5500

OPERATING INSTRUCTIONS

5500 Salinity Bridge

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Fig. 1 View of Bridge Panel Showing Operating Parts

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The #5500 Salinity Bridge was carefully inspected prior to shipment. Critical components were sealed at the factory to ensure proper calibration of the unit. Handle the instrument with care at all times for long, trouble-free operation. Batteries were installed in the unit just prior to shipment so the Bridge is ready to operate immediately upon receipt.

Open the cover of the Bridge by pulling out on the bottom of the two latches. The cover can be opened and left attached (Figure 3). You can remove the cover completely by pinching together the two knurled pins that project from the bottom of the hinge.

Fig. 3

Features

The #5500 Salinity Bridge is a special purpose, alternating current bridge designed specifically for use with the #5000-A and #5100-A Soil Salinity Sensors. The Bridge makes it possible to read out soil solution conductivity in millimhos/cm at 25ºC directly from the sensors. The Bridge also provides a separate scale for resistance readings. Three resistance ranges are available: 0-1,000 ohms, 0-10,000 ohms, and 0-100,000 ohms.

The selector switch on the panel selects one of the three conventional resistance-measuring circuits or the special direct reading conductivity circuit. A receptacle on the panel accepts the polarized plug from the salinity sensor. Two small dials on the panel are used to set the two characteristic values of the individual sensor that are permanently marked on the plug of each sensor. The conductivity at 25ºC is read out directly on the conductivity scale of the large center read-out dial that is graduated 1-1/2 to 40 millimhos.

Two terminals are provided for connection to an unknown resistance. The terminals will accept either conventional banana plugs or the terminal cap can be unscrewed to accept a wire connection or a wire lug. The unknown resistance is read out on the outer ohms scale of the

large center read-out dial, which is graduated from 0 to 1,000. When the selector switch is in the 0-1K ohms position, the ohms scale on the readout dial indicates actual resistance. When the selector switch is in the 0-10K ohms position, the reading values on the ohms scale must be multiplied by 10 to give actual resistance. Correspondingly, when the selector switch is in the 0 to 100K ohms position, the ohms scale values must be multiplied by 100 to give actual resistance.

The two position resistance terminal switch on the panel makes it possible to read normal non-inductive resistance at the “unknown” terminals or to read the resistance of the electrolytic element of the soil salinity sensor separately, where the circuit is corrected for the electrical capacitive characteristics of the electrolytic element.

The Salinity Bridge incorporates solid state circuitry. The Bridge circuit is energized at 1,000 Hertz, full sine wave. The Bridge unbalance voltage is amplified and chopped to feed half wave direct current to the balancing galvanometer. Four separate bridge circuits are provided. One of each of the three conventional resistance ranges and an additional one for direct readout of conductivity. Four 9-volt transistor batteries, Ever Ready No. 216 or equivalent supply power.

The Bridge case is made of heavy aluminum with baked enamel finish. Neoprene seals protect against moisture and dust. A manually separating hinge allows you to completely remove the cover for more convenient laboratory use. The Bridge panel and dials are anodized sealed aluminum. Rubber feet on the bottom and one side of the Bridge allow for maximum convenience in handling. All of the dials on the Bridge are friction loaded to facilitate easy setting of the dials and to eliminate disturbance of the dial setting.

The Bridge circuit is normally off and a spring-loaded push button switch is used to energize the bridge circuit when a reading is to be made. This feature eliminates the hazard of leaving the Bridge on when it is not in use, which adds to the life of the battery. A separate push button switch on the panel permits testing of the battery power at any time.

Check Out Prior to Use

Galvanometer Check

Before making any measurements, examine the pointer setting of the balancing galvanometer. The pointer on the galvanometer should be lined up exactly with the center line mark of the galvanometer scale, as shown in Figure 1. If the pointer has been shifted off of the center line setting during shipment, reset it to 0 by turning the recessed slotted screw either clockwise or counterclockwise with a narrow screwdriver.

Battery Check

The battery test push button should be pressed down. If the batteries are connected and in good operating condition, the galvanometer pointer will move to the right beyond the end of the galvanometer scale. If the galvanometer pointer does not move beyond the end of the galvanometer scale, it means that the battery voltage has dropped to the point where it cannot be relied upon to properly actuate the bridge circuit.

Conductivity Circuit Check

A test plug is provided to check the direct reading conductivity circuit and to make sure that the dial settings are correct. The test plug is calibrated to correspond to a 4 millimhos solution. To test the bridge functions, insert the test plug into the Salinity Sensor receptacle on the panel, as shown in Figure 6. Turn the selector switch clockwise to the "SOIL SOLUTION CONDUCTIVITY" position. Next set the plug intercept setting dial to the value on the test plug. Then set the slope-thermistor setting dial to the value on the test plug. Push the red "Read" button to energize the Bridge and turn the large center read-out dial until the galvanometer pointer is lined up with the center null position of the galvanometer scale. If the galvanometer pointer is in the correct null position, the read-out dial should be turned counterclockwise to balance the Bridge. Correspondingly, if the galvanometer pointer is to the left of the galvanometer null position, the read-out dial should be turned clockwise to balance the Bridge
When the test plug is in position and the intercept dial and slope-thermistor dial are set as indicated above, the galvanometer pointer should balance when the conductivity scale of the center read-out dial indicates 4 millimhos at the index line.

Note that the index line for each of the dials is actually two lines, one on either side of a thick Plexiglas bar. When you are reading the dial, move your eyes back and forth until the two vertically separated lines coincide. At this point read the value on the scale. This procedure eliminates parallax and give consistently reproducible values.

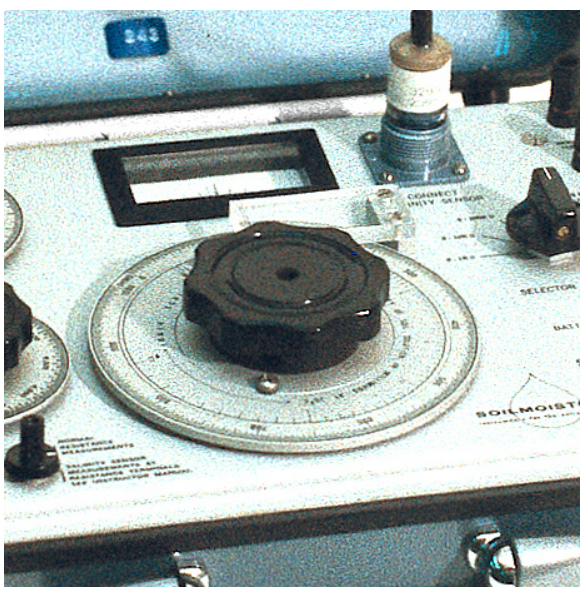

Figure 6

If the dial settings are correct and the circuit is functioning properly, the reading on the conductivity dial should be 4 millimhos. Variations of approximately .1 millimhos can be expected due to minor variations in calibration and component characteristics. Under the test conditions that are outlined above, when the conductivity dial reads 4 millimhos, the outer resistance dial should read approximately 327 ohms.

The check out that is given above will confirm that dial settings have not shifted during shipment and that the circuits are functioning properly.

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Resistance Circuit Check

If a conventional resistance decade box is available you can further check the three resistance scales. When doing so, connect the resistance terminals directly to the decade box with jumpers.

Turn the resistance terminal switch counterclockwise to “NORMAL RESISTANCE MEASUREMENTS” and set the selector switch on the resistance range desired. Then read out the resistance value set on the decade box on the outer ohms scale of the read-out dial. Accuracy of the conventional resistance readings is within 1% of true value in each of the ranges.

Making Conductivity Measurements with the #5000-A & 5100-A Soil Salinity Sensors

For routine measurement of soil salinity sensors that have been installed in the field and in equilibrium with the soil solution, plug the polarized plug of the individual sensor into the sensor receptacle marked “Connect Salinity Sensor” on the panel of the Bridge, as shown in Figure 7.
The Intercept setting and the Slope-thermistor Setting are marked on the plug of each sensor and can be seen after the plug is inserted into the receptacle on the Bridge panel. The intercept setting dial on the panel should be set to the value marked on the plug of the sensor. In the event the intercept setting value exceeds 20,000 ohms, set the dial to 20,000 ohms to make the reading.

The Slope-Thermistor setting dial must also be set at the value given on the plug of the Individual sensor. Turn the selector switch to the full clockwise position marked “SOIL SOLUTION CONDUCTIVITY FROM SALINITY SENSOR”. The position the resistance terminal switch does not matter since this switch is not a part of the conductivity measuring circuit.
To make a reading, press the red “Read” push button switch and adjust the read-out dial until the galvanometer pointer is in the center null position. Conductivity of the soil solution at 25ºC can then be read out on the inner scale of the read-out dial.

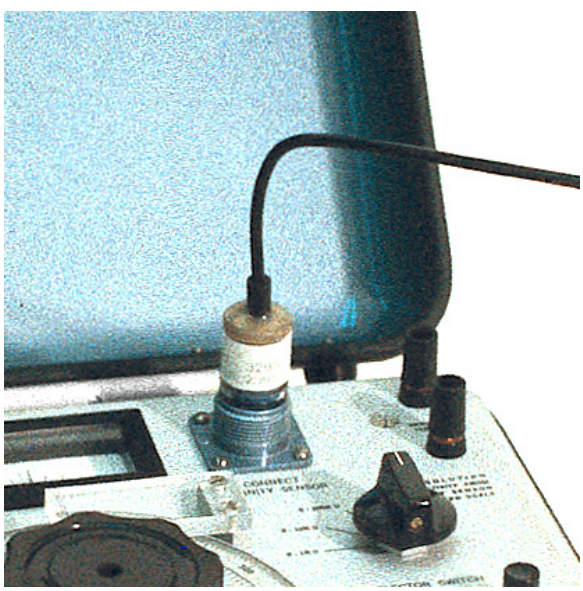

Figure 7

Reading the Resistance Value of the Electrolytic Element and the Thermistor of the Sensor Separately Using the Resistance Terminals

To check the calibration of the soil salinity sensors, it is necessary to read the resistance of the electrolytic element independently.

You may also wish to read the resistance value of the thermistor, which is incorporated in the salinity sensor, separately. The resistance value of the thermistor can be used to give an accurate

measurement of temperature of the soil in which the sensor is buried. Data to accomplish this is given with each sensor.

The above tasks can be accomplished using the Salinity Bridge with the #5501 Plug-Terminal Adapter. The #5501 Adapter accepts the plug from the Salinity Sensor. The #5500 Adapter has two sets of terminal lugs, as shown in Figure 8. One set connects to the electrolytic element of the Sensor and the other connects to the thermistor, which is built into the Sensor.

Loosen the screw caps of the resistance terminals on the panel, insert one set of lugs and then tighten them to secure the adapter in place to make a reading.

Reading the Salinity Sensor Thermistor Resistance

To read the Sensor Thermistor resistance, first connect the "THERMISTOR" lugs on the Plug Terminal Adapter to the resistance terminals of the Salinity Bridge. Next turn the resistance terminal switch to the "NORMAL RESISTANCE MEASUREMENTS" position and turn the selector switch to the 0-10K ohms position. Then balance the galvanometer by adjusting the read-out dial and read the Thermistor resistance on the outer ohms scale. When the selector switch is in the 0-10K ohms position, the ohms scale readings must be multiplied by 10 to give the correct resistance value.

The Thermistor incorporated into the sensor has a resistance of 2,000 ohms ±10% at 25ºC. The specific resistance of the particular Thermistor at 25ºC for each sensor is given on the data sheet that accompanies each sensor. The Thermistor resistance rate of change with temperature at 25ºC is 3.9% per degree centigrade. For detailed information on the relationship of the Thermistor resistance to temperature, please see the instructions that accompany the Salinity Sensors.

Reading the Salinity Sensor Electrolytic Element Resistance

To measure the resistance of the Electrolytic Element of the sensor, connect the "ELECTROLYTIC ELEMENT" lugs on the Plug-Terminal Adapter to the resistance terminals. Then turn the resistance terminal switch to the 'SALINITY SENSOR MEASUREMENTS AT RESISTANCE TERMINALS" position. Turn the selector switch to the 0-1K ohms setting. If the sensor resistance is within the 0 to 1,000 ohms range, balance the galvanometer at the center null position and read the resistance of the electrolytic element on the outer ohms scale of the read-out dial.
If the resistance of the Sensor is higher than the above range, turn the selector switch to the 0-10K ohms position. Then balance the galvanometer by adjusting the read-out dial and read the Sensor resistance on the outer ohms scale of the read-out dial.

Measuring Solution Conductance with Standard Conductivity Cells

When you are checking the conductivity of standard calibrating solutions, such as solutions

used for calibrating the salinity sensors, the Salinity Bridge can be used to measure the solution resistance with various commercially available conductivity cells.

Connect the conductivity cell leads to the resistance terminals on the panel of the Bridge. Turn the Terminal switch to the “NORMAL RESISTANCE MEASUREMENTS” position and the Selector switch to the 0-1K ohms position. Balance the galvanometer by adjusting the read-out dial and read the resistance and read the resistance of the cell on the outer ohms scale. Then divide the resistance reading by the cell constant to give the specific resistance of the solution. The specific resistance in ohms divided into 1,000 will give the conductivity of the solution in millimohs/cm. In the event the resistance value of the conductivity cell is beyond the range of the 0-1K ohms scale, turn the selector switch to the next higher scale range.

When using conductivity cells to determine the conductivity of calibrating solutions for Salinity Sensors, it is essential that the conductivity cells be cleaned frequently to the manufacturer’s specifications. Films of foreign matter form quickly on the platinum black electrode surfaces of the conductivity cell. These films cause resistance readings to be higher than they should. As a result, substantial errors can occur in the determination of the solution conductivity and correspondingly in the calibration of the Salinity Sensor.

When considerable use is made of conductivity cells, we recommend making up a reference solution of a known salt on a weight basis in the general conductivity range desired. The conductivity cells can then be checked in this reference solution at a known temperature before use to determine if they are reading correctly.

Measuring Miscellaneous Unknown Resistance

The Salinity Bridge can be used for measuring any non-inductive resistance value in the range of 0 to 100,000 ohms. One such application is the resistance measurement of various electrical moisture sensing blocks, such as gypsum blocks.

To make a measurement, connect the unknown resistance to the resistance terminals. Turn the resistance terminal switch to the “NORMAL RESISTANCE MEASUREMENT” position. If the approximate value of the resistance is not known, the selector switch should be turned to the 0-100K ohms position. If the galvanometer cannot be balanced by adjusting the read-out dial, then the resistance is beyond 100,000 ohms and cannot be read with the Bridge. If the Bridge can be balanced and the resistance is in the range of 0 to 100,000 ohms, then the selector switch should be turned to the 0-100K ohms position and the Bridge again balanced to obtain a more accurate resistance reading.
If, from the above measurement, the resistance value is in the range of 0 to 1,000 ohms, then the selector switch should be turned to the 0-1K ohms position and the bridge again balanced to give a more accurate resistance reading. Read the resistance values on the outer ohms scale of the read-out dial.

Precautions

Resistance terminals and the Salinity Sensor receptacles should never be occupied simultaneously. Doing so will introduce errors in readings.

Make sure Sensor Plugs are free of soil particles before insertion into the receptacle on the Bridge. Otherwise plugs will bind or clog the receptacle.

Guard against water spray and wind blown particles by keeping the Bridge cover down and latched when not in use. Also wipe areas that are covered by excessive dust with a damp cloth.

Maintenance

Battery Replacement

If the galvanometer pointer does not go beyond the end of the galvanometer scale when the battery test button is pushed, it is an indication that the battery voltage has dropped to where it cannot be relied upon to properly activate the Bridge circuits.

You must replace all four batteries. To replace the batteries, loosen the center screw in the round battery compartment on the bottom of the Bridge case by turning it counterclockwise. Then remove the battery case round cover plate along with the captive screw. Lift out the four individual batteries together with their connecting plugs. Unsnap each battery from the battery plug and replace them in order. When you remove the battery plug, do not put undue strain on the connecting wire leads.

After new batteries have been installed, make sure that the connecting leads are clear of the sealing gasket at the edge of the compartment. Then screw the battery compartment round cover plate into place with the center captive screw.

The batteries required are standard transistor batteries, Ever Ready #216 or equivalent.

Adjusting Null Position of Galvanometer

Handling shocks may jar the galvanometer pointer so that it is not exactly lined up with the center null position of the galvanometer scale. To return the pointer to the center position, use a small sized screwdriver to turn the recessed slotted screw either clockwise or counterclockwise, shown in Figure 5, page 3.

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Damage

In the event of damage or suspected damage to the Bridge, test the conductivity circuit using the test plug supplied, as described under “CHECK OUT PRIOR TO USE” on page 3. If a resistance decade box is available, it is helpful to further check the resistance circuits to determine whether they are reading the proper resistance.

These two checks will indicate any shifting of the dial positions or malfunction of a component.

If the Bridge is not functioning properly, it should be returned to Soilmoisture Equipment Corp. for repair. Before returning the unit, call or write us for instructions on how to make the return shipment, and describe the nature of the damage or malfunction.

-NOTICE-

REMOVAL OF BRIDGE PANEL

Refer to the instructions that follow In the event it becomes necessary to remove the Bridge Panel.

1. Unscrew the four (4) rubber feet attached to the bottom of the Bridge Case. (See Figure 9.) It is not necessary to remove the round battery compartment cover plate.

2. Set the Bridge Case right side up and gently pull straight up by the knobs to remove the Bridge Panel. If the panel is tight, gently loosen the edges around the panel with a screwdriver.

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