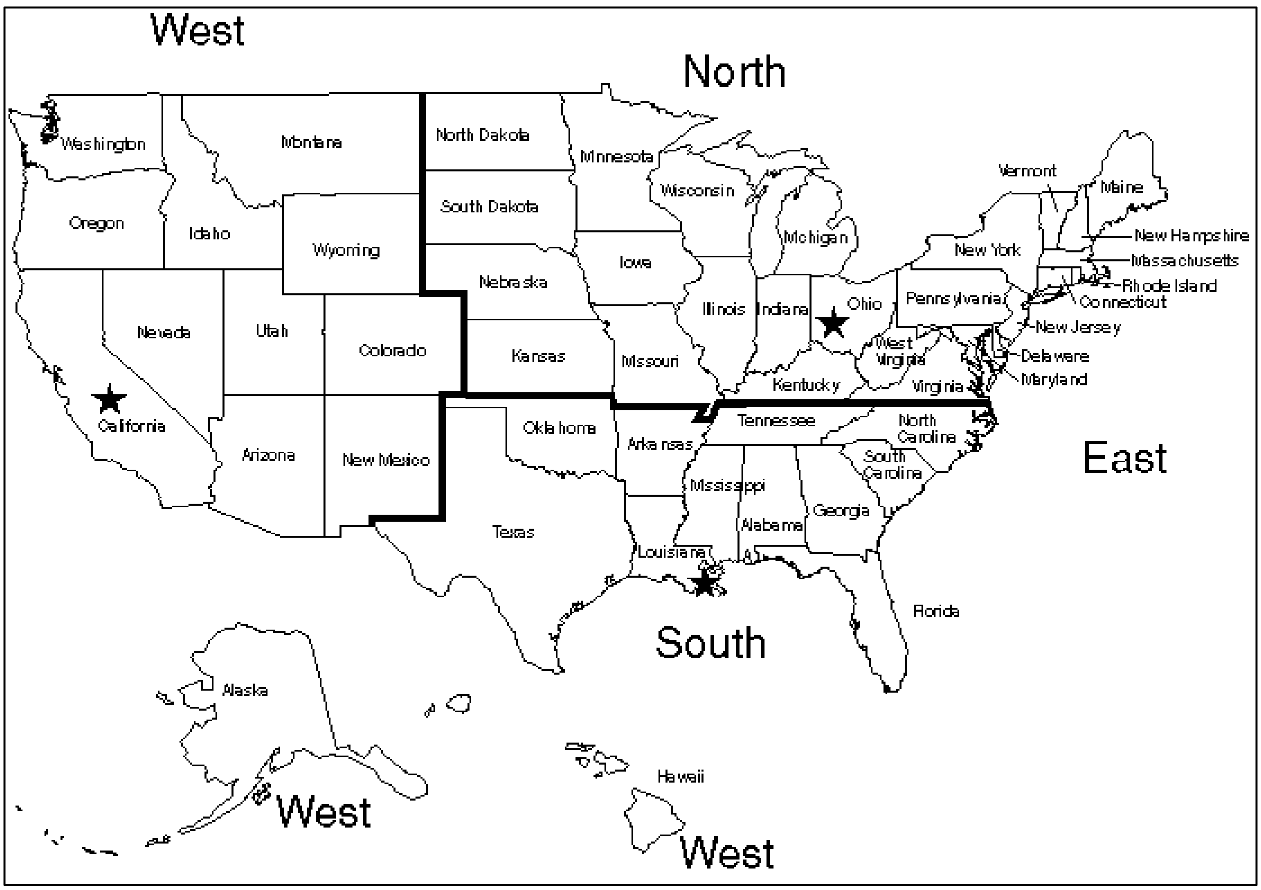
YSI Incorporated • Repair Center • 1725 Brannum Lane • Yellow Springs, Ohio • 45387 • Phone: (937) 767-7241• (800) 897-4151• Fax: (937) 767-9353 • E-Mail: ysi@info.com

SOUTH REGION

C.C. Lynch & Associates • 212 E. 2nd Street • Suite 203 • Pass Christian, Mississippi • 39571 • Phone: (800) 333-2252 • (228) 452-4612 • Fax: (228) 452-2563

WEST REGION

EnviroServices & Repair • 1110 Burnett Avenue, Suite D • Concord, CA • 94520 • Phone: (800)550-5875 • Fax: (510)674-8655



INTERNATIONAL SERVICE CENTERS

YSI Incorporated • Repair Center • 1725 Brannum Lane • Yellow Springs, Ohio • 45387 • Phone: (937) 767-7241• E-Mail: info@ysi.com

Lynchford House • Lynchford Lane • Farnborough • Hampshire • GU146LT • Phone: (44-1252) 514711 • Fax: (44-1252) 511855 • Tlx: 858210

Sakura – Building 6-5-6-13 • Shinjuku, Shinjuku-ku, Tokyo • 160 • Phone: (81-3) 5360-3561 • Fax: (81-3) 5360-3565

SPECIALTY SERVICE CENTERS

Aquaculture
Aquatic Eco Systems, Inc. • 1767 Benbow Court • Apopka, Florida • Phone: (407) 886-3939 • Fax: (407) 886-6787

Aquacenter • 166 Seven Oaks Road • Leland, Mississippi • 38756 • Phone: (601) 378-2861 • Fax: (601) 378-2862

Wastewater
Q.C. Services • P.O. Box 68 • Harrison, Maine • 04040 • Phone: (207) 583-2980

Q.C. Services • P.O. Box 14831 • Portland, Oregon • 97293 • Phone: (503) 236-2712

APPENDIX A ACCESSORIES AND REPLACEMENT PARTS

The following parts and accessories are available from YSI or any YSI Franchise Dealer.

YSI Order Number	Description
YSI 5906	Replacement Membrane Cap Kit (6 each)
YSI 3161	Conductivity Calibration Solution 1,000 µ/cm (1 Quart)
YSI 3163	Conductivity Calibration Solution 10,000 µ/cm (1 Quart)
YSI 3165	Conductivity Calibration Solution 100,000 µ/cm (1 Quart)
YSI 3167	Conductivity Calibration Solution 1,000 µ/cm (8 pints)
YSI 3168	Conductivity Calibration Solution 10,000 µ/cm (8 pints)
YSI 3169	Conductivity Calibration Solution 50,000 µ/cm (8 pints)
YSI 5520	Carrying Case
118510	Probe & Cable Assembly (10 feet)
118522	Probe & Cable Assembly (25 feet)
118527	Probe & Cable Assembly (50 feet)
118519	Probe and Cable Assembly (100 feet)
038501	Front Case Cover
055242	Rear Case Cover
055244	Battery Cover Kit
055204	Case Hardware Kit
055219	Sponge, Storage Chamber
038502	Main Board Assembly
038213	Brush, Electrode Cleaning
030156	Main Board Assembly, CE, w/o Display
030898	Display Assembly, CE versions

APPENDIX B TEMPERATURE CORRECTION DATA FOR TYPICAL SOLUTIONS

A. Potassium Chloride (KCl)

Concentration: 1 mole/liter		
°C	m_/cm	%/°C (to 25°C)
0	65.10	1.67
5	73.89	1.70
10	82.97	1.72
15	92.33	1.75
20	101.97	1.77
25	111.90	1.80

Concentration: 1 x 10^{-1} mole/liter		
°C	m_/cm	%/°C (to 25°C)
0	7.13	1.78
5	8.22	1.80
10	9.34	1.83
15	10.48	1.85
20	11.65	1.88
25	12.86	1.90
30	14.10	1.93
35	15.38	1.96
37.5	16.04	1.98
40	16.70	1.99
45	18.05	2.02
50	19.43	2.04

Concentration: 1 x 10^{-2} mole/liter		
°C	m_/cm	%/°C (to 25°C)
0	0.773	1.81
5	0.892	1.84
10	1.015	1.87
15	1.143	1.90
20	1.275	1.93
25	1.412	1.96
30	1.553	1.99
35	1.697	2.02
37.5	1.771	2.03
40	1.845	2.05
45	1.997	2.07
50	2.151	2.09

Concentration: 1 x 10^{-3} mole/liter		
°C	m_/cm	%/°C (to 25°C)
0	0.080	1.84
5	0.092	1.88
10	0.105	1.92
15	0.119	1.96
20	0.133	1.99
25	0.147	2.02
30	0.162	2.05
35	0.178	2.07
37.5	0.186	2.08
40	0.194	2.09
45	0.210	2.11
50	0.226	2.13

** Charts developed by interpolating data from *International Critical Tables*, Vol. 6, pp. 229-253, McGraw-Hill Book Co., NY.

B. Sodium Chloride* (NaCl)

Saturated solutions at all temperatures		
°C	m_/cm	%/°C (to 25°C)
0	134.50	1.86
5	155.55	1.91
10	177.90	1.95
15	201.40	1.99
20	225.92	2.02
25	251.30	2.05
30	277.40	2.08

Concentration: 0.5 mole/liter		
°C	m_/cm	%/°C (to 25°C)
0	25.90	1.78
5	29.64	1.82
10	33.61	1.86
15	37.79	1.90
20	42.14	1.93
25	46.65	1.96
30	51.28	1.99
35	56.01	2.01
37.5	58.40	2.02
40	60.81	2.02
45	65.65	2.04
50	70.50	2.05

Concentration: 1 x 10^{-1} mole/liter		
°C	m_/cm	%/°C (to 25°C)
0	5.77	1.83
5	6.65	1.88
10	7.58	1.92
15	8.57	1.96
20	9.60	1.99
25	10.66	2.02
30	11.75	2.04
35	12.86	2.06
37.5	13.42	2.07
40	13.99	2.08
45	15.14	2.10
50	16.30	2.12

Concentration: 1 x 10^{-2} mole/liter		
°C	m_/cm	%/°C (to 25°C)
0	0.632	1.87
5	0.731	1.92
10	0.836	1.97
15	0.948	2.01
20	1.064	2.05
25	1.186	2.09
30	1.312	2.12
35	1.442	2.16
37.5	1.508	2.17
40	1.575	2.19
45	1.711	2.21
50	1.850	2.24

Concentration: 1 x 10^{-3} mole/liter		
°C	m_/cm	%/°C (to 25°C)
0	0.066	1.88
5	0.076	1.93
10	0.087	1.98
15	0.099	2.02
20	0.111	2.07
25	0.124	2.11
30	0.137	2.15
35	0.151	2.19
37.5	0.158	2.20
40	0.165	2.22
45	0.180	2.25
50	0.195	2.29

* Charts developed by interpolating data from the *CRC Handbook of Chemistry and Physics*, 42nd ed., p. 2606, The Chemical Rubber Company, Cleveland.

APPENDIX C CALIBRATION VALUES TABLE

Table A: Calibration values for various atmospheric pressures and altitudes.
Note: This table is for your information only. It is not required for calibration.

Pressure Inches of Hg	Pressure mm Hg	Pressure kPA	Altitude in feet	Altitude in meters	Calibration Value in %
30.23	768	102.3	-276	-84	101
29.92	760	101.3	0	0	100
29.61	752	100.3	278	85	99
29.33	745	99.3	558	170	98
29.02	737	98.3	841	256	97
28.74	730	97.3	1126	343	96
28.43	722	96.3	1413	431	95
28.11	714	95.2	1703	519	94
27.83	707	94.2	1995	608	93
27.52	699	93.2	2290	698	92
27.24	692	92.2	2587	789	91
26.93	684	91.2	2887	880	90
26.61	676	90.2	3190	972	89
26.34	669	89.2	3496	1066	88
26.02	661	88.2	3804	1160	87
25.75	654	87.1	4115	1254	86
25.43	646	86.1	4430	1350	85
25.12	638	85.1	4747	1447	84
24.84	631	84.1	5067	1544	83
24.53	623	83.1	5391	1643	82
24.25	616	82.1	5717	1743	81
23.94	608	81.1	6047	1843	80
23.62	600	80.0	6381	1945	79
23.35	593	79.0	6717	2047	78
23.03	585	78.0	7058	2151	77
22.76	578	77.0	7401	2256	76
22.44	570	76.0	7749	2362	75
22.13	562	75.0	8100	2469	74
21.85	555	74.0	8455	2577	73
21.54	547	73.0	8815	2687	72
21.26	540	71.9	9178	2797	71
20.94	532	70.9	9545	2909	70
20.63	524	69.9	9917	3023	69

20.35	517	68.9	10293	3137	68

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