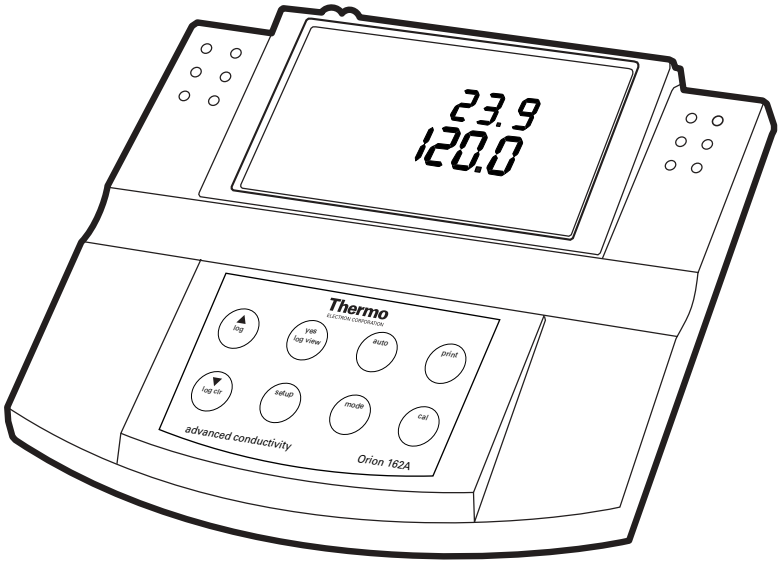
Orion 162A

# Orion Benchtop Conductivity Meter

INSTRUCTION MANUAL

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# Chapter I.

## Introduction

The Orion 162A Conductivity Meter is a full featured meter which can be used for a wide variety of applications. Water, acids, bases and other samples can be easily analyzed for conductivity, salinity, resistivity and total dissolved solids.

This meter features microprocessor design, which automates complicated and time consuming calibration and measurement procedures for a wide variety of applications. The Orion DirectCal™ calibration technique allows calibration by direct input of actual calibration standard values, eliminating iterative adjustments of cell constants. The Orion AutoCal™ calibration technique features automatic recognition of Orion conductivity standards. A wide variety of cells, Conductivity and TDS Standards and accessories are available.

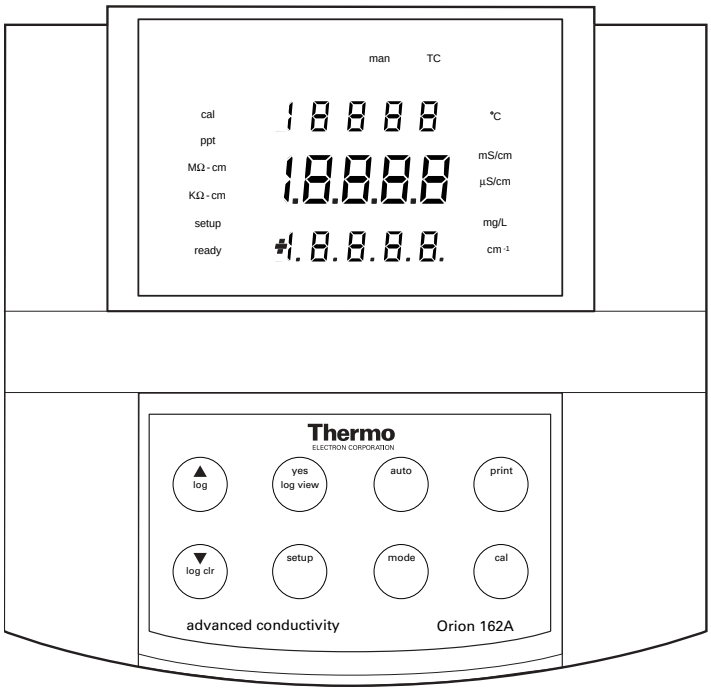



***FIGURE 1 - Orion 162A***

# Chapter II.

## Measurement Theory

### *Conductivity Measurement*

The term conductance refers to the ability of materials to carry an electric current. Liquids which carry an electric current are referred to as electrolytic conductors. Under the influence of an electric field, the flow of current through an electrolytic conductor is accomplished by the movement of positive and negative ions. The conductance of a liquid is defined by the ratio of current to voltage between any two points within the liquid. As the two points move closer together or further apart the ratio will change. For analytical purposes, a dimension is given to the measurement; i.e., the physical parameters of the measurement.

By defining the physical parameters of the measurement, a standard measure is created. The standard measure is referred to as specific conductance or conductivity, which is defined as the reciprocal of the resistance in ohms, measured between the opposing faces of 1 cm cube of liquid at a specific temperature.

The units used to define conductance are:1/ohm = 1 mho = 1 Siemen(S) =1,000 mS = 1,000,000 µS. The conductivity value is obtained by multiplying the conductance value by the cell constant. See **Figure 2** for Conductivity Ranges of Common Aqueous Solutions.

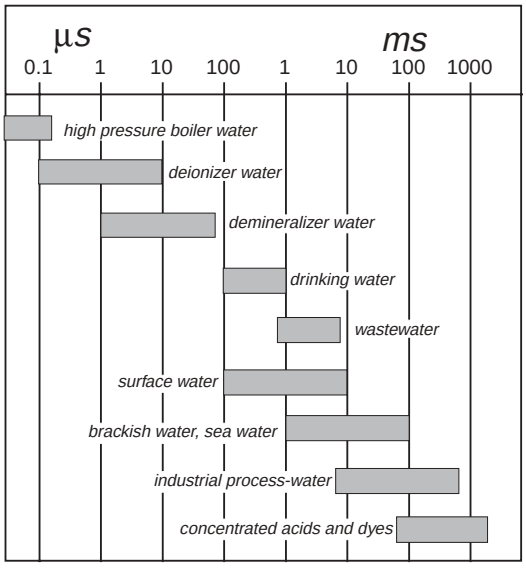



***FIGURE 2 - Ranges of Common Aqueous Solutions***

## Cell Constants

In theory, a conductivity-measuring cell is formed by two 1 cm square surfaces spaced 1 cm apart. The theoretical cell just described has a cell constant of K = 1.0 $cm^{-1}$. The cell constant, K, is defined as the ratio of the distance between the electrodes, d, to the electrode area, A. However, the existence of a fringe-field effects the electrode area by the amount AR, therefore K = d/(A + AR). See **Figure 3**. Because it is normally impossible to measure the fringe-field effect and the amount of AR to calculate the cell constant, K, the actual K of a specific cell is determined by a comparison measurement to a standard solution of known conductivity (e.g., 0.01 M KCl).

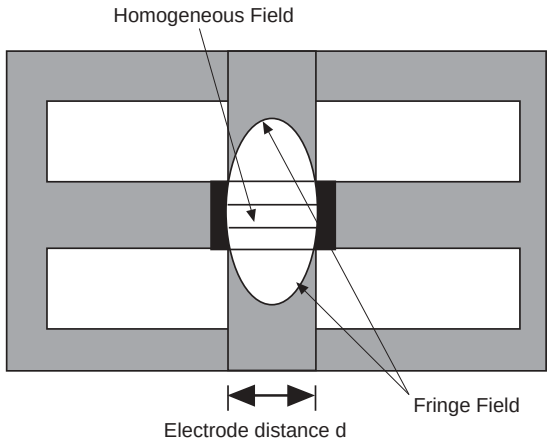



***FIGURE 3 - Conductivity Cell Schematic***

Cells of different physical configuration are characterized by their cell constant, K. Often, for considerations having to do with sample volume or space, a cell's physical configuration is designed differently. Cells with constants of 1.0 $cm^{-1}$ or greater normally have small, widely spaced electrodes. Cells with constants of 0.1 $cm^{-1}$ or less normally have large closely spaced electrodes.

Since K is a "factor" which reflects a particular cell's physical configuration, the cell constant must be multiplied by the observed conductance to obtain the actual conductivity reading. For example, an observed reading of 200 mS using a cell with K = 0.1 $cm^{-1}$, the conductivity value is 200 mS x 0.1 $cm^{-1}$= 20 mS/cm.

Solutions with low conductivity, up to 1-2 mS/cm, are best measured with cells having a cell constant of K = 0.1 $cm^{-1}$. Cells with K = 1.0 $cm^{-1}$ are best used for solutions with conductivity of 1 mS/cm to 1000 mS/cm. Cells with K = 10.0 $cm^{-1}$ are best used for solutions with conductivity of 10 mS/cm to 2000 mS/cm. See **Figure 4** for typical conductivity ranges for cell constants.

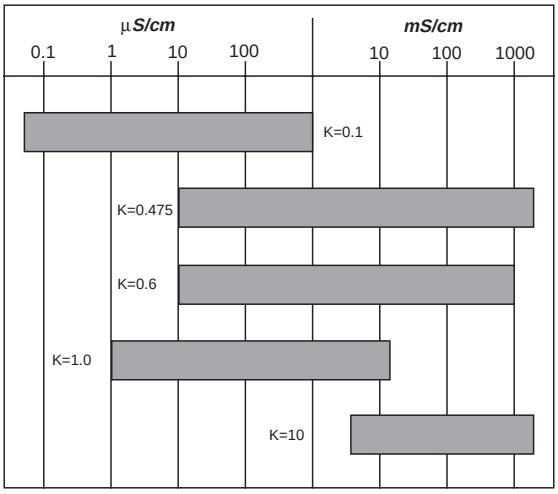



***FIGURE 4 - Typical Measuring Ranges of Conductivity Cells***

## Temperature Effects

The conductivity of a solution with a specific electrolyte concentration changes with temperature. The relationship of the change in conductivity as a function of temperature is described by a solution's temperature coefficient. Temperature coefficients vary with each solution. Some examples are shown in **Table 1**. The Orion 162A uses 2.1%/˚C as a default temperature coefficient, which is representative of many aqueous samples, to compensate for temperature changes. The meter has an adjustable temperature coefficient of 0.0 to 10.0%/˚C. The meter also has two selectable nonlinear temperature coefficients: "nLFn" which is helpful for measurements of natural waters, and "nLFu" for ultrapure water.

By definition, temperature compensated conductivity of a solution is the conductivity which that solution exhibits at the reference temperature. The reference temperature is chosen to be either 25 ˚C or 20 ˚C. A measurement made at the reference temperature needs no compensation. The closer the sample is to the reference temperature, the smaller the error will be if the meter temperature coefficient is incorrect. The Orion 162A automatically compensates for temperature changes based on the temperature coefficient and the reference temperature when a temperature measurement is simultaneously made.

**Table 1**
**Typical Temperature Coefficients Between 25 and 50 ˚C**
**(Percent change of Conductivity per ˚C)**

| Solution | %/˚C |
|---|---|
| Ultrapure Water | 4.55 |
| Salt (NaCl) Solutions | 2.12 |
| 5% NaOH | 1.72 |
| Dilute Ammonia | 1.88 |
| 10% HCl | 1.32 |
| 5% Sulfuric Acid | 0.96 |
| 98% Sulfuric Acid | 2.84 |
| Sugar Syrup | 5.64 |

The Orion 162A allows the operator to enter their own temperature coefficient, with a selectable range from 0.0 to 10.0 %/˚C or select non-linear functions (nLFu and nLFn for ultra-pure water and natural water, respectively). If the temperature coefficient is set to 0.0 the values will not be compensated. The user can enter their own temperature coefficient by hitting the SETUP key to enter the setup menu and hitting the YES key until the TC 2.1 screen is displayed. This value can be changed by scrolling up or down with the arrow keys, and the new value can be selected with the YES key. *(**NOTE:** The YES key must be pressed to accept the change.)* The default value for TC factor on the 162A meter is 2.1%/˚C.

## *Salinity*

Salinity is a measure of the total dissolved salts in a solution and is used to describe seawater, as well as natural and industrial waters. Salinity is a relative scale based on a KCl solution. A Salinity value of 35 is relative to seawater at 15 ˚C and a conductivity value equivalent to a KCl solution containing 32.4356 g KCl in 1 Kg of solution. The units to describe salinity are ‰ or ppt (parts per thousand). Orion 162A calculates the salinity based on the Practical Salinity Scale of 1978, as referenced in Standard Methods of Water and Wastewater.

## Total Dissolved Solids

Total Dissolved Solids (TDS) refers to the dissolved inorganics in a solution. These dissolved inorganics will carry a current and will be reflected as a conductivity reading. Since a relationship can be shown between conductivity and TDS, a conductivity reading can be used as an estimation of the presence of inorganics.

The standard method of determining TDS (Total Dissolved Solids) is by evaporating the sample to dryness at 180 ˚C and weighing the residue. After evaporating the sample, one would have to calculate a specific "factor" for the solution by taking the TDS value obtained in weighing and dividing it by the conductivity of the sample. This factor would then be multiplied by the subsequent conductivity readings to obtain the TDS value of the sample as referenced in Standard Methods of Water and Wastewater.

The Orion 162A allows the operator to enter their own TDS factor for the calculation of the TDS value in mg/L, with a selectable range from 0.50 to 1.00 and a default value of 0.66. The user can enter their own TDS factor by hitting the SETUP key to enter the setup menu and hitting the YES key until the TDS FCTR 0.66 screen is displayed. This value can be changed by scrolling up or down with the arrow keys, and the new value can be selected with the YES key. (***NOTE:*** *The YES key must be pressed to accept the change.*) The default value for TDS factor on the 162A meter is 0.66, which is a reasonable estimate of a TDS factor for natural water applications. Always use temperature compensation, if samples and standards are at different temperatures.

For TDS values between 0 to 19,900 mg/L and temperature values between 5 and 50 ˚C, the displayed TDS value agrees with Critical Tables values with an accuracy of 0.87% R.S.D.

## Resistivity

Resistivity is equal to the reciprocal of measured conductivity values. Resistivity measures the resistance to the flow of the current through an aqueous solution at a specific temperature. This current is carried by ions and is measured between opposite electrode plates forming a centimeter cube. The units for resistivity are Megohm-cm or Kilohm-cm.

## Conductivity Standard Values

Table 2 contains conductivity values for Orion Conductivity/TDS Standards at a range of temperatures. The conductivity value at the temperature of the standard should be used when using the manual, DirectCal™ and multipoint calibration procedures. For higher accuracy, data in this table may be interpolated between integral temperature readings. There may be small differences between the values shown here and other values in the literature. These small differences are due to using kilograms of water rather than liters, as well as changes in assigned molecular weights, definitions of the Siemen, the use of slightly different temperature scales, and whether or not the inherent conductivity of water was subtracted out. For further information, see “Review of Electrolytic Conductance Standards”, Wu, Koch, Hamer and Kay, J. Soln. Chem. 1987,16, 985-997.

**Table 2**
**Table of Conductivity vs. Temperature For Orion Conductivity Standards. Values shown are in µS (microSiemens).**

| Temp. ˚C | 12.9 mS/cm Standard Orion 011006 | 1413 µS/cm Standard Orion 011007 | 100 µS/cm Standard Orion 011008 |
|---|---|---|---|
| 0 | 7131 | 776 | 54 |
| 1 | 7344 | 799 | 56 |
| 2 | 7560 | 822 | 58 |
| 3 | 7776 | 846 | 59 |
| 4 | 7995 | 870 | 61 |
| 5 | 8215 | 894 | 63 |
| 6 | 8436 | 918 | 64 |
| 7 | 8659 | 943 | 66 |
| 8 | 8884 | 968 | 68 |
| 9 | 9110 | 992 | 70 |
| 10 | 9337 | 1017 | 72 |
| 11 | 9566 | 1043 | 73 |
| 12 | 9796 | 1068 | 75 |
| 13 | 10027 | 1094 | 77 |
| 14 | 10260 | 1119 | 79 |
| 15 | 10494 | 1145 | 81 |
| 16 | 10729 | 1171 | 83 |
| 17 | 10956 | 1198 | 85 |
| 18 | 11203 | 1224 | 87 |
| 19 | 11441 | 1251 | 88 |
| 20 | 11681 | 1277 | 90 |
| 21 | 11922 | 1304 | 92 |
| 22 | 12164 | 1331 | 94 |
| 23 | 12407 | 1358 | 96 |
| 24 | 12651 | 1386 | 98 |
| 25 | 12896 | 1413 | 100 |

| Temp. ˚C | 12.9 mS/cm Standard Orion 011006 | 1413 µS/cm Standard Orion 011007 | 100 µS/cm Standard Orion 011008 |
|---|---|---|---|
| 26 | 13142 | 1441 | 102 |
| 27 | 13389 | 1468 | 104 |
| 28 | 13637 | 1496 | 106 |
| 29 | 13885 | 1524 | 108 |
| 30 | 14135 | 1552 | 110 |
| 31 | 14385 | 1580 | 112 |
| 32 | 14636 | 1608 | 114 |
| 33 | 14888 | 1636 | 117 |
| 34 | 15141 | 1665 | 119 |
| 35 | 15394 | 1693 | 121 |
| 36 | 15648 | 1722 | 123 |
| 37 | 15903 | 1751 | 125 |
| 38 | 16158 | 1780 | 127 |
| 39 | 16414 | 1808 | 129 |
| 40 | 16671 | 1837 | 131 |
| 41 | 16928 | 1866 | 134 |
| 42 | 17185 | 1896 | 136 |
| 43 | 17443 | 1925 | 138 |
| 44 | 17701 | 1954 | 140 |
| 45 | 17960 | 1983 | 142 |
| 46 | 18220 | 2013 | 145 |
| 47 | 18479 | 2042 | 147 |
| 48 | 18739 | 2071 | 149 |
| 49 | 18999 | 2101 | 151 |
| 50 | 19260 | 2103 | 154 |

# Chapter III.

## General Information

### *Instrument Description*

#### *Display*

A large bright LED display shows either Conductivity, Resistivity, TDS or Salinity results in the main (middle) field. Temperature is displayed in the upper field. The lower display shows the current cell constant. The icon indicators at the sides and top of the display indicate the mode or function in which you are operating. See **Figure 5**.

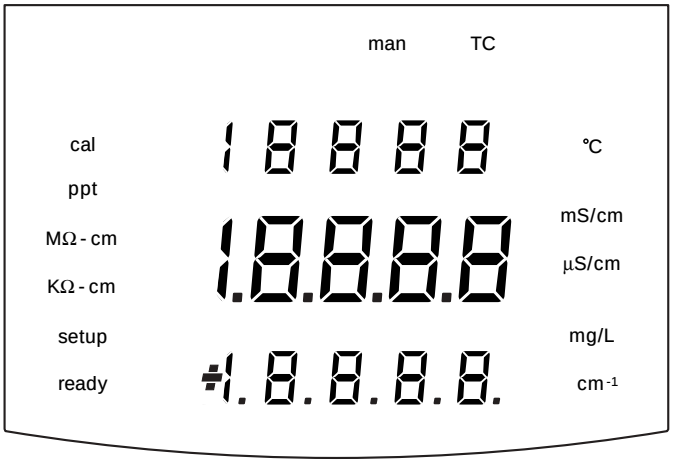



***FIGURE 5 - Orion 162A Display***

### MAN
This icon is an indication that manual temperature has been set on the meter if a temperature probe is not in use.

### TC
Indicates that temperature compensation is set. The default temperature coefficient setting is 2.1%/˚C with a range from 0.0 to 10%/˚C. Non-linear functions (nLFu for ultra-pure water and nLFn for natural water) are available on the 162A as well.

### cal
This icon is the calibration mode indicator. This is an indication that the meter is being calibrated.

### ppt
This icon represents salinity units in parts per thousand and when lit, it indicates that the main (middle) field of the meter is displaying salinity results.

### MΩ-cm
The megohm centimeter icon represents units of resistivity and when lit, indicates that the meter is displaying resistivity results in the main (middle) field.

### KΩcm
The kilohm centimeter icon represents the alternate unit of resistivity and when lit, indicates that the meter is displaying resistivity results in the main (middle) field.

### setup
When the setup icon is lit, it is an indication that the meter is in the setup mode.  This mode is used to define or view operating parameters.

### *ready*

This icon is displayed when the reading has stabilized.

### ˚C

This icon represents temperature in degrees Celsius. This indicator is lit whenever temperature is being displayed in the upper field of the meter.

### *mS/cm*

This icon represents units of conductivity in milli-siemens per centimeter. This icon is lit when conductivity is being displayed in the main (middle) field.

### *µS/cm*

This icon represents units of conductivity in micro-siemens per centimeter. This icon is lit when conductivity is being displayed in the main (middle) field.

### *mg/L*

Indicates the units of TDS (Total Dissolved Solids) in milligrams per liter. This icon is lit when the TDS value is being displayed in the main (middle) field.

### $cm^{-1}$

Indicates that the current cell constant is being displayed in the bottom field.

### LED Display Indicators

| Parameter | LED Display |
|---|---|
| ATC | AtC |
| Automatic | AUtO |
| Calibrate | CAL |
| Cell Constant | CELL |
| Clear | CLr |
| Conductivity | COnD |
| Continue | COnt |
| Data | DAtA |
| DATE | DAtE |
| Differential Logging | DIFF |
| Direct Cal. | DIr |
| Factor | FCtr |
| Hour | HOUr |
| Interval Logging | Int |
| Manual Cal. | MAn |
| Multiple Point Cal. | MUL |
| Parameter | PAr |
| Print | Prnt |
| REF | rEF |
| Resistivity | r5t |
| Salinity | 5AL |
| Select Cal.Type | 5EL |
| SET | 5Et |
| TDS | tD5 |
| Autosampler | AUtO SAPL |
| Tray Selection | AUtO trAy |
| Sample Number | AUtO nUbr |
| Rinse Time | rlnS Sec |
| Stirrer Speed | AUtO Stlr |

### *Keypad*

The Orion 162A meter has an 8-button keypad used to control all meter functions. Each keypress is acknowledged by the meter via a positive feel response. See **Figure 6**.

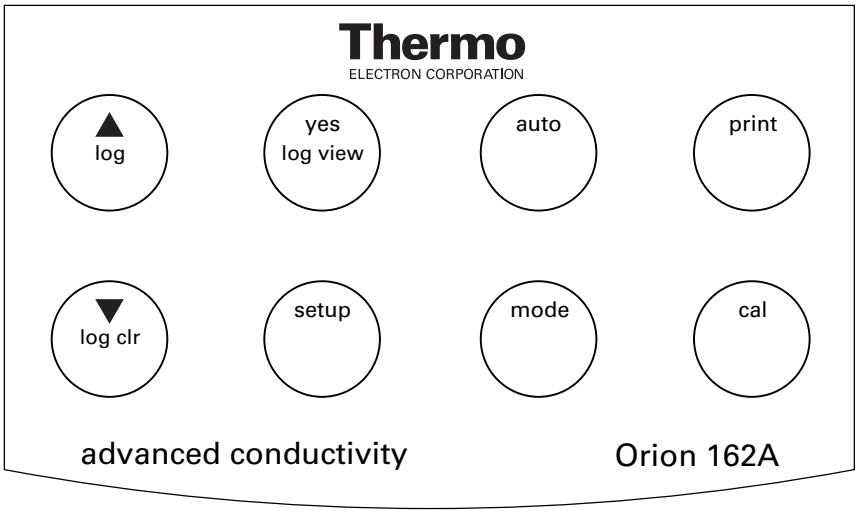



***FIGURE 6 - Orion 162A Keypad***

| Key | Function |
|---|---|
| ▲<br>LOG | Dual function key, LOG logs data when in the measurement mode, or ▲ allows scrolling through options in the setup mode and numeric scrolling during calibration. |
| ▼<br>LOG CLR | Dual function key, LOG CLEAR clears log data when in the measurement mode, or ▼ allows scrolling through options in the setup mode and numeric scrolling during calibration. |
| YES<br>LOG VIEW | Dual function key, YES allows entry of parameter settings. LOG VIEW allows the user to view and scroll through any logged data. |
| SETUP | Press to enter setup mode. Setup is entered to change operating parameters and to enter calibration options. |
| AUTO | Press to obtain options for automatic logging of data, or options for automatic printing. When pressed in conjunction with the LOG key (AUTO then LOG), the meter will automatically log data according to user-defined parameters. When pressed in conjunction with the PRINT key (AUTO then PRINT), the meter will automatically print data according to user-defined parameters. |
| MODE | Press to enter measurement mode from any screen. Used to change the measuring mode of the meter. Modes include conductivity, salinity, TDS and resistivity. |
| CAL | Press to initiate conductivity calibration. |
| PRINT | Press to print measured data or press in conjunction with the AUTO key (AUTO then PRINT) to choose type of automatic printing. |

## *Meter Connections*

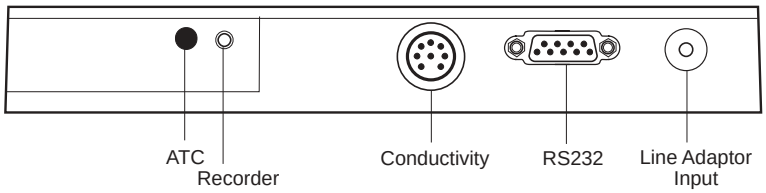



***FIGURE 7 - Orion 162A Meter Connections***

| Item | Feature | Function |
|---|---|---|
| 1 | 8 pin DIN Connection | Conductivity Probe Connection |
| 2 | Power Connection | For connection of line adapter |
| 3 | RS232 Connection | For Printer or computer |
| 4. | Separate ATC port | Separate temp. probe connection |

# Chapter IV.

## System Setup

### *Instrument Setup*

#### *Power Source*

Orion 162A operates on an AC line adapter (Orion 020125 for 110 V, Orion 020130 for 220 V, or Orion 020135 for 240 V). See **Fig 7** For Orion 162A meter connections.

#### *Power Up*

1. Connect the conductivity cell to the meter.
2. Plug the meter in. All display indicators will be displayed briefly, followed by the Orion meter number and software revision.

   ***NOTE:*** *If Autosampler was selected "ON" in the setup menu, then after the model number and software revision is displayed, screen will display "AUtO InIt". If Autosampler is not being used with the meter, then press MODE to exit this screen and enter the measurement mode.*

#### *Self-Diagnostics Checkout*

This test is automatically performed every time that the meter is powered up (plugged in) **WHILE THE YES KEY IS PRESSED**.

1. Disconnect the conductivity cell for the following test. If the cell is attached and immersed in solution, the meter will fail "Test 3."
2. Press and hold the YES key while powering up the meter. The instrument automatically performs electronic and hardware diagnostic tests.
3. If any problems are found during self-test, the meter will display an operator assistance code until the YES key is pressed. See page 47 for operator assistance codes.
4. After Test 7, a "0" will appear on the display. Press each of the eight keys from left to right starting from the top row.

   ***NOTE:*** *The time between each keypress must be less than 4 seconds.*
5. If any problems are found during self-test, the meter will display an operator assistance code until the YES key is pressed. See page 47 for operator assistance codes.

### Meter Reset

Plug the meter in. When software revision is displayed, press the CAL key. Screen will display dEFS and the display ESC automatically. The meter will then go into measure mode.

## Setup Menu

System operating parameters are configured by pressing the Setup key to access the setup menu. The “setup” indicator on the display will be illuminated.

- Scroll through Setup functions by pressing the YES key.
- Changes are made with the ▲ or ▼ keys.
- All changes must be acknowledged by pressing the YES key.
- Return to Measure mode by pressing the MODE key.

## List of Setup Features

| Display | Feature | Options | Comments |
|---|---|---|---|
| TC | Temperature Coefficient | 0.0 to 10.0%/˚C or nLFu (non-linear function for ultrapure water) or nLFn (non-linear function for natural water) | Default is 2.1% per ˚C |
| MAN (ATC) | Manual Temperature Input **(available only when temperature sensor is not in use)** | -5 to 105 ˚C | For Manual Temperature Input (sample temperature) |
| REF | Reference Temperature | 25 ˚C or 20 ˚C | Default is 25 ˚C |
| TDS FCTR | TDS Factor | 0.50 to 1.00 | Default is 0.66 |
| CAL SEL | Calibration Select | Auto Calibration<br>Manual Calibration<br>Direct Calibration<br>Multiple Point Calibration | Manual Cal. is the default calibration selection |
| RDY PRNT | Print on Ready | ON or OFF | Default is OFF.<br>Set to ON to enable automatic printing when input stabilizes. |
| SET DATE | Sets meter Date | Year<br>Month<br>Day | |
| SET TIME | Sets meter clock | Hour<br>Minute | |
| SET BAUD | Baud Rate | 1200, 2400, 4800 or 9600 | Default is 1200 |
| Auto Sapl | Autosampler mode | ON or OFF | Default is OFF.<br>(Refer to Autosampler section for more options with this feature) |

***NOTE:*** *Manual Temperature Input is not accessible in the Setup mode when a conductivity cell with an internal temperature sensor or an external temperature sensor is attached to the meter.*

***NOTE:*** *If the setup mode is entered and changes are made, when setup is accessed again, it will automatically display the last parameter that was changed.*

# Chapter V.
# Operation

## *Measurement*

The Orion 162A has four measurement modes: conductivity, total dissolved solids (TDS), salinity and resistivity. These modes can be accessed by pressing the MODE key until the desired mode icon is displayed.

**Conductivity Mode:** Conductivity measurements are displayed in the middle (main) field and are reported in millisiemens per centimeter, or microsiemens per centimeter depending upon the sample concentration.

**Salinity Mode:** Salinity measurements are displayed in the middle (main) field and are reported in parts per thousand. Orion 162A meter calculates salinity based upon the Practical Salinity Scale of 1978, as referenced in Standard Methods for Water and Wastewater.

**TDS Mode**: The Orion 162A allows the operator to enter their own TDS factor for the calculation of the TDS value in mg/L, with a selectable range from 0.50 to 1.00 and a default value of 0.66. The user can enter their own TDS factor by hitting the SETUP key to enter the setup menu and hitting the YES key until the TDS FCTR 0.66 screen is displayed. This value can be changed by scrolling up or down with the arrow keys, and the new value can then be selected with the YES key. **(*NOTE**: The YES key must be pressed to accept the change.*)** The default value for TDS factor on the 162A meter is 0.66, which is a reasonable estimate of a TDS factor for natural water applications.

**Resistivity Mode:** Resistivity measurements are displayed in the middle (main) field and are reported in megohms-centimeter, or kilohms-centimeter depending upon the sample concentration. Resistivity is equal to 1/conductivity. The chart below briefly displays the relationship between units of conductivity and resistivity.

| **Conductivity (µS/cm)** | **Resistivity (megohm-cm)** |
|---|---|
| 0.056 | 18 |
| 0.1 | 10 |
| 1.0 | 1.0 |
| 10.0 | 0.1 |
| *100.0 | 0.01 |
| *1413 | 0.0007 |
| *12900 (12.9 mS) | $8 \times 10^{-5}$ (0.08 kilohm-cm) |

*Denotes Thermo Orion Conductivity Standard Values

## *Calibration of the Cell Constant*

It is recommended to calibrate the cell constant against known conductivity standards as the conductivity cell constant may shift with time. The Orion 162A has four means of calibration. The meter may be calibrated by a Manual Calibration (cell constant adjustment method) or the meter may also be calibrated by performing a DirectCal™, an AutoCal™ or a Multiple point (Multipoint) calibration. Calibration for TDS and Salinity must be performed in the conductivity mode using conductivity standards.

A **Manual** calibration is performed by placing the electrode into the desired conductivity standard and adjusting the cell constant value until the displayed conductivity value corresponds with the conductivity value of the standard at its actual temperature. For Orion conductivity standards, the conductivity values of the standards at their actual temperature are found in **Table 2**.

A **DirectCal** is performed by placing the electrode into the desired conductivity standard and then inputting the standard value at the actual temperature of the standard. The cell constant is then calculated by the meter. The Orion 162A meter allows a maximum of two conductivity standards to be used for DirectCal (see Multipoint calibration for using 3 to 5 conductivity standards).

An **AutoCal** is performed by entering the nominal cell coefficient and then measuring the Orion calibration standard(s). When the reading stabilizes, the nominal calibration standard value is displayed. Whether using a temperature sensor or manual temperature, the meter corrects for temperature internally. For best results, calibrate at the chosen reference temperature.

A **Multipoint** calibration (up to 5 points) is performed by placing the electrode into the desired conductivity standard and then inputting the standard value at the actual temperature of the standard. (for Orion standards, see **Table 2**). The cell constant is then calculated by the meter for the first point. Each subsequent standard used requires input of the standard value at the actual temperature of the standard. Thermo suggests that the user calibrate the meter by placing the probe into the conductivity standards starting from low concentration working up to the higher concentrations in order to reduce carryover during calibration.

### Manual Calibration - The Cell Constant Adjustment Method

The default calibration mode is Manual calibration. If the calibration selection in SETUP has not been changed, then pressing the CAL key will activate a manual calibration option.

> **NOTE:** *To return to active measurement modes from the calibration mode, press the MODE key.*

If the calibration selection in setup has been changed, press the SETUP key to enter the setup mode. Press the YES key until the CAL SEL (select) prompt is given. Scroll through the calibration options with the ▼ and ▲ keys until CAL MAN is displayed. Press the YES key to select cell constant adjustment (MAN) method. Then press the MODE key to return to Measure mode.

1. Immerse the conductivity cell in the standard. Slightly agitate the cell to remove any air bubbles. Wait for a stable temperature and conductivity value to be displayed.
2. To initiate the cell constant adjustment method, press the CAL key. “CAL MAN” will flash for several seconds and then the “CAL” indicator, the current (or manual) temperature, the non-temperature corrected conductivity value and the last cell constant will flash on the display.
3. Enter the cell constant printed on the cell cable or estimate the cell constant of the cell in use. Scroll the cell constant value, using the ▲ and ▼ keys, until the correct non-temperature compensated value of the conductivity standard is displayed. The measured conductivity value is updated as the cell constant is scrolled. Press the YES key to accept the value. The meter will automatically return to measure mode.

### *AutoCal™*

The AutoCalibration feature, when activated, allows the meter to recognize Orion Conductivity Standards. **Only the following Orion standards may be used: 12.9mS (Orion 011006), 1413µS (Orion 011007) and 100µS (Orion 011008).**

To perform an AutoCalibration, the user must first activate the AutoCalibration feature in setup mode. Then, upon entering Calibration mode, the nominal cell constant or current value in memory must be entered. The meter is then ready to recognize Orion Conductivity Standards. AutoCal can perform calibrations utilizing up to two Orion Conductivity Standards.

> ***NOTE:*** *When a standard is recognized, the nominal standard value (printed on the bottle) is displayed. However, the non-temperature-corrected value is used internally as the calibration value.*

### AutoCal Method

1. To perform an AutoCal, enter the setup menu by pressing the SETUP key. Press the YES key until the CAL SEL (select) prompt is given. Scroll through the calibration options with the ▼ or ▲ until AUTO CAL is displayed. Press the YES key to accept AUTO CAL as your calibration choice. Press the MODE key to return to measurement mode.

   ***NOTE:*** *Calibrate the meter by placing the probe into the conductivity standards starting from low concentration working up to the higher concentrations in order to reduce carryover during calibration. To avoid carryover, always rinse the probe between standards.*

2. Place the conductivity probe into the standard. Slightly agitate the probe to remove air bubbles. **Only the following Orion standards may be used: 12.9mS (Orion 011006), 1413µS (Orion 011007) and 100µS (Orion 011008). Wait for stable temperature and conductivity reading.**
3. Initiate calibration by pressing the CAL key. When "SET CELL" is displayed, the current cell constant will be displayed. This value may be accepted with the YES key or the cell constant may be changed to a nominal value (default is 0.475) using a SCROLL key (▼ or ▲). When the desired cell constant is displayed, press the YES key.
4. The meter will then display P1 to indicate the first calibration point. While the meter is attempting to recognize the standard, dashes (----) will flash on the display.
5. When the meter recognizes a standard, the READY indicator will be displayed simultaneously with the nominal value of the recognized standard displayed. **If the probe input stabilizes without recognizing a standard, the dashes will stop flashing and the READY indicator will be displayed. Press mode key to exit if the standard was not recognized, check the standard and try again (See Troubleshooting section).**
6. When the recognized standard value is displayed, press the YES key.
7. After the first point is accepted, the meter will then display P2 & dashes (----) to indicate the second calibration point  If the operator wishes to add a second point, go to STEP 8. If a one-point calibration is desired, press the MODE key to return to measurement mode.
8. If a two-point calibration is desired, rinse the probe & place it into the

### DirectCal™ Direct Calibration Method

***NOTE:*** *To return to active measurement modes from the calibration mode, press the MODE key.*

1. To perform the Direct Calibration method, enter the setup menu by pressing the SETUP key. Press the YES key until the CAL SEL (select) prompt is given. Scroll through the calibration options with the ▼ or ▲ until CAL DIr is displayed. Press the YES key to enter DirectCal (DIr) mode. Then press the MODE key to return to Measure mode.

   ***NOTE:*** *Calibrate the meter by placing the probe into the conductivity standards starting from low concentration working up to the higher concentrations in order to reduce carryover during calibration. To avoid carryover, always rinse the probe between standards.*

2. Immerse the conductivity cell in the standard. Slightly agitate the cell to remove any air bubbles.

3. Initiate calibration by pressing the CAL key. The “CAL” indicator will be lit and the display will ask “SET P-1?”

4. Press YES to begin. The display will now indicate the current temperature in the top field and the standard value of 199.9µS. Press the CAL key to select the correct standard value range (ranges from 199.9µS to 1999µS to 19.99mS to 199.9mS). Scroll each digit with ▼ or ▲ until the desired value (at the standard temperature) is displayed. Press YES to accept.

   ***NOTE:*** *If “E-22,” cell constant out of range, appears on the display, press the YES key to clear the error. See the* ***Troubleshooting*** *section for corrective action.*

5. The meter will then display “SET P-2?”, if a one-point cal is desired, press the MODE key. The meter will return to measure mode. If two-points are desired immerse call into second standard. Slightly agitate the cell to remove air bubbles. Then repeat steps 4 and 5 to complete the DirectCal. After the second point has been entered, the meter will automatically return to measure mode.

### Multipoint Calibration Method

**NOTE:** *To return to active measurement modes from the calibration mode, press the MODE key.*

1. To perform the multipoint calibration method, enter the setup menu by pressing the SETUP key. Press the YES key until the CAL SEL (select) prompt is given. Scroll through the calibration options with the ▼ or ▲ until CAL MUL is displayed. Press the YES key to enter multipoint (MUL) mode. Then press the MODE key to return to Measure mode.

   **NOTE:** *Calibrate the meter by placing the probe into the conductivity standards starting from low concentration working up to the higher concentrations in order to reduce carryover during calibration. To avoid carryover, always rinse the probe between standards.*

2. Immerse the conductivity cell in the standard. Slightly agitate the cell to remove any air bubbles.

3. Initiate calibration by pressing the CAL key. The "CAL" indicator will be lit and the display will ask "SET P-1?"

4. Press YES to begin. The display will now indicate the current temperature in the top field and the standard value of 199.9µS. Press the CAL key to select the correct standard value range (ranges from 199.9µS to 1999µS to 19.99mS to 199.9mS). Scroll each digit with ▼ or ▲ until the desired value (at the standard temperature) is displayed. Press YES to accept.

   **NOTE:** *If "E-22," cell constant out of range, appears on the display, press the YES key to clear the error. See the* ***Troubleshooting*** *section for corrective action.*

5. Once the meter has stabilized and accepts the value, the meter will then display "SET P-2?", To continue, immerse the conductivity cell into the second standard and then repeat step 4. This step must be repeated until the desired number of points are entered (up to 5 points) to complete the Multipoint Cal. If only calibrating up to 4 points, press MODE key to end calibration and to display average cell constant. After the final calibration point has been entered, press the MODE key. The meter will return to measurement mode after flashing the average call constant.

### Auto Range Selection

The 162A features automatic range selection. The most accurate range is automatically chosen by the meter based on the sample's conductivity value. A small amount of overlap is provided between all ranges to avoid "range flip" when measuring a sample whose conductivity is near the end of a range.

### Temperature Compensation and Measurement

The Orion 162A automatically compensates for temperature changes based on the temperature coefficient and the reference temperature when a temperature measurement is simultaneously made by the temperature probe or manually entered into the meter. The temperature coefficient, reference temperature, and manual temperature input are accessed in the SETUP mode. Most Orion probes have built-in temperature sensors.

### Temperature Coefficients

The Orion 162A has a default temperature coefficient of 2.1%/˚C. The temperature coefficient can be adjusted from 0.0 to 10.0%/˚C. The temperature coefficient may also be set to either of the non-linear functions. The ultra-pure non-linear function (nLFu) is most helpful in measuring ultra-pure waters. The natural non-linear function (nLFn) is most helpful in measuring natural waters.

> ***NOTE:*** *If the coefficient is set to zero, the conductivity reading will not be temperature compensated to the reference temperature and the TC icon on the display will not be lit. The displayed value is the actual conductivity of the sample at its current temperature.*

**To adjust the temperature coefficient:**

1. Press the SETUP key to enter the Setup mode.
2. When "TC" is displayed, 2.1%/˚C or the last temperature coefficient in memory will be displayed.
3. Use the ▼ or ▲ key to change the value.
4. Press the YES key to accept the new value.
5. Return to Measure mode by pressing the MODE key.

### Reference Temperature (rEF)

When temperature compensation is activated, the conductivity value is referenced back to 25 or 20 ˚C. The default is 25 ˚C.

**To adjust the reference temperature:**

1. Press the SETUP key to enter the Setup mode.
2. Press the YES key until “rEF” is displayed. The current reference temperature will be displayed.
3. Use the ▼ or ▲ key to toggle between 25 ˚C and 20 ˚C.
4. Acknowledge the change by pressing the YES key.
5. Return to Measure mode by pressing the MODE key.

### Automatic Temperature Compensation

When a conductivity cell with an integral temperature sensor or a temperature probe is connected, the meter automatically recognizes the connection and the “MAN” Indicator will be turned off. The measured values are automatically temperature corrected based on the entered temperature coefficient and reference temperature.

### Manual Temperature Compensation

Temperature corrected values based on the manually entered temperature, temperature coefficient and reference temperature will be displayed. It is recommended that the temperature of the sample be accurately determined for use with this method. Errors of 1% to 3% per ˚C are typically encountered if the effects of temperature are ignored.

> ***NOTE:*** *A temperature sensor must not be connected to the meter for manual temperature compensation. If a temperature sensor is connected, the manual temperature function cannot be accessed.*

1. Press the SETUP key to enter the Setup mode.
2. Press the YES key until “MAN” is displayed.
3. Using the ▼ and ▲ keys, adjust the displayed temperature to the sample temperature.
4. Press the YES key to accept the value.
5. Return to Measure mode by pressing the MODE key.

### No Temperature Compensation

Setting the temperature compensation (coefficient) to 0.0 can be used for conductivity, TDS and resistivity measurements only. When 0.0 is entered, the displayed value is the actual conductivity of the sample at its current temperature.

> ***NOTE:*** *In Salinity mode, all measurement values are temperature compensated. If a temperature probe is not plugged into the meter, manual temperature compensation, at the currently entered manual temperature setting (default of 25 ˚C), is used.*

1. Press the SETUP key to enter the Setup mode.
2. When "TC" is displayed, the last temperature coefficient in memory will be displayed.
3. Use the ▼ key to change the value to 0.0%/˚C.
4. Acknowledge the change by pressing the YES key.
5. Return to Measure mode by pressing the MODE key.

### Measurement with an External Temperature Probe

Temperature compensation and measurement is most conveniently accomplished by using an Orion Conductivity cell with an integral temperature sensor. A conductivity cell with a dual banana plug and a separate temperature probe may be used on the Orion 162A with an adapter, Orion 010023. Temperature probes, which may be used on the Orion 162A, are Orion 917005, 917006 and 917007.

## Data Logging

The Orion 162A has a data log that can store up to 200 data points. Each data point will include the active measurement value, the temperature, the date and time of logging. Readings may be stored to the data log either manually or automatically. If the meter is set up to automatically log data, it may be done either on a timed interval or based on a difference in the reading.

### Manual Storage of Data

1. To log data from any measurement mode, simply press the LOG key. The current reading will be written to the log and a log point (L001 to L200) will be displayed in the lower readout. After display of the logged reading for approximately one second, the display will return to an active reading.
2. A maximum of 200 points can be stored. Attempting to log data after 200 points will result in an "E-26" error message on the display. If this happens, the log must be cleared to continue logging data.

   ***NOTE:*** *If the logged data is not transferred or printed before clearing the log, it will be lost.*

### Automatic Storage of Data

1. To automatically log data from the current measurement mode, simply press the AUTO key followed by the LOG key. The meter will display AUTO LOG OFF. (Be sure to setup meter with autosampler "OFF")
2. Press the ▼ key to cause the meter to display AUTO LOG ON. Then press the YES key.
3. The meter will then display CONT? The YES keystroke will cause the meter to immediately go to measure mode & begin automatically logging data based upon the logging parameters that are currently in the meter memory. The logging will resume from the last logged point in the log. If the user hits the ▼ or ▲ keys then the datalogging option (SET PAR) will be displayed.

4. The SET PAR option allows the user to set up the logging parameters if chosen with the YES key.
5. The SET PAR allows the user to select interval data logging (INT?) or scroll to differential data logging (DIFF?). The user's choice of either INT? or DIFF? should be entered with the YES key. The interval logging (INT) will cause the meter to log points on a timed interval. The interval range is 5 seconds to 60 minutes. The default interval is 1 minute. The differential logging (DIFF) will cause the meter to log points based on a difference in the measurement value. The differential range depends upon the measurement mode that the meter was in before entering the log setup function. The Conductivity differential range is 0.01 µS to 500 mS. The default is 20 µS. The Salinity differential range is 0.1 to 70.0 ppt. The default is 1.0 ppt. The TDS differential range is 1 mg/L to 19900 mg/L. The default is 10 mg/L. The resistivity differential range is 0.001 KΩ-cm to 20.00 MΩ-cm. The default is 1.000 MΩ-cm.
6. Press the ▼ key until the desired option is displayed. Then press the YES key.
7. If the INT option is chosen, the meter will display the current interval in memory. Use the ▼ and ▲ keys to scroll in the desired interval. If the DIFF option is chosen, the meter will display the current difference in memory. Use the ▼ or ▲ keys to scroll in the desired difference.
8. When the desired setting is displayed, press the YES key. The meter will return to measure mode. Automatic logging will then start based upon the parameters that have been established. "AUTO" will appear on the bottom line of the display.

A maximum of 200 points can be stored. Attempting to log data after 200 points will result in an "E-26" error message on the display. If this happens, the log must be cleared to continue logging data.

***NOTE:*** *If the logged data is not transferred or printed before clearing the log, it will be lost.*

### Readout of Stored Data

1. To view data, press the LOG VIEW key from the measurement mode. Point L001, the log point measurement value and the temperature of the data point will be displayed.
2. To view other points, use the ▼ or ▲ keys to scroll through the data.
3. To return to active measurement modes, press the MODE key or the LOG VIEW key.

### Printing of Stored Data

1. To print all the logged data, press the LOG VIEW key from the measurement mode.
2. Press the PRINT key while in LOG VIEW mode to start data transmission. The entire log will be printed. Each data set is separated by one blank line. The following information is printed:

   Date and Time
   Calibration number
   Date and Time of Calibration
   Serial Number
   Calibration Type
   Cell Constant
   Cell Constant2 (if more than 1 point is used)
   Slope
   Temperature Coefficient
   Reference Temperature

   Date and Time of Logging
   Log Point Number
   Mode and measurement value
   Sample Temperature
   Temperature Coefficient
   Reference Temperature

### Erasure of Stored Data

1. To clear all data in the log, exit from log view by pressing the MODE key.
2. Press and hold the LOG CLR key for 2 seconds. The prompt “CLr DAtA???”will be displayed. A YES key strike will clear the log of all data.

   ***CAUTION:*** *This will permanently erase all data from the log. Transfer or print out needed data before clearing the log.*

## Print Function

The Orion 162A allows printing of data points. Each data point will include the current measurement value, the temperature, the date and time of printing, the cell constant, the temperature coefficient and reference temperature for the sample. Readings may be printed either manually or automatically. If the meter is set up to automatically print, it may be done either on a timed interval or based on a difference in the reading. The meter can also be configured to print when the sensor input stabilizes. See **Print on Ready** in **Setup Menu**.

### Manual Printing

To print the current reading to a printer or computer while in any measurement mode, press the PRINT key.

### Automatic Printing

1. To automatically print from the current measurement mode, simply press the AUTO key followed by the PRINT key. The meter will display AUTO PRT OFF.
2. Press the ▼ key to cause the meter to display AUTO PRT ON. Then press the YES key.
3. The meter will then display either STRT? or SET PAR?. The start option (STRT) will cause the meter to immediately go to measure mode & begin automatically printing data based upon the printing parameters that are currently in the meter memory. The parameter settings option (SET PAR) will allow the user to set up the printing parameters.
4. Press the ▼ key until the desired option is displayed. Then press the YES key.
5. The SET PAR allows the user to select interval data logging (INT?) or scroll to differential data logging (DIFF?). The user's choice of either INT? or DIFF? should be entered with the YES key. The interval printing (INT) will cause the meter to print points on a timed interval. The interval range is 5 seconds to 60 minutes. The default interval is 1 minute. The differential printing (DIFF) will cause the meter to print points based on a difference in the measurement value. The differential range depends upon the measurement mode that the meter was in before entering the print setup function. The Conductivity differential range is 0.01 µS to 500 mS. The default is 20 µS. The Salinity differential range is 0.1 to 70.0 ppt. The default is 1.0 ppt. The TDS differential range is 1 to 19900 mg/L. The default is 10 mg/L. The resistivity differential range is 0.001 KΩ-cm to 20.00 MΩ-cm. The default is 1.000 MΩ-cm.
6. Press the ▼ key until the desired option is displayed. Then press the YES key.
7. If the INT option is chosen, the meter will display the current interval in memory. Use the ▼ or ▲ keys to scroll in the desired interval. If the DIFF option is chosen, the meter will display the current difference in memory. Use the ▼ or ▲ keys to scroll in the desired difference.
8. When the desired setting is displayed, press the YES key. The meter will return to measure mode. Automatic printing will then start based upon the parameters that have been established. "Auto" will appear on the bottom line of the display.

# Chapter VI.

## Use with Printers and Computers

One way communication to printers or two-way communication to computers is available on the Orion 162A.

### *RS232 Interface*

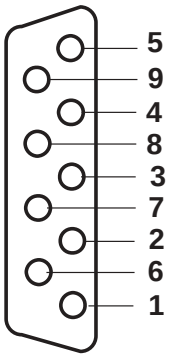



***FIGURE 8***

### *Connections*

| Meter | Pin | Printer | Pin |
|---|---|---|---|
| RXD | 2 | | |
| TXD | 3 | RXD | 3 |
| DSR | 4 | | |
| SIG GND | 5 | SIG GND | 5 |
| DTR | 6 | | |
| RTS | 7 | | |
| CTS | 8 | RTS | 8 |

***NOTE:*** *Jumper 4 + 6 together and to SIG GND.*

### Data Transmission Settings

| | |
|---|---|
| Baud Rate | 1200 (adjustable) |
| Parity (PC only) | None |
| Data Bits (PC only) | 8 |
| Stop Bit (PC only) | 1 |
| Start Bit | 1 |

### Cables and Cable Connections

For Computer, use: DB9 Connector

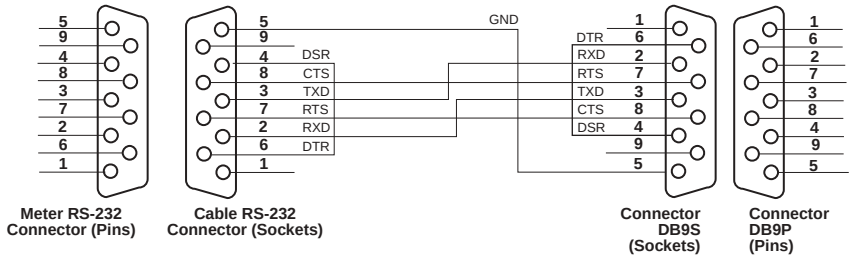



*FIGURE 9*

## Use with Orion 55PR40 and PRT300 Printers

Connect printer Orion 55PR40 or Orion PRT300 to the RS232 connector on the side panel. See Ordering Information for information on printers and accessories.

# Chapter VII

## Interfacing the Orion 162A with the Orion AS3000 Autosampler

The Orion 162A utilizes the capability of the Orion AS3000 Autosampler to automate analysis.

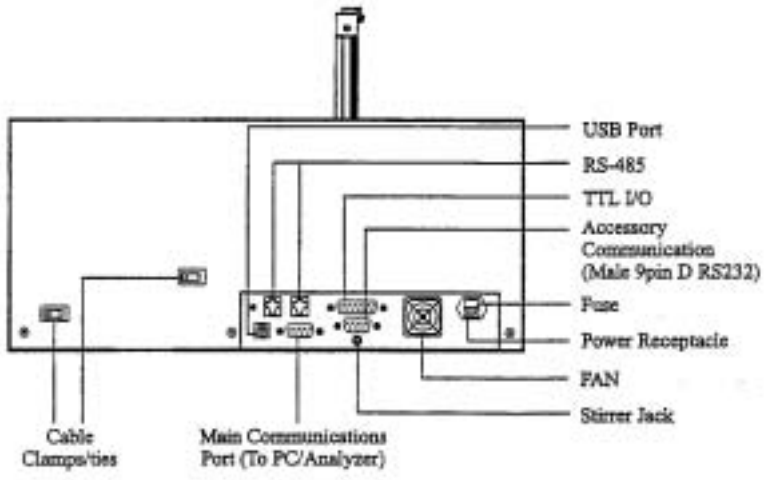
### *Meter Setup*

Press SETUP key to enter SETUP mode and press the YES key until "Auto Sapl" is displayed. Press the ▼ or ▲ key to display "On Auto Sapl" then press the YES key to accept. When re-powering the meter, "Auto Init" will appear on the screen for initializing the autosampler system. Be sure that all correct connections have been made before re-powering the meter. Otherwise press the MODE key to abort autosampler initialization and enter the measure mode immediately. The meter setup menu allows for the following selections:

- Autosampler selectable for ON or OFF. Default is OFF. In order to print while using the Autosampler, the setting must be selected for ON in the setup menu.
- Select Autosampler tray beaker capacity in 18, 28, or 45-beaker capacity. Default is 28.
- Select the number of samples you wish to analyze. This is dependent upon what the previously selected tray capacity. Default is 25.

| Tray Capacity | No. of Rinse Beakers | Sample Selection |
|---|---|---|
| 18 | 3 | 1 to 15 |
| 28 | 3 | 1 to 25 |
| 45 | 3 | 1 to 42 |

- Select the electrode "rinse time" at the rinse station from 5 to 60 seconds. Default is 10 seconds. The rinse beaker positions are 1, 2, and 3.
- Select auto stirrer speed from 0 to 5 (0 off, 5 fastest). Default is 0. If the stirrer is selected on, then the stirrer will be turned on while the electrode(s) are in the sample and rinse beakers.




- Connect the meter to the Orion AS3000 Autosampler via the RS232 cable part number 236931-001. The female connector on the cable plugs into the meter's RS232 input and the male portion of the cable connects to the female 9-pin D RS232 connector (main communications port) of the autosampler. This is labeled port (to PC/Analyzer).
- Connect the printer to the male 9-pin D RS232 connector port (labeled accessory port) on the autosampler and make sure that the autosampler ON has been selected in the setup mode for the meter.
- Connect the stirrer to the port underneath the male 9-pin D RS232 connector.
- Turn the autosampler on and the user can prepare for automated analysis.

The AUTO key is used to initiate the autosampler sequence when the meter is connected to the autosampler via cable part number 236931-001, and if the sequence is already running, the AUTO key is used to pause the sampling sequence. Press the AUTO key when ready in order to continue analyzing the remaining samples.

The autosampler sequence may be aborted at any time by pressing the MODE key.

The user must press the AUTO key to initialize the auto sampling sequence. The autosampler will then move the electrode or electrodes into the rinse beakers. Once the electrode(s) have been rinsed they are then sent to the first sample beaker in the sequence. When the autosampler has achieved a stable reading for all parameters being measured, the data is logged into the meter's memory (Lxxx) and printed. After the meter has logged the readings the sampler will move the electrode(s) into the rinse beaker for the time specified in the setup menu. Once the electrode has been rinsed the autosampler will move the electrode(s) to the next sample in the sequence and will repeat for each subsequent sample.

> ***NOTE:*** *If the data log is full (200-points) before completing a sequence, the sampler will abort the rest of the scheduled sequence so that no data points may be over-written. The user may begin another sequence by first clearing the log from the meter by pressing the "log clr" (log clear) key. This will allow the user to begin the sampling sequence by pressing the AUTO key. Pressing the MODE key aborts the autosampling sequence and returns the electrode holder to home position.*
>
> ***NOTE:*** ***If a possible electrode jam should occur and the red light on the autosampler illuminates, turn the autosampler off for at least 45 seconds while removing any obstructions and then back on to return the electrode holder to home position.***

The sampling cycle can be paused at any time by pressing the AUTO key. The meter screen will then display "paus" indicating that the cycle has been paused. Pressing the AUTO key again starts the sampling sequence at the exact point it was previously paused.

## Error Codes

- The error code for autosampler communication is E-54. Clear the error by pressing the YES key.
- The error code for an autosampler jam is E-55 with red light flashing on the autosampler. Clear the error by pressing the YES key. If the red light is still flashing on the autosampler then turn the autosampler off wait 45 seconds (remove any obstructions), turn on again to clear the error.

Please see the AS3000 Autosampler manual for more detailed information regarding operation of the AS3000 autosampler.

If the red light on the front of the autosampler is blinking then clear any autosampler jams by removing all obstructions before trying to clear the meter error. If the red light continues to blink, turn the autosampler off and after 45 seconds turn it on again to re-initialize the autosampler. Clear the meter error by pressing the YES key and then the meter will go into pause mode. You may then return to the beaker where the error occurred and complete your measurements or press the MODE key to abort.

> ***NOTE:*** *If error occurs, return to the troubleshooting section or call Thermo for technical assistance.*

# Chapter VIII.

## Orion 162A Remote Control Computer Commands

The Orion 162A meter has the capability to be operated by a remote device (computer or terminal). After connecting the meter to the device, press the carriage return (<CR>) to initiate remote control. The commands are as follows (x denotes numeric digit).

| Action | Command | Function |
|---|---|---|
| Entering and exiting remote control | <CR> | Start communication with the first carriage return |
| | CLOC<CR> | Reverts the Orion 162A to normal operation |
| | HELP<CR> | Displays remote control command set |
| Calibration | SCxxxxx<CR> | Performs a manual calibration with the specified cell constant |
| | SD<CR> | Performs DirectCal calibration |
| | SACAL<CR> | Performs AutoCal calibration procedure |
| | SMUL<CR> | Performs Multipoint calibration procedure |
| Setting Temperature Coefficient, Ref. Temperature, and TDS Factor | STCxx.x<CR> | Set temperature coefficient with specified value |
| | SREFxx<CR> | Set reference temperature with specified value |
| | STDSx.xx<CR> | Set TDS Factor, selectable range 0.50 to 1.00 |
| Measure Conductivity and Temperature | CLF<CR> | 0.0 to 199,900 measuring range, autoranging always on |
| Measure Salinity and Temperature | CSAL<CR> | 0.0 to 80 measuring range |
| Measure Resistivity and Temperature | CRES<CR> | 0 to 20 megohm measuring range |
| Measure TDS and Temperature | CTDS<CR> | 0 to 19990 mg/L measuring range |
| Readout of Input Values | RC<CR> | Read cell constant |
| | RTC<CR> | Read temperature coefficient |
| | RREF<CR> | Read reference temperature |
| | RTDS<CR> | Read TDS Factor |

### Command Specifics

***NOTE:*** *Meter must be in a measurement mode to initiate remote operation.*

**1) Logging On/Off**

Before <CR> is entered, meter responds "Not Logged On" to all remote commands. When <CR> is entered, meter responds "Orion 162A Logged On" (meter keypad is now inactive). Meter will enter conductivity measure mode. When CLOC<CR> is entered, meter responds "Logged Off" (power-down always exits remote mode).

**2) Calibrations**

***NOTE:*** *During calibrations, the meter display is active and displays the current measurement with the cell constant in effect applied to the measurement. If a standard is bad, "E-22:BAD STANDARD" is displayed on the terminal and the user is reprompted for the calibration point.*

**a) Manual Calibration (Cell Constant Adjustment): SCxxxxx<CR>**

When SCxxxxx<CR> is entered, the cell constant is checked to be between .0700 and 14.99 and, if valid, it is set. The new cell constant takes effect in the meter's display as well. A confirmation message will be returned: "xxxxx,/cm" or an error message of "INVALID RANGE".

**b) Direct Calibration: SDCAL<CR>**

When SDCAL<CR> is entered, the user is prompted "P1 Value (wait for READY) or 'ESC'(return)". At this point, the user should have the cell in the first standard. When the input stabilizes, the terminal will display the measured conductivity and temperature values: "xxxxxuS Temp xx.xC". The user should enter the standard value "xxxxx<CR>". The terminal will prompt for units: "Enter 'U', 'M' or 'ESC'(return)". The user must enter "M" for millisiemens or "U" for microsiemens. A confirmation message will be returned: "P1=xxxxxu", "P1=xxxxxm" or an error message of "INVALID RANGE".

The entered values MUST conform to the following ranges:

0.0 to 199.9 uS (one decimal place)
200 to 1999 uS (no decimal places)
2.00 to 19.99 ms (two decimal places)
20.0 to 199.9 ms (one decimal place)

Values will be rounded to the appropriate precision.

At this point, a one-point calibration is in effect. The user is prompted "P2 Value (wait for READY) or 'ESC'(return)". If a one point calibration is desired, enter "ESC<CR>". If a two-point cal. is desired, the user should have the cell in the second standard. When the input stabilizes, the user should enter the standard value "xxxxx<CR>". The terminal will prompt for units: "Enter 'U', 'M' or 'ESC'(return)". The user must enter "M" for millisiemens or "U" for microsiemens. A confirmation message will be returned: "P2=xxxxxu", "P2=xxxxxm" or an error message of "INVALID RANGE". The computed cell constant and percent linearity are then displayed on the terminal.

**c) Multipoint Calibration: SMUL<CR>**

Follow the instructions for DirectCal (in section b above). Repeat as necessary for each calibration point.

**d) AutoCal: SACAL<CR>**

***NOTE:*** *Only the following Orion standards may be used: 12.9mS (Orion 011006), 1413µS (Orion 011007) and 100µS (Orion 011008).*

Before AutoCal is entered, the approximate cell constant must be in the meter memory. This can be accomplished by either using the cell constant from the previous calibration or using the Manual Calibration command (SCxxxxx<CR>). The cell should then be placed into the first standard. At this point, the SACAL<CR> command should be entered. The terminal will display "P1, Start to Measure?" An affirmative response (Y<CR>) will cause the meter to attempt to recognize the standard. To cancel the calibration, enter "ESC<CR>".

If the standard is not recognized, the terminal will display “No Standard Found ‘ESC<CR>’ to exit, <CR> to continue:”. The calibration standard should be checked. To cause the meter to reattempt to recognize the standard, enter “<CR>”. To cancel the calibration, enter “ESC<CR>”. If the standard is recognized, the terminal will display “Value=xxxxxm” for millisiemens or “Value=xxxxxu” for microsiemens. Then the terminal will prompt for the second calibration point “P2, Start to Measure?”.

If a one point calibration is desired, enter “ESC<CR>”. The terminal will display “1 Pt Cal Complete” followed by the cell constant (xxxxx,/cm). If a two point cal. is desired, the cell should be placed into the second calibration standard. The meter then attempts to recognize the standard. When the standard is recognized, the terminal will display “Value=xxxxxm” for millisiemens or “Value=xxxxxu” for microsiemens. Then the terminal will display “2 Pt Cal Complete” followed by the cell constant (xxxxx,/cm) and the percent linearity (% Linearity= xxx.x).

**3) Setting Temperature Coefficient and Reference Temperature**

**a) Temperature Coefficient**

When “STCxx.x<CR>” is entered, the temperature coefficient is checked to be between 0.0 and 10.2 and set. If 0.0 is entered, Temp Compensation is disabled. If 10.1 is entered, Temp Coefficient is set to nLFn. If 10.2 is entered, Temp Coefficient is set to nLFu. The terminal response is either “TC = xx.x” or “INVALID RANGE”.

**b) Reference Temperature**

When “SREFxx<CR>” is entered, the reference temperature is checked to be 20 or 25 and set. The terminal response is either “RT = xx.0” or “INVALID RANGE”.

**4) Measurement**

When “CLF<CR>” is entered, conductivity and temperature are displayed on the terminal as “xxxxx, uS/cm*, 27.2˚C”.
* or mS/cm

When “CRES<CR>” is entered, resistivity and temperature are displayed on the terminal as “xxxxx,Kohm-cm*,27.2˚C”.
* or Mohm-cm

When “CSAL<CR>” is entered, salinity and temperature are displayed on the terminal as “xx.x,SAL,27.2˚C”.

When “CTDS<CR>” is entered, TDS and temperature are displayed on the terminal as “xxxxx,mg/L,27.2˚C”.

If a measurement is requested and the meter is autoranging, “AUTORANGING” will be displayed on the terminal. The user must input another display command.

# Chapter IX.
# Troubleshooting

## *Operator Assistance Codes*

| Displayed Error Message | Cause | Action |
|---|---|---|
| E-02 | Memory failure | Call Thermo for service |
| E-03 through E-06 | Hardware failure | Disconnect the conductivity cell and repeat the self test |
| E-07 | Keypad failure | Repeat the self-test insuring that all keys are pressed within 4 seconds during test 7. If problem persists, call Thermo for service |
| E-20 | Reading out of range | Adjust cell constant<br>Verify cell constant is appropriate for sample conductivity |
| E-22 | Cell Constant out of range | Calibrate with fresh standards.<br>Clean conductivity cell<br>Replatinize conductivity cell (if applicable) |
| E-26 | Data logger full | Clear data from memory<br>***NOTE:*** *Print out any needed logged data before clearing the log.* |
| E-29 | Printer error | Verify printer is attached<br>Verify printer is on<br>Check printer operation (on line) |
| E-40 | Memory checksum error | Call Thermo for service |
| E-54 | Autosampler communication | Clear the error by pressing the YES key |
| E-55 | Autosampler jam | Clear the error by pressing the YES key.<br>If the red light is still flashing on the autosampler then turn the autosampler of, wait 45 seconds (remove any obstructions) turn on again to clear the error. |

# Chapter X.

## Assistance

After troubleshooting all components of your measurement system, contact The Technical Edge℠ for Orion products. Within the United States call 1.800.225.1480, outside the United States call 978.232.6000 or fax 978.232.6031. In Europe, the Middle East and Africa, contact your local authorized dealer. For the most current contact information, visit www.thermo.com.

For the most current warranty information, visit www.thermo.com.

# Chapter XI.

## Warranty

For the most current warranty information, visit www.thermo.com.

The Thermo Electron Corporation, Orion products warranty covers failures due to manufacturer's workmanship or material defects from the date of purchase by the user. User should return the warranty card and retain proof of purchase. Warranty is void if product has been abused, misused, or repairs attempted by unauthorized persons.

Warranties herein are for product sold/installed by Thermo or its authorized dealers.

Any product sold by a U.S. or Canadian distributor must be returned to Thermo for any warranty work. Please contact our Technical Service department for further information. A Return Authorization Number must be obtained from The Technical EDGE℠ for Orion Products before returning any product for in-warranty repair or replacement.

In the event of failure within the warranty period, Thermo will at the company's option, repair or replace product not conforming to this warranty. There may be additional charges, including freight, for warranty service performed in some countries. For service, call Thermo or its authorized dealer outside the United States and Canada. Thermo reserves the right to ask for proof of purchase, such as the original invoice or packing slip.

Field Service is available on Orion BOD AutoEZ™, EZ Flash® GC Accessory and TEA Analyzer®. Contact our Field Service department for details on quotations and service, other field service-related activities.

The following products are warranted to be free from defects in material and workmanship in the period listed below from the date of purchase from the user or from the date of shipment from Thermo, whichever is earlier, provided use is in accordance with the operating limitations and maintenance procedures in the instruction manual and when not having been subjected to accident, alteration, misuse, abuse or breakage of electrodes:

Thirty-six months from date of purchase by the user (or forty-two months from date of shipment from Thermo)

- Waterproof Meters (Orion 630, 635, 830A, 835A, 260A, 261S, 265A, 266S, 130A, 131S, 135A and 136S), Conductivity Meters (Orion 105Aplus, 115Aplus, 125Aplus, 145Aplus, 150Aplus and 162A), PerpHect® pH/ISE Meters (Orion 310, 320, 330, 350, 370) pH/ISE Meters (Orion 210Aplus, 230Aplus, 250Aplus, 290Aplus, 410Aplus, 420Aplus, 520Aplus, 525Aplus, 710Aplus, 720Aplus and 920Aplus), pHuture MMS™ Meters (Orion 535A and 555A), pH/Conductivity Meter (Orion 550A), Dissolved Oxygen Meters (Orion 805Aplus, 810Aplus, 850Aplus and 862A).

Twenty-four months from date of purchase by the user (or thirty-six months from date of shipment from Thermo)

- Orion ROSS Ultra® Electrodes, Orion AQUAfast® IV Colorimeters, Orion AQUAfast® IV Turbidimeter, Orion 925 Flash Titrator™, Series 100 DuraProbe™ Conductivity Cells and Series 800 Dissolved Oxygen Probes.

Twelve months from date of purchase by the user (or eighteen months from date of shipment from Thermo)

- Laboratory pH Meters, (Orion 301, 611 and 940), SensorLink®, pHuture™ pH Meters (Orion 610 and 620), Sage® Pumps, Cahn® Balances, 930 Ionalyzer®, 950 ROSS™ FAST QC™ Titrator, 960 Titrator PLUS®, Karl Fischer Titrators, Autosamplers, Liquid Handling Devices, Liquid Handling Automation Workstations (Orion AS2000, AS2500 and AS4000), Pumps (Orion SP201, SP201-HR, SP201-S, Peristaltic and Rinse), pHuture® Conversion Box, Wine Master®, 607 Switchbox, rf link™, AQUAfast® II Colorimeters, Vacuum Degasser and Flowmeter.
- Orion EZ Flash® GC Accessory, Orion TEA Analyzer® 610 and 510 excluding consumable items carry twelve months warranty only.
- Orion Ion Selective Electrodes, ionplus® Electrodes, ROSS™ Electrodes, Sure-Flow® Electrodes, PerpHecT® Electrodes, AquaPro Professional Electrodes, No Cal™ pH electrodes, Standard Line pH Electrodes, Tris pH Electrodes, KNIpHE® electrode, ORP Triode™ (Orion 9180BN), pHuture™ pH Probes (Orion 616500) and pHuture MMS™ Quatrode™ and Triode™ (Orion 616600 and 617900), Orion 97-08 DO Probe, Series 100 Conventional Conductivity Cells, temperature probes and compensators (except those products noted).

- Orion 93 and 97 ionplus Series sensing modules are warranted to give six months of operation if placed in service before the date indicated on the package, except 93-07 and 97-07 Nitrate modules are warranted to give ninety days of operation if placed in service before the date indicated on the package.

Six months from date of purchase by the user (or twelve months from date of shipment from Thermo)

- Orion Flash Titration™ Probe (Orion 092518), pHuture™ Electrode (Orion 615700), pHuture MMS™ Pentrode™ (Orion 617500), Quatrode™ (Orion 617800) and Triode™ (Orion 615800), Low Maintenance Triode™ (Orion 9107BN), ORP Low Maintenance Triode™ (Orion 9179BN), and PerpHecT® Low Maintenance Triode™ (Orion 9207BN), Waterproof Triode™ (Orion 9107WP, 9107WL, 9109WL and 9109WP), QuiKcheK® Meters and Micro Electrodes.

Three months from date of purchase by the user (or six months from date of shipment from Thermo)

- Economy Line Electrodes, Orion 91-05, 91-06, 91-15, 91-16, 91-25, 91-26, 91-35, 91-36, 92-06. Warranty also includes failure for any reason (excluding breakage), except abuse, provided the electrode is not used in solutions containing silver, sulfide, perchlorate, or hydrofluoric acid; or in solutions more than one (1) Molar in strong acid or base at temperatures above 50 °C.

“Out-of-Box” Warranty - Should any of the following products fail to work when first used, contact Thermo immediately for replacement.

- Orion Solutions, Standards, Reagents, Cables, Ferrules, Tubing, Line adapters, Printers, Software, Cases, Stands, Probe Membranes, AQUAfast® Test Strips, EZ Flash® columns, Liquid Handling Probes, Adapter Plates and Racks and general accessories.

For products in the catalog not listed in this warranty statement, please visit our website at: www.thermo.com

THE WARRANTIES DESCRIBED ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER STATUTORY, EXPRESS OR IMPLIED INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A

PARTICULAR PURPOSE AND ALL WARRANTIES ARISING FROM THE COURSE OF DEALING OR USAGE OF TRADE. THE BUYER'S SOLE AND EXCLUSIVE REMEDY IS FOR REPAIR OR REPLACEMENT OF THE NON-CONFORMING PRODUCT OR PART THEREOF, OR REFUND OF THE PURCHASE PRICE, BUT IN NO EVENT SHALL THERMO (ITS CONTRACTORS AND SUPPLIERS OF ANY TIER) BE LIABLE TO THE BUYER OR ANY PERSON FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHETHER THE CLAIMS ARE BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE), OR OTHERWISE WITH RESPECT TO OR ARISING OUT OF THE PRODUCT FURNISHED HEREUNDER.

REPRESENTATION AND WARRANTIES MADE BY ANY PERSON, INCLUDING ITS AUTHORIZED DEALERS, REPRESENTATIVES AND EMPLOYEES OF THERMO WHICH ALTER OR ARE IN ADDITION TO THE TERMS OF THIS WARRANTY SHALL NOT BE BINDING UPON THERMO UNLESS IN WRITING AND SIGNED BY ONE OF ITS OFFICERS.

# Chapter XII.

## Notice of Compliance

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

“This digital apparatus does not exceed the (Class A) limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.”

“Le prÈsent appareil numÈrique n’ Èmet pas de bruits radioÈlectriques dÈpassant les limites applicables aux appareils numÈriques (de la class A) prescrites dans le RËglement sur le brouillage radioÈlectrique ÈdictÈ par le ministËre des Communications du Canada.”

# Chapter XIII.
## *Declaration of Conformity*

**Thermo Electron Corporation**

***Manufacturer:***

Thermo Electron Corporation
166 Cummings Center
Beverly, MA 01915 U.S.A.

***hereby declares that the product***

162A Benchtop Conductivity Meter

***conforms with the following standards and documents***

| | | |
|---|---|---|
| **Safety** | EC Directive 72/23/EEC Low Voltage Directive | |
| | IEC 1010 Safety For Laboratory Equipment | |
| | UL 1262 Laboratory Equipment | |
| | CSA C22.2 No. 151 Laboratory Equipment | |
| **EMC** | EC 89/336/EEC Electromagnetic Compatibility | |
| | **Emissions:** | EN 55022 Emissions |
| | | FCC Part 15 Class A |
| | **Immunity:** | EN 50082-1 Generic Immunity |
| | | IEC 801-2 ESD Susceptibility |
| | | IEC 801-3 Radiated Susceptibility |
| | | IEC 801-4 Conducted Susceptibility |

**These Orion products have been manufactured in compliance with the provisions of the relevant Thermo Electron manufacturing and test documents and processes. Further, these documents and processes are recognized as complying with ISO 9000:2000 by QMI, listed as File # 001911.**

Place and date of issue:

Beverly, MA.

June, 2003

John Meserve

Quality Assurance Manager

# Chapter XIV.
## Specifications

### *Meter Performance Specifications*

**Conductivity measurement**

| | |
|---|---|
| Conductivity range | 0 to 500 mS/cm |
| Conductivity resolution (µS/cm) | 0.01 |
| Conductivity accuracy | 0.5% ± 1 digit |
| Auto ranging | Yes |
| Cell constant | 0.07-14.99 |
| Cell types | 2 or 4 electrode cells with thermosensor |

**Resistivity measurement**

| | |
|---|---|
| Resistivity range | 0-20 MΩ-cm |
| Resistivity resolution | 0.02 of current range |
| Resistivity accuracy | 0.5% ± 1 digit |

**Salinity measurement**

| | |
|---|---|
| Salinity range | 0.0 to 80.0 ppt |
| Salinity resolution | 0.1 |
| Salinity accuracy | ± 0.1 |

**TDS measurement**

| | |
|---|---|
| Range | 0 to 19,900 mg/L |
| Resolution | 1 mg/L |
| Accuracy | ± .5% |

**Temperature measurement**

| | |
|---|---|
| Temperature range | -5.0 to 105.0 ˚C |
| Temperature resolution | 0.1 |
| Temperature accuracy | ± 0.1 ˚C |
| Reference temperature | 20.0 or 25.0 ˚C |
| Temperature compensation | Linear adj. (0.0-10.0%/˚C), nLFn, nLFu |

**Inputs**

| | |
|---|---|
| Probe connection | 8 pin DIN |
| Separate temperature probe | 3.5 mm |

**Outputs**

| | |
|---|---|
| Two way RS232 | yes |
| Recorder output | yes |

**Data Management**

| | |
|---|---|
| Data log points | 200 |
| Timed print | yes |
| Automatic datalogging/printing | yes |
| Log interval | 5 secs. - 1 hour, or user defined threshold |

**Power**

| | |
|---|---|
| 110/115/220/240 line adapter | yes |

# Chapter XV.

## Ordering information

| Orion | Description |
|---|---|
| 0162A0 | Orion 162A and Conductivity Cell 013005A, 110V |
| 013016A | Two Electrode Conductivity Cell with Integral Temperature Sensor, Stainless Steel, K=0.1 |
| 018020A | Two Electrode Conductivity Cell with Integral Temperature Sensor, Glass/Platinum K=10.0 |
| 013005A | Four Electrode Conductivity Cell with Integral Temperature Sensor, Epoxy/graphite, K = 0.475, 1.5 meter Cable |
| 013610 | Four Electrode Conductivity Cell with Integral Temperature Sensor, Epoxy/graphite, K = 0.55, 3 meter cable |
| 010500 | Orion 105 and Orion 011510 Conductivity Cell |
| 010502 | Orion 105, meter only |
| 011500 | Orion 115 and Orion 011510 Conductivity Cell |
| 011502 | Orion 115, meter only |
| 011510 | Conductivity Cell with Integral Temp.Sensor, Epoxy/graphite, K = 1.0 |
| 012500 | Orion 125 and Orion 013005A Conductivity Cell |
| 012502 | Orion 125, meter only |
| 014500 | Orion 145 and Orion 011510 Conductivity Cell |
| 014502 | Orion 145, meter only |
| 0145US | USP Package including Orion 145 meter, AC adapter, conductivity cell, cell adapter, calibration kit and conductivity standard |
| 015000 | Orion 150 and Conductivity Cell, Orion 013005A |
| 015002 | Orion 150, meter only |

| Orion | Description |
|---|---|
| 0150US | USP Package including Orion 150 meter, AC adapter, conductivity cell, cell adapter, calibration kit and conductivity standard |
| 010023 | Adapter for cells with banana plugs and ATC |
| 011010A | Conductivity Cell, Glass, K = 1.0, 8 pin WP DIN |
| 011020A | Conductivity Cell, Glass, K = 0.1, 8 pin WP DIN |
| 011050A | Conductivity Cell, Epoxy, K = 1.0, 8 pin WP DIN |
| 917005 | ATC Probe, Epoxy Body |
| 917006 | ATC Probe, Glass Body |
| 917007 | ATC Probe, Stainless Steel |
| 011006 | Conductivity/TDS Standard, 12.9 mS/cm, 7230 ppm as NaCl, 5 x 60 mL Bottles |
| 011007 | Conductivity/TDS Standard, 1413 µS/cm, 692 ppm as NaCl, 5 x 60 mL Bottles |
| 011008 | Conductivity/TDS Standard, 100 µS/cm, 47 ppm as NaCl, 5 x 60 mL Bottles |
| 011221 | Calibration Kit, 4 precision conductance/resistance calibrators in container |
| 020125 | Line Adapter, 110 V |
| 020130 | Line Adapter, 220 V |
| 020135 | Line Adapter, 240 V |
| 0ACBL0 | Cable, RS232, for use with IBM PC compatible |
| PRT 300 | Ink Based Printer, 110 V, Cable Included |
| PRT 301 | Ink Based Printer, 220 V, Cable Included |
| PRT 302 | Replacement Printer Ribbon |
| 55PR40 | Orion 550PR40 Printer, 115 V |
| 55PR49 | Orion 550PR49 Printer, 220 V |

Thermo offers a variety of probe accessories, materials & cable lengths. Refer to the Laboratory Products Catalog or call Customer Service.

**Environmental Instruments**
Water Analysis

**North America**
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Beverly, MA 01915 USA
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Dom. Fax: 978-232-6015
Int'l. Fax: 978-232-6031

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12-16 Sedgeway Business Park
Witchford, Cambridgeshire
England, CB6 2HY
Tel: 44-1353-666111
Fax: 44-1353-666001

**Far East**
Room 904, Federal Building
369 Lockhart Road
Wanchai, Hong Kong
Tel: 852-2836-0981
Fax: 852-2834-5160

**Customer Support**
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**For updated contact information, visit www.thermo.com**

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