1 YEAR WARRANTY

MADE IN USA

CE

User's Guide

CDCN674
Electrodeless Analyzer

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IMPORTANT SAFETY INFORMATION

This analyzer is compliant with safety standards as outlined in:

FMRC Class Numbers 3600, 3611, and 3810 (U.S.A.)
CSA C22.2 No. 142 and C22.2 No. 213 (Canada)
EN 61010-1 (European Community)

Please read and observe the following:

- Line voltage may be present at terminals on TB1 at the back of the analyzer enclosure. This may be hazardous. Always remove line power before going near this area of the analyzer. The front bezel assembly of the analyzer, however, contains only low voltage and is completely safe to handle.
- Wiring or repairs should only be performed by qualified personnel and only to an unpowered analyzer.
- Whenever it appears that analyzer safety is questionable, disable the analyzer to ensure against any unintended operation. For example, an unsafe condition is likely when:

  1) The analyzer appears visibly damaged.
  2) The analyzer fails to operate properly or provide the intended measurements.
  3) The analyzer has been stored for long periods at temperatures above 158°F (70°C).

- This analyzer must be installed by specially trained personnel in accordance with relevant local codes and instructions contained in this operating instruction manual. Observe the analyzer's technical specifications and input ratings. If one line of the line power mains is not neutral, use a double-pole mains switch to disconnect the analyzer.

HELPFUL IDENTIFIERS

In addition to information on installation and operation, this instruction manual may contain WARNINGS pertaining to user safety, CAUTIONS regarding possible instrument malfunction, and NOTES on important, useful operating guidelines.

WARNING:

A WARNING LOOKS LIKE THIS. ITS PURPOSE IS TO WARN YOU OF THE POTENTIAL FOR PERSONAL INJURY.

CAUTION:

A CAUTION LOOKS LIKE THIS. ITS PURPOSE IS TO ALERT YOU TO POSSIBLE INSTRUMENT MALFUNCTION OR DAMAGE.

NOTE: *A note looks like this. Its purpose is to alert you to important operating information.*

Definition of Equipment Symbols

This symbol **means CAUTION** and alerts you to possible danger or instrument malfunction. Refer to this manual before proceeding.

This symbol, which appears on the analyzer POWER terminal block (shown in Figure 2-2), **means that this is a protective ground terminal** and alerts you to connect an earth ground to it.

This symbol **means that there is alternating current present** and alerts you to be careful.

CONDENSED OPERATING INSTRUCTIONS

This manual contains details for all operating aspects of the instrument. The following condensed instructions are provided to assist you in getting the instrument started up and operating as quickly as possible. **These condensed instructions only pertain to basic conductivity measurement operation.** To measure % concentration or TDS, or to use specific features of the instrument, refer to the appropriate sections in this manual for instructions.

A. CONNECTING SENSOR/CONFIGURING TEMPERATURE ELEMENT TYPE

1. After the analyzer is properly mounted (Part Two, Section 2), connect the OMEGA electrodeless conductivity sensor, matching wire colors to terminals as indicated:

Sensor Wire Colors	Connect To
Blue	Terminal #5 on TB3
White	Terminal #6 on TB3
Red	Terminal #7 on TB3
Clear (inner shield wire)	Terminal #8 on TB3
Yellow	Terminal #9 on TB3
Green	Terminal #10 on TB3

NOTE: *For best immunity to electromagnetic interference, connect the sensor cable's outer shield wire (clear with black band -- not its clear only inner shield wire) to a "SENSOR SHIELD (OUTER)" terminal on TB2.*

2. The analyzer is supplied factory-set for automatic temperature compensation using the Pt 1000 ohm temperature element built into OMEGA electrodeless conductivity sensors. If you want fixed MANUAL temperature compensation, you must change the temperature element type (see Part Three, Section 3.2, subheading "Selecting Temperature Element Type").

B. CONNECTING LINE POWER

Important: Follow the instructions in Part Two, Section 3.4 to connect line power to the analyzer.

C. CALIBRATING THE ANALYZER

The analyzer must be calibrated so that measured values will correspond to actual process values. Preferably, use the "COND CAL" calibration method to enter the known value of a properly prepared conductivity reference solution. (When using a sample of the process to calibrate, use the "SAMPLE CAL" method to enter its known value determined by laboratory analysis or a comparison reading.)

Calibration Tip! Each electrodeless conductivity sensor has a unique zero point and offset. Consequently, when calibrating a sensor for the first time, always zero it according to step 1. Zeroing provides the best possible measuring accuracy.

NOTE: *An in-progress calibration can always be aborted by pressing the **ESC key**. After the "ABORT: YES?" screen appears, do one of the following:*

- *Press **ENTER key** to abort. After the "CONFIRM ACTIVE?" screen appears, press **ENTER key** to return analog outputs and relays to their active states, and display to the MEASURE screen.*
- *Use ⇧ **or** ⇩ **key** to choose "ABORT: NO?" screen, and press **ENTER key** to continue calibration.*

1. Zero the sensor if it is being calibrated for the first time. If not, disregard this step and perform steps 2 through 16.

Zeroing Tip! If at any time during zeroing, the "ZERO: CONFIRM FAILURE?" screen appears, press **ENTER key** to confirm. Then, use the ⇧ **or** ⇩ **key** to select between "CAL REPEAT?" or "CAL EXIT?" and do one of the following:

(continued on next page)

CONDENSED OPERATING INSTRUCTIONS

C. CALIBRATING THE ANALYZER -- (continued)

- With the "ZERO: CAL REPEAT?" screen selected, press **ENTER key** to repeat zeroing.
- With the "ZERO: CAL EXIT?" screen selected, press **ENTER key**. After the "ZERO: CONFIRM ACTIVE?" screen appears, press **ENTER key** to return the analog outputs and relays to their active states (MEASURE screen appears).

A. Make sure that the sensor is dry before zeroing.

B. Press **MENU key** to display
```
≡MAIN MENU
▶CALIBRATE          ↓
```
.

C. Press **ENTER key** to display
```
≡CALIBRATE
▶SENSOR             ↓
```
.

D. Press **ENTER key** again to display
```
≡SENSOR
▶COND CAL           ↓
```
.

E. Press ⇩ **key** twice to display
```
≡SENSOR
▶ZERO               ↓
```
.

F. Press **ENTER key** to display
```
ZERO?
(HOLD OUTPUTS    )
```
.

G. Press **ENTER key** again to "hold" the analog outputs and relays at their present states during zeroing. (Outputs can also be transferred to preset values or allowed to remain active.)

H. With the "ZERO: IN DRY AIR?" screen displayed and the dry sensor held in air, press **ENTER key** to start the automatic zeroing.

I. After the "ZERO: CONFIRM ZERO OK" screen appears, press **ENTER key** to end zeroing.

J. After the "ZERO: CONFIRM ACTIVE?" screen appears, press **ENTER key** to return the analog outputs and relays to their active states (MEASURE screen appears).

2. Prepare a reference solution that has a conductivity value within the measuring range that you set for the analyzer. For best accuracy, the conductivity reference solution value should be near the typical measured process value. Refer to step 1 and Table F in Part Three, Section 4.3, subsection "COND CAL Method" for preparation details.

3. Thoroughly rinse the clean sensor in de-ionized water. Then immerse the sensor in the prepared reference solution. **Important:** Allow the sensor and solution temperatures to equalize. Depending on their temperature differences, this may take up to 30 minutes.

NOTE: *Suspend the sensor to prevent it from touching the container. Simply laying it into the container will produce calibration error.*

Calibration Tip! If at any time during calibration, the "COND CAL: CONFIRM FAILURE?" screen appears, press **ENTER key** to confirm. Then, use the ⇧ **or** ⇩ **key** to select between "CAL REPEAT?" or "CAL EXIT?" and do one of the following:

- With the "COND CAL: REPEAT?" screen selected, press **ENTER key** to repeat calibration of the point.
- With the "COND CAL: CAL EXIT?" screen selected, press **ENTER key**. Then, after the "COND CAL: CONFIRM ACTIVE?" screen appears, press **ENTER key** to return the analog outputs and relays to their active states (MEASURE screen appears).

(continued on next page)

CONDENSED OPERATING INSTRUCTIONS

C. CALIBRATING THE ANALYZER -- (continued)

4. Press **MENU key** to display
```
≡MAIN MENU
▶CALIBRATE          ↓
```
.

5. Press **ENTER key** to display
```
≡CALIBRATE
▶SENSOR             ↓
```
.

6. Press **ENTER key** again to display
```
≡SENSOR
▶COND CAL           ↓
```
.

7. Press **ENTER key** again to display
```
COND CAL?
(HOLD OUTPUTS       )
```
.

8. Press **ENTER key** again to "hold" the analog outputs and relays at their present states during calibration. (Outputs can also be transferred to preset values or allowed to remain active.)

9. With the
```
ENTER REF TEMP?
(25.0 °C            )
```
screen displayed, use ⇧ **and** ⇩ **keys** to adjust the displayed temperature to match the known temperature of the reference solution. Then press the **ENTER key**.

10. With the
```
ENTER SLOPE?
(2.00 %/°C          )
```
screen displayed, use ⇧ **and** ⇩ **keys** to adjust the displayed % per °C value to match the known slope of the reference solution. Then press the **ENTER key**.

NOTE: *Measured values are normally compensated using the configured temperature compensation method. While using the "COND CAL" method to calibrate, the measured reference solution is linearly compensated by these entered reference temperature and slope values.*

11. With the
```
COND CAL:
SAMPLE READY?
```
screen displayed and the sensor in the solution, press **ENTER key** to confirm. This active
```
XXXX uS/cm
READING STABLE?
```
screen appears showing the measured reference solution value.

12. Wait for the reading to stabilize which may take up to 30 minutes. Then press **ENTER key**. The "PLEASE WAIT" screen may appear if the reading is still too unstable. After the reading has stabilized, this static
```
COND CAL?
(XXXX uS/cm         )
```
screen appears showing the "last-measured" value.

13. Use the ⇧ **and** ⇩ **keys** to adjust the displayed value to exactly match the known value of the reference solution.

14. Press **ENTER key** to enter the value and complete calibration ("CONFIRM CAL OK?" screen appears).

15. Re-install the sensor into the process.

16. Press **ENTER key** to display the active measurement reading on the "CONFIRM ACTIVE?" output status screen. When the reading corresponds to the actual typical process value, press **ENTER key** again to return the analog outputs and relays to their active states (MEASURE screen appears).

This completes "COND CAL" calibration. The analyzer is now ready to measure conductivity.

NOTE: *To change MEASURE screen display format, for example from 0-2000 µS/cm to 0-2.000 mS/cm, refer to Part Three, Section 3.2 under the subheading "Selecting Measurement Display Format."*

D. COMPLETING ANALYZER CONFIGURATION

To further configure the analyzer to your application requirements, use the appropriate CONFIGURE screens to make selections and "key in" values. Refer to Part Three, Section 3 for complete configuration details.

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ILLUSTRATIONS

TABLES

PART ONE - INTRODUCTION

SECTION 1
GENERAL INFORMATION

1.1 Capability Highlights

Sensor Input

The analyzer can be used with any OMEGA Model CDE-3600 series electrodeless conductivity sensor. These sensors have a built-in Pt 1000 RTD temperature compensator element.

MEASURE Screen

The MEASURE screen (normal display mode) can provide five different readouts of measured data. With the MEASURE screen displayed, press ⇦ **or** ⇨ **key** to show:

1. Measured conductivity (or % concentration or TDS).
2. Measured uncompensated conductivity that corresponds to readout item 1.
3. Measured temperature (°C or °F).
4. Measured Analog Output # 1 and #2 values (mA).
5. Measured conductivity (or % concentration or TDS) and temperature values.

Passcode-protected Access

For security, you can enable a passcode feature to restrict access to configuration and calibration settings to authorized personnel only. See Part Three, Section 3.6 for details.

Calibration Methods

Each sensor has a unique zero point and offset. Therefore, always "zero" the sensor in air if it is being calibrated for the first time (Section 4.2). Specific methods are available to calibrate the sensor offset. They are dependent on the analyzer's configured measurement (conductivity, % concentration, or TDS). For calibration details, refer to Part Three, Sections 4.3, 4.4, or 4.5 respectively. The mA values for each analog output can also be calibrated (Section 4.6).

Analog Outputs

The analyzer provides two isolated analog outputs (#1 and #2). Each output can be set to be 0-20 mA or 4-20 mA, and assigned to represent one of the following:

- Measured conductivity, % concentration, or TDS.
- Measured temperature.

Parameter values can be entered to define the endpoints at which the minimum and maximum analog output values are desired.

During calibration, both analog outputs can be selected to:

- Hold their present values (HOLD OUTPUTS).
- Transfer to preset values to operate control elements by an amount corresponding to those values (XFER OUTPUTS).
- Remain active to respond to the measured value (ACTIVE OUTPUTS).

For analog output transfer setup details, refer to Part Three, Section 3.4 under the subheading "Setting Transfer Value."

Relays

The analyzer has two electromechanical relays with SPDT contacts. Each relay can be set to function as a control relay, a dual-alarm relay, or a status relay. A control or alarm relay can be assigned to be driven by one of the following:

- Measured conductivity, % concentration, or TDS.
- Measured temperature.

Refer to Part Three, Section 3.5 for relay setup details.

NOTE: *When a relay is set to function as a status relay, it is no longer configurable. Instead, it becomes a dedicated system diagnostic-only alarm relay that automatically energizes when the "WARNING CHECK STATUS" message flashes on the MEASURE screen. This occurs when the analyzer detects a diagnostic condition. See Part Three, Section 5.1 for more details.*

Except for status relays, during calibration the relay on/off states are affected in the same way as the analog outputs by the "(HOLD/XFER/ACTIVE) OUTPUTS" screen selection. These relays are also held at their present on/off states, transferred to desired preset on/off states, or remain active to respond to measured values. For relay transfer setup details, see Part Three, Section 3.5 under the subheading "Selecting Transfer Mode."

1.2 Modular Construction

The modular construction of the analyzer provides electrical safety. The front panel keypad assembly uses voltages no greater than 24 VDC, and is completely safe to handle.

Line power must be connected to specifically designated terminals on TB1.

WARNING:

REMOVE LINE POWER BEFORE NEARING THIS AREA TO PREVENT ELECTRICAL SHOCK.

1.3 Retained Configuration Values

All user-entered configuration values are retained indefinitely, even if power is lost or turned off. The non-volatile memory of the analyzer does not require battery backup.

1.4 Analyzer Serial Number

A label with the analyzer model number, serial number, build date, and other items is located on top of the enclosure.

1.5 EMI/RFI Immunity

The analyzer is designed to provide protection from most normally encountered electromagnetic interference. This protection exceeds U.S. standards and meets European IEC 801-series testing for electromagnetic and radio frequency emissions and susceptibility. Refer to Figure 1-1 and the specifications in Section 2.1 for more information.

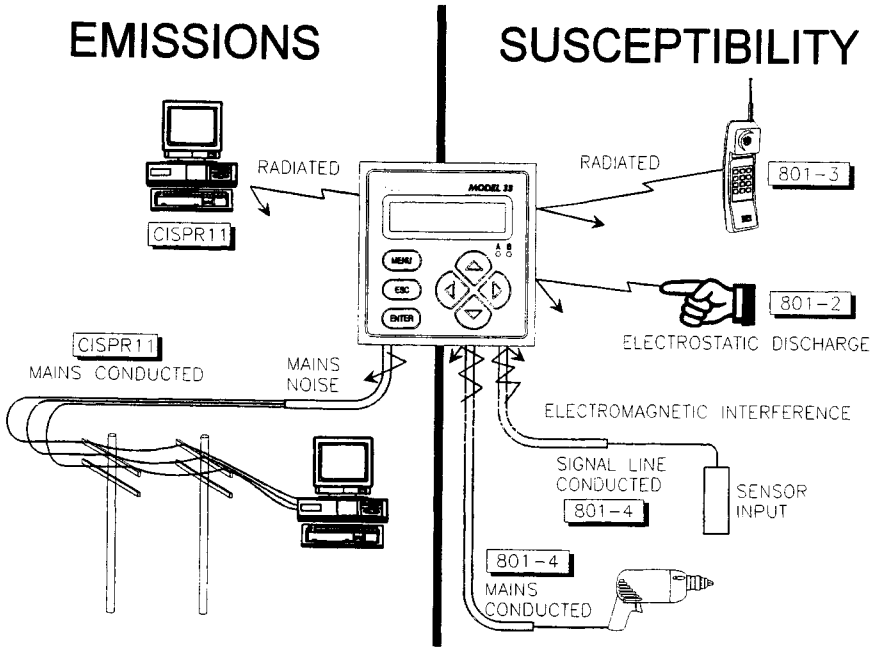


FIGURE 1-1 EMI/RFI Immunity Diagram

SECTION 2
SPECIFICATIONS

2.1 Operational

Display .....Two-line by 16 character backlit LCD

NOTE: *The measured value (conductivity, % concentration, or TDS) or temperature can be shown separately, or both measurements can be displayed together. Both analog output values can also be displayed.*

Measurement	Selectable Ranges
Conductivity	µS/cm: 0-200.0 or 0-2000 mS/cm: 0-2.000, 0-20.00, 0-200.0, or 0-2000 S/cm: 0-2.000
% Concentration	0-99.99% or 0-200.0%
TDS	0-9999 ppm
Temperature	-4.0 to 392.0°F or -20.0 to +200.0°C
mA Outputs (#1 and #2)	0.00-20.00 mA or 4.00-20.00 mA

Ambient Conditions:

- Operation: -4 to +140°F (-20 to +60°C); 0-95% relative humidity, non-condensing
- Storage: -22 to +158°F (-30 to +70°C); 0-95% relative humidity, non-condensing

Relays:

- Types/Outputs: Two electromechanical relays; SPDT (Form C) contacts; U.L. rated 5A 115/230 VAC, 5A @ 30 VDC resistive
- Operational Mode: Each relay (A and B) can be assigned to be driven by the:
  - Selected measurement (conductivity, % concentration, or TDS)
  - Measured temperature
- Function Modes:
  - Control: Settings for high/low phasing, setpoint, deadband, overfeed timer, off delay, and on delay
  - Alarm: Settings for low alarm point, low alarm point deadband, high alarm point, high alarm point deadband, off delay, and on delay
  - Status: Not configurable; relay only activates when a sensor or analyzer diagnostic WARNING condition exists
- Indicators: Relay A and B LEDs indicate respective relay status

Temperature Compensation .....Automatic or manual, 14.0 to 392.0°F (-10.0 to +200.0°C), with selection for temperature element (Pt 1000 ohm RTD) or a manually entered value

NOTE: *Depending on the selected measurement (conductivity, % concentration, or TDS) not all of the following temperature compensation methods are available:*

Linear % per °C slope, built-in natural water temperature properties table, user-entered temperature table, or no compensation

Sensor-to-Analyzer Distance .....Maximum cable length is a function of the measuring range and allowable non-linearity. The following schedule is recommended:

Full-scale Range	Max. Length
200 to 2000 µS/cm	200 ft. (61 m)
2000 to 2,000,000 µS/cm	300 ft. (91 m)

NOTE: *When measuring % concentration, convert the analyzer full-scale value to conductivity to determine the maximum distance.*

Power Requirements .....90-130 VAC, 50/60 Hz. (10 VA max.) or 190-260 VAC, 50/60 Hz. (10 VA max.)

Calibration Methods:

COND CAL (for cond. or % concentration).....Enter known reference solution value, and its linear % per °C slope and reference temperature values.

SAMPLE CAL (for cond.), CONC CAL, and TDS CAL ...Enter one sample value (determined by laboratory analysis or a comparison reading).

ZERO (for cond., % conc. or TDS) .....With the dry sensor in air, press keys to initiate automatic system zeroing.

Analog Outputs .....Two isolated 0/4-20 mA outputs; each with 0.004 mA (12-bit) resolution and capability to drive up to 600 ohm loads

NOTE: *Each output can be assigned to represent the selected measurement (conductivity, % concentration, or TDS) or temperature. Parameter values can be entered to define the endpoints at which the minimum and maximum mA output values are desired. During calibration, both outputs can be selected to hold their present values, transfer to preset values to operate control elements by an amount corresponding to those values, or remain active to respond to the measured value.*

Communication: RS-232 .....For factory configuration only.

Memory Backup (non-volatile) .....All user settings are retained indefinitely in memory (EEPROM)

EMI/RFI Conformance .....Exceeds US and meets European standards for conducted and radiated emissions and immunity; certified CE compliant for applications as specified by EN 50081-2 for emissions and EN 50082-2 for immunity

Electrical Certifications:

General Purpose (pending).....UL, C-UL, FM, and CENELEC
Division 2 (pending) .....UL, C-UL, and FM: Groups A, B, C, D, F, and G
Zone 2 (pending).....CENELEC: Group IIC

2.2 Analyzer Performance (Electrical, Analog Outputs)

Accuracy .....0.5% of span*
Stability .....0.2% of span per 24 hours, non-cumulative*
Repeatability .....0.1% of span or better*
Temperature Drift.....Zero and Span: less than 0.02% of span/°C*

**These typical performance specifications are:*

1. *Based on 25°C with conductivity of 500 µS/cm and higher. Consult OMEGA for applications in which conductivities are less than 500 µS/cm.*
2. *Derated above 100°C to the maximum displayed temperature of 200°C. Consult OMEGA for details.*

2.3 Mechanical

Enclosure .....Polycarbonate with NEMA 4X front panel; general purpose; two zinc-plated steel brackets for panel mounting

Mounting Configuration.....Panel mounting

Net Weight .....1.7 lbs. (0.8 kg) approximately

PART TWO - INSTALLATION

SECTION 1
UNPACKING

After unpacking, it is recommended to save the shipping carton and packing materials in case the instrument must be stored or re-shipped. Inspect the equipment and packing materials for signs of shipping damage. If there is any evidence of damage, notify the transit carrier immediately.

SECTION 2
MECHANICAL REQUIREMENTS

2.1 Location

1. It is recommended to locate the analyzer as close as possible to the installed sensor. The maximum allowable distance between an installed sensor and the analyzer depends upon the full-scale value you set for the analyzer measuring range.

200-2000 µS/cm Full-scale Value	2000-2,000,000 µS/cm Full-scale Value
200 feet (61 m)	300 feet (91 m)

NOTE: *When measuring % concentration, convert the analyzer full-scale value to conductivity to determine the maximum distance.*

2. Mount the analyzer in a location that is:
   - ↙ Clean and dry where there is little or no vibration.
   - ↙ Protected from corrosive fluids.
   - ↙ Within ambient temperature limits (-4 to +140°F or -20 to +60°C).

CAUTION:

EXPOSING THE ANALYZER TO DIRECT SUNLIGHT MAY INCREASE THE OPERATING TEMPERATURE ABOVE ITS SPECIFIED LIMIT.

2.2 Mounting

Figure 2-1 illustrates the analyzer enclosure dimensions and panel mounting details. Use the two supplied brackets to panel mount the analyzer. The brackets may be attached to the top and bottom of the analyzer case, or to each of its sides.

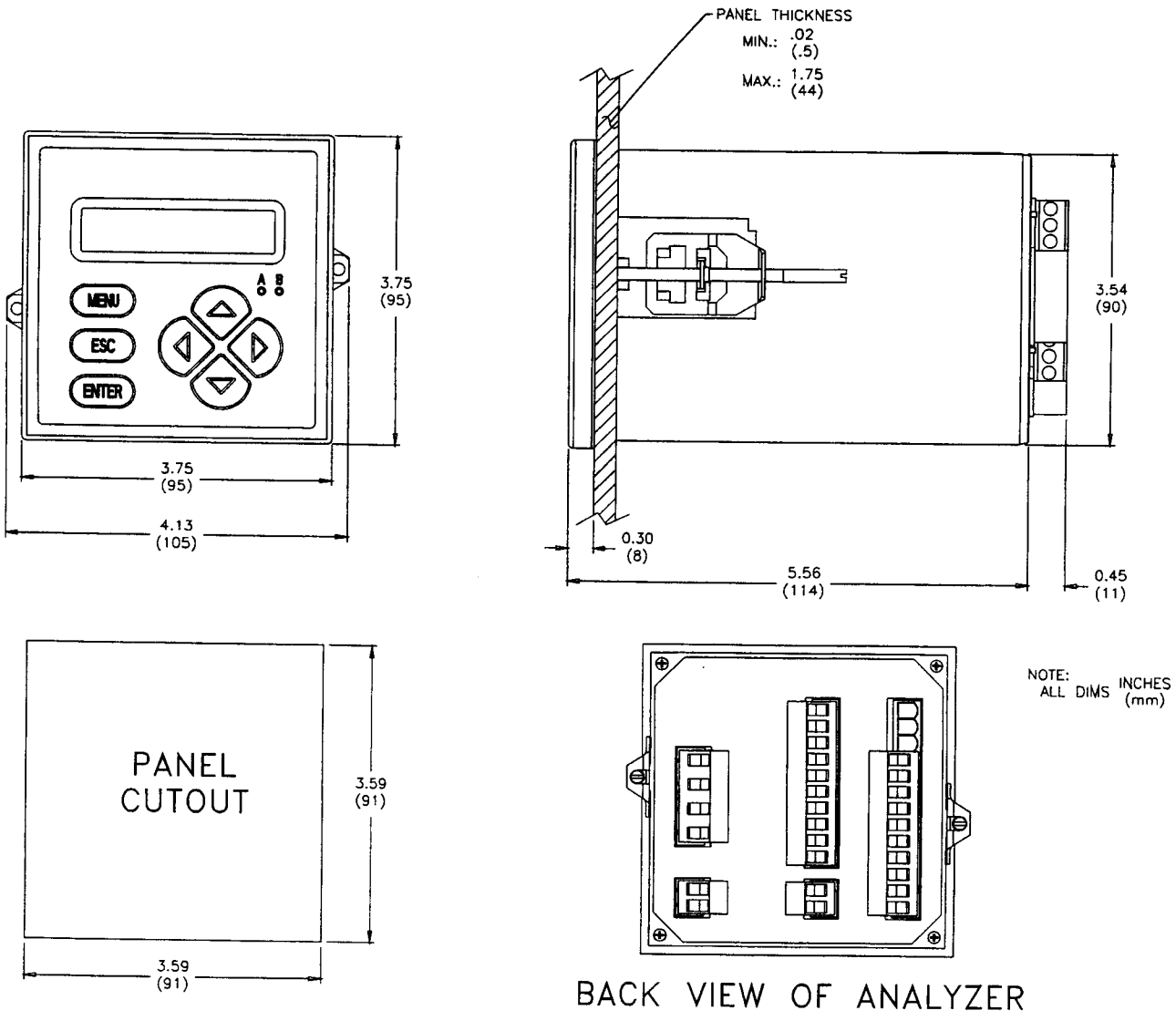


FIGURE 2-1 Analyzer Enclosure Dimensions and Panel Mounting Details

SECTION 3
ELECTRICAL CONNECTIONS

Figure 2-2 shows the terminal block arrangement and terminal designations on the back of the analyzer case.

NOTE: *For easier wiring, terminal blocks can be unplugged from their mating connectors. All terminals are suitable for single wires up to 14 AWG (2.5 mm^2).*

Wiring Tip! To comply with European Community (CE) electromagnetic compatibility requirements, follow these general wiring guidelines:

1. Keep all cable shields as short as possible and connect them to earth ground.
2. Use Steward ferrite 28 B0590-000 or equivalent on:
   - Mains (line power) cable -- no turns required.
   - Sensor cable -- one turn required.
   - mA analog output cables -- two turns required.
   - Relay cables -- no turns required.
3. In harsh conducted RF conditions, connect the earth ground of the instrument (Terminal 4 on TB1) to a local, known earth ground source.

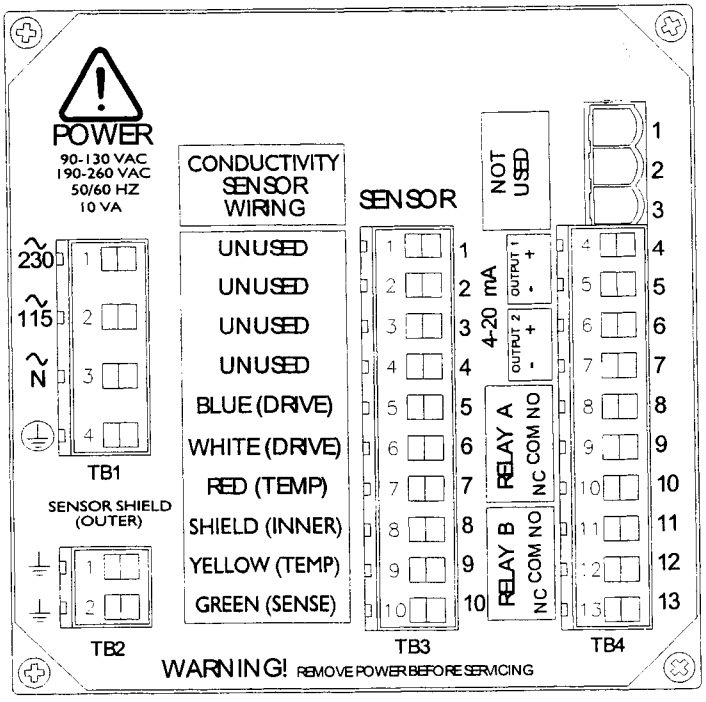


FIGURE 2-2 Analyzer Terminal Block Designations

3.1 OMEGA Electrodeless Conductivity Sensor

All OMEGA Model 3700E-series electrodeless conductivity sensors have a built-in Pt 1000 ohm RTD temperature element for automatic temperature compensation and for measuring process temperature.

Wiring Tip! Route the sensor cable in 1/2-inch, grounded metal conduit to protect it from moisture, electrical noise, and mechanical damage.

For installations where the distance between sensor and analyzer exceeds the sensor cable length, indirectly connect the sensor to the analyzer using a junction box and interconnect cable.

NOTE: *Do not route the sensor cable in any conduit containing AC power wiring ("electrical noise" may interfere with the sensor signal). Also, always recalibrate the system when the cable length between sensor and analyzer changes.*

Refer to Figure 2-3 and connect the sensor (or interconnect) cable wires to SENSOR Terminals 5 through 10 on TB3, matching colors as indicated.

NOTE: *For best immunity to electromagnetic interference, connect the sensor cable's <u>outer</u> shield wire (clear with black band -- not its clear-only inner shield wire) to a "SENSOR SHIELD (OUTER)" terminal on TB2.*

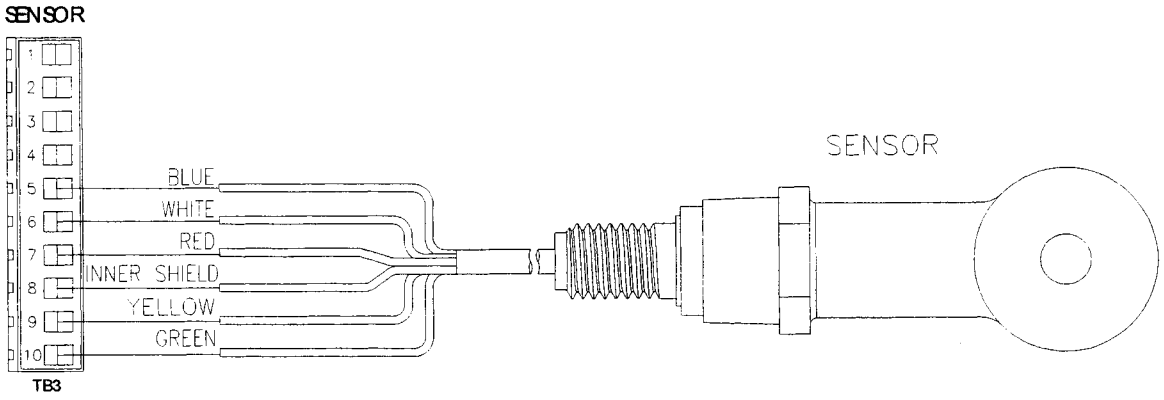


FIGURE 2-3 Connecting OMEGA Electrodeless Conductivity Sensor

3.2 Analog Outputs

Two analog outputs (#1 and #2) are provided. Each output can be set to be 0/4-20 mA. These outputs are isolated from the inputs and earth ground, but not from each other. Each output can be assigned to represent one of the following:

- Measured conductivity, % concentration, or TDS.
- Measured temperature.

For details on configuring the outputs, refer to Part Three, Section 3.4.

Wiring Tip! Use high quality, shielded instrumentation cable for connecting the analog outputs.

Each 0/4-20 mA output can drive a load of up to 600 ohms.

- **Output #1:** Connect the load to Terminals 4 and 5 on TB4, matching polarity as indicated.
- **Output #2:** Connect the load to Terminals 6 and 7 on TB4, matching polarity as indicated.

3.3 Relay Outputs

The analyzer is equipped with two electromechanical relays. For relay setup details, see Part Three, Section 3.5.

CAUTION:

DO NOT EXCEED THE CONTACT RATING FOR EACH RELAY (5A 115/230 VAC). WHEN SWITCHING LARGER CURRENTS, USE AN AUXILIARY RELAY SWITCHED BY THE ANALYZER RELAY TO EXTEND ANALYZER RELAY LIFE. WHEN USING RELAY OUTPUTS, MAKE SURE THAT LINE POWER WIRING CAN ADEQUATELY CONDUCT THE CURRENT DRAW OF THE SWITCHED LOAD(S).

Two sets of SPDT relay outputs (Relays A and B) are provided at Terminals 8 through 13 on TB4. **The relay outputs are not powered.** The line power used to power the analyzer may also be used to power control/alarm devices with these relay contacts. Refer to Figure 2-4 for a general wiring arrangement. Always check control wiring to insure that line power will not be shorted by the relay switching action, and that wiring conforms to local codes.

WARNING:

MAKE SURE THAT LINE POWER IS NOT PRESENT WHILE CONNECTING WIRES TO TB5 RELAY TERMINALS.

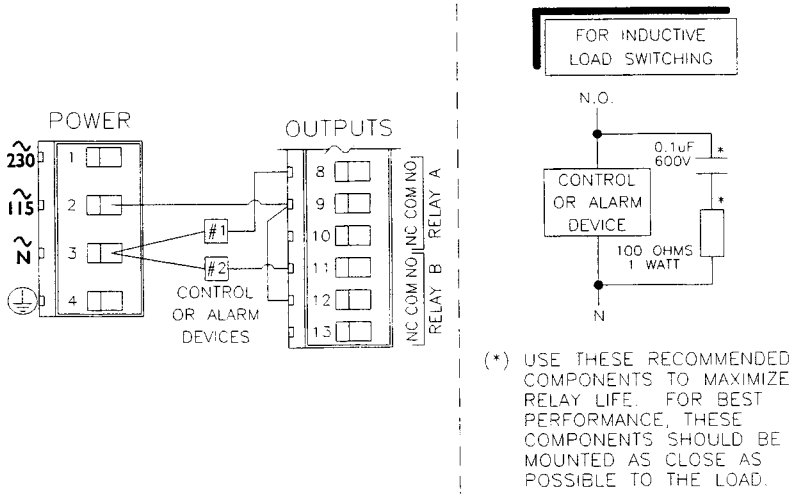


FIGURE 2-4 Connecting Control/Alarm Device(s) to Electromechanical Relay(s)

3.4 Line Power

Refer to Figure 2-5, 2-6 or 2-7 and connect line power to appropriate terminals on TB1 using the standard three-wire connection arrangement. **Use wiring practices which conform to local codes** (example: National Electric Code Handbook in the U.S.A.).

WARNING:

REMOVE LINE POWER WHILE CONNECTING LINE POWER WIRES TO THE TB1TERMINALS. ALSO, USE ONLY THE STANDARD THREE-WIRE CONNECTION ARRANGE-MENT FOR SINGLE-PHASE LINE POWER TO PREVENT AN UNSAFE CONDITION, AND TO ENSURE PROPER ANALYZER OPERATION.

NOTE: *In all cases, connect the line power cable ground wire (usually green) to the "ground symbol" terminal on TB1.*

The "115" and "230" voltage circuits are protected with internal, board-mounted slow-blow fuses.

NOTE: *For 230 volt split phase line power, be sure to conform to local codes with regard to fusing the 115 volt line connected to the "N" terminal.*

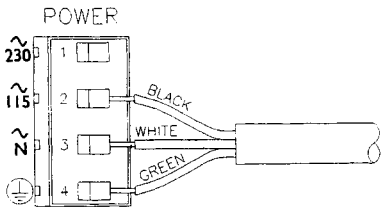


FIGURE 2-5
Connecting 115 Volt
Single Phase Line Power
(90-130 VAC)

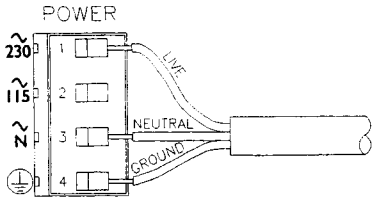


FIGURE 2-6
Connecting 230 Volt
Single Phase Line Power
(190-260 VAC)

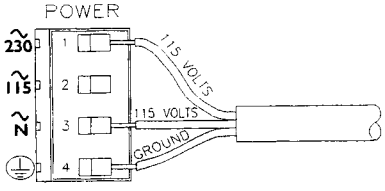


FIGURE 2-7
Connecting 230 Volt
Split Phase Line Power
(190-260 VAC)

PART THREE - OPERATION

SECTION 1
USER INTERFACE

The user interface consists of a two-line LCD display and a keypad with **MENU**, **ENTER**, **ESC**, ⇦, ⇨, ⇧, **and** ⇩ **keys**.

1.1 Display

The backlit, high resolution display is factory-set for optimum viewing contrast under all lighting conditions. By using the keypad, you can display three types of screens:

- **MEASURE screen** to sequentially show, by pressing the ⇦ **or** ⇨ **key**, the measured conductivity (or % concentration or TDS), corresponding uncompensated conductivity value, process temperature, analog Output #1 and #2 mA values, and the sensor value with measured temperature.
- **MENU screens** to move within the three main branches of the analyzer menu tree, enabling access to edit/selection screens. (EXIT screens indicate the end of a menu branch and, by pressing the **ENTER key**, enable you to move up one level in the menu tree. This is functionally the same as pressing the **ESC key**.)
- **Edit/Selection screens** to enter values/choices to calibrate, configure, and test the analyzer.

1.2 Relay A and B Indicators

Relay A and B red LED indicators light when their respective relay energizes. (When a relay overfeed timer has "timed out," the respective indicator blinks continuously until the overfeed condition is resolved.)

1.3 Keypad

The keypad enables you to move throughout the analyzer menu tree. The keys and their related functions are:

1. **MENU key:** Pressing this key always displays the top of the menu tree ("MAIN MENU ▶ CALIBRATE" screen). To display the CONFIGURE and TEST/MAINT main branches of the menu tree, press the ⇩ **key**. The **MENU key** can also be used to "abort" the procedure to change values or selections.

2. **ENTER key:** Pressing this key displays an available submenu or edit/selection screen, or enters (saves) values/selections.

3. **ESC key:** Pressing this key always takes the display up one level in the menu tree. (Example: With the "MAIN MENU" screen displayed, pressing the **ESC key** once takes the display up one level to the MEASURE screen.) This key can also "abort" the procedure to change a value or selection.

4. ⇦ **and** ⇨ **keys:** Depending on the type of displayed screen, these keys do the following:

   - MEASURE Screen: Changes the readout (in continuous loop sequence) to show different measurements.
   - Menu Screens: These keys are non-functional.
   - Edit/Selection Screens: "Coarse" adjusts the displayed numerical value.

5. ⇧ **and** ⇩ **keys:** Depending on the type of displayed screen, these keys do the following:

   - MEASURE Screen: These keys are non-functional.
   - Menu Screens: Moves up or down respectively between other same-level menu screens.
   - Edit/Selection Screens: "Fine" adjusts the displayed numerical value (holding key down changes value faster), or moves up or down between choices.

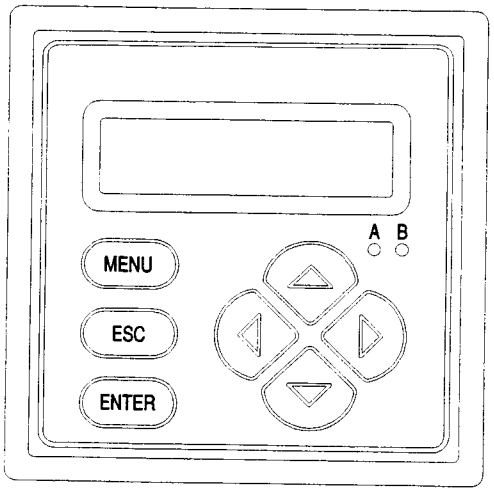
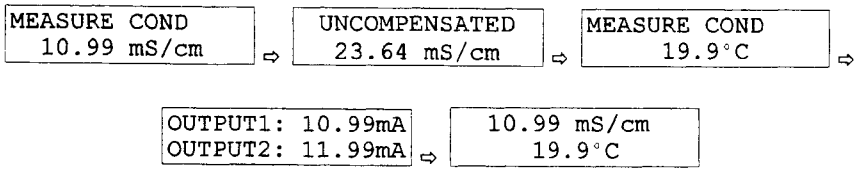


FIGURE 3-1 Analyzer Keypad

1.4 MEASURE Screen (normal display mode)

The MEASURE screen is normally displayed. Pressing the **MENU key** temporarily replaces the MEASURE screen with various screens to calibrate, configure, or test the analyzer. If the keypad is not used within 30 minutes, except during calibration and while using specific analyzer test/maintenance functions, the display automatically returns to the MEASURE screen. To display the MEASURE screen at any time, press the **MENU key** once and then the **ESC key** once.

The MEASURE screen can be viewed in one of five different readout versions. To select between them, in continuous loop sequence, press the ⇦ **or** ⇨ **key**:



NOTE: *When the analyzer returns to its normal MEASURE screen mode, the appearing MEASURE screen readout is always the version last selected. Note that the upper left and right MEASURE screen readout examples show "COND" notations on their top lines, illustrating the analyzer notation feature. To create your own notation, refer to Part Three, Section 3.2, under the subheading "Changing Top Line Notation on MEASURE Screen."*

When the measured value is beyond the analyzer measuring range, a series of " + " or " - " screen symbols appear, respectively indicating that the value is above or below range.

SECTION 2
MENU STRUCTURE

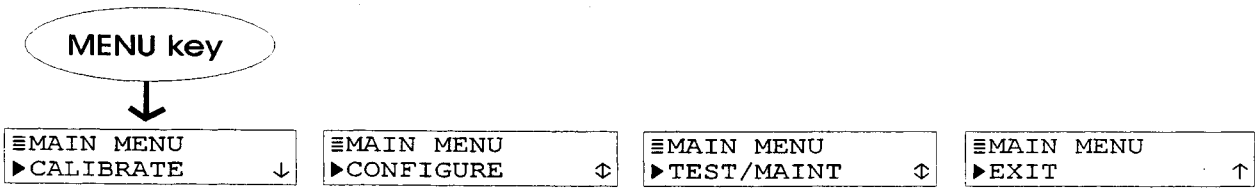
The analyzer menu tree is divided into three main branches: CALIBRATE, CONFIGURE, and TEST/MAINT. Each main branch is structured similarly in layers with top-level screens, related lower-level submenu screens and, in many cases, sub-submenu screens.

Each layer contains an EXIT screen to return the display up one level to the previous layer of screens.

Menu Structure Tip! For operating convenience, the layers within each main branch are organized with the most frequently used function screens at their beginning, rather than the function screens used for initial startup.

2.1 Displaying Main Branch Selection Screens

1. Press **MENU key** to always display the start of the analyzer menu tree (CALIBRATE branch selection screen).
2. Press ⇩ **and** ⇧ **keys** to select between the three main branch selection screens or the EXIT screen:

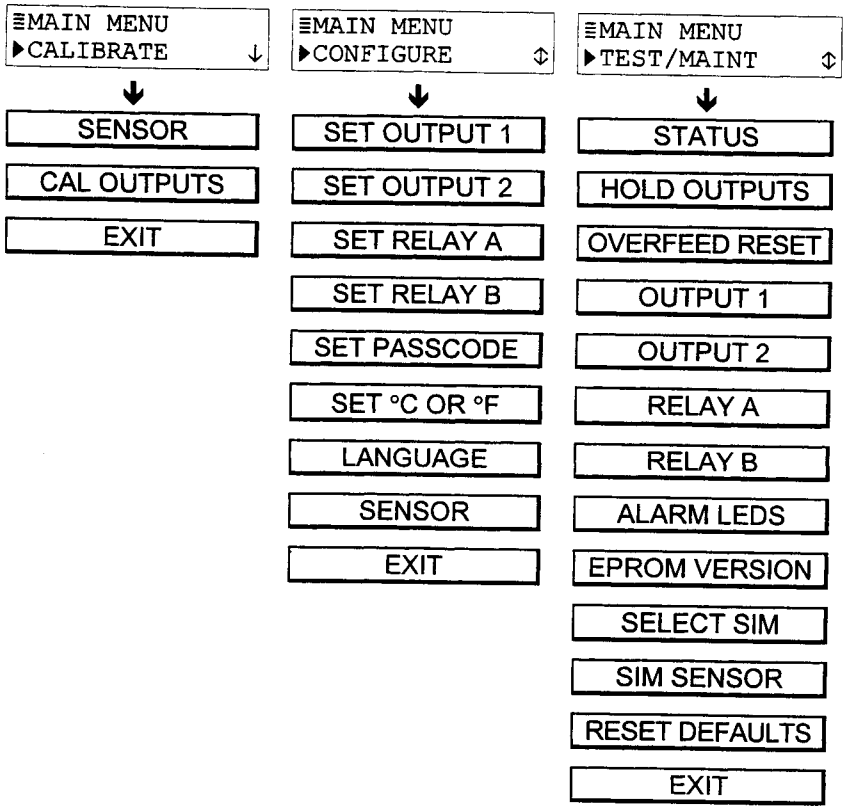


3. With the desired branch selection screen displayed, press **ENTER key** to display the first top-level menu screen within that branch.

2.2 Displaying Top-level Menu Screens

With the first top-level menu screen within the desired main branch displayed, use the ⇩ **and** ⇧ **keys** to scroll through other top-level screens to access a desired screen.

The top-level menu screens for each main branch are:



Menu Structure Tip! A menu screen with a horizontal bar symbol (≡) at the start of its first line indicates there is a related submenu or edit/selection screen.

A menu screen with a ▶ symbol at the start and a ↓ symbol at the end of its second line indicates that you can select other screens within the same layer by pressing the ⇩ **key**. A " ≮ " symbol at the end of the second line indicates that you can move up or down between screens by respectively pressing the ⇧ **or** ⇩ **key**. When a "↑" symbol appears, it indicates you have reached the end of the screens in that layer. You can select previous screens using the ⇧ **key**.

2.3 Displaying Submenu Screens

After selecting a top-level menu screen, press the **ENTER key** to display a related submenu or edit/selection screen:

- **Submenu Screens** always have a first line starting with a horizontal bar symbol. Pressing the ⇩ **key** displays one or more related menu screens within this same level.

  Example: With this submenu screen displayed:

  ```
  ≡SET OUTPUT 1
  ▶SET PARAMETER ↓
  ```

  pressing the ⇩ **key** displays this related, same-level submenu screen:

  ```
  ≡SET OUTPUT 1
  ▶SET 4mA VALUE ↕
  ```

- **Edit/Selection Screens** always have a first line ending with a "?". Pressing the ⇩ **or** ⇧ **key** changes the value/ choice enclosed by parenthesis (second line on screen).

  Example: With this submenu screen displayed:

  ```
  SET °C OR °F?
  (°C              )
  ```

  pressing the ⇩ **key** displays this related choice:

  ```
  SET °C OR °F?
  (°F              )
  ```

2.4 Adjusting Edit/Selection Screen Values

Edit/selection screens always contain a second line enclosed by parenthesis -- see examples shown above and below. The enclosed value/choice can be edited/changed by using the ⇧ **and** ⇩ **keys**. Pressing the **ENTER key** saves the change.

```
SET PARAMETER?
(SENSOR          )
```

```
SET 4mA VALUE?
(10.22 uS/cm     )
```

Use the ⇦ **and** ⇨ **keys** to "coarse" adjust numerical values. The ⇧ **and** ⇩ **keys** "fine" adjust numerical values up or down respectively. The longer the key is pressed, the faster the number changes.

2.5 Entering (Storing) Edit/Selection Screen Values/Choices

After the desired value/choice is displayed, press the **ENTER key** to enter (store) it into the non-volatile analyzer memory. The previous screen will then re-appear.

NOTE: *You can always press the **ESC key** to abort saving a new setting. The original setting will be retained.*

SECTION 3
CONFIGURING THE ANALYZER

NOTE: *When the passcode feature is enabled (Section 3.6), you must successfully enter the passcode before attempting to enter a configuration setting.*

3.1 Selecting Language to Operate Analyzer

The analyzer can display screens in various languages including English, French (Français), German (Deutsche), Spanish (Español), and others. The analyzer is factory-set for English. To change languages:

1. Press **MENU key** to display `≡MAIN MENU ▶CALIBRATE ↓`.
2. Press ⇩ **key** once to display `≡MAIN MENU ▶CONFIGURE ⇕`.
3. Press **ENTER key** to display `≡CONFIGURE ▶SET OUTPUT 1 ↓`.
4. Press ⇩ **key** six times to display `≡CONFIGURE ▶LANGUAGE ⇕`.
5. Press **ENTER key** to display `LANGUAGE? (ENGLISH )`. Use ⇩ **and** ⇧ **keys** to view the language choices.
6. With the desired language displayed, press **ENTER key** to enter this selection.

NOTE: *After a language is selected and entered, all screens will be displayed in that language.*

3.2 Configuring Sensor Characteristics

The analyzer must be configured to define the characteristics of the sensor including its temperature element type, its "T" factor, and other related items such as temperature compensation, input signal filtering, pulse suppression, etc.

Selecting Measurement (CONDUCTIVITY, CONCENTRATION, or TDS)

1. With the `≡CONFIGURE ▶LANGUAGE ⇕` screen displayed, press ⇩ **key** once to display `≡CONFIGURE ▶SENSOR ⇕`.
2. Press **ENTER key** to display `≡SENSOR ▶SELECT MEASURE↓`.

3. Press **ENTER key** again to display `SELECT MEASURE? (CONDUCTIVITY )`. Use ⇩ **and** ⇧ **keys** to view the three choices:
   - **CONDUCTIVITY:** Selects system to measure conductivity.
   - **CONCENTRATION:** Selects system to measure % concentration. (See subheading "Configuring Measurement" for details to convert measured conductivity to % concentration by selecting a BUILT-IN chemical concentration table or creating a USER-DEFINED table.)
   - **TDS:** Selects system to measure total dissolved solids.

WARNING:

CHANGING THE SENSOR MEASUREMENT AUTOMATICALLY REPLACES ALL USER-ENTERED VALUES WITH FACTORY-DEFAULT VALUES.

4. With the desired choice displayed, press **ENTER key** to enter this selection.

Selecting Measurement Display Format

After choosing the measurement, select the desired MEASURE screen display format. The selected units and resolution will also appear on all applicable edit/selection menu screens.

1. With the `≡SENSOR ▶SELECT MEASURE↓` screen displayed, press ⇩ **key** <u>once</u> to display `≡SENSOR ▶DISPLAY FORMAT↕`.

2. Refer to the selected measurement and do the following:

   ■ **CONDUCTIVITY:**

   A. Press **ENTER key** to display `DISPLAY FORMAT? (200.0 uS/cm )`.

   B. Use ⇩ **and** ⇧ **keys** to view the choices (200.0 µS/cm, 2000 µS/cm, 2.000 mS/cm, 20.00 mS/cm, 200.0 mS/cm, 2000 mS/cm, or 2.000 S/cm).

   C. With desired choice displayed, press **ENTER key** to enter this selection.

■ **CONCENTRATION:**

A. Press **ENTER key** to display
```
≡DISPLAY FORMAT
▶CONC FORMAT    ↓
```
.

B. Press **ENTER key** to display
```
CONC FORMAT?
(99.99%         )
```
.

C. Use ⇩ **and** ⇧ **keys** to view choices (99.99% or 200.0%). With desired choice displayed, press **ENTER key**.

D. Now format the uncompensated conductivity MEASURE screen. Press ⇩ **key** once to display
```
≡DISPLAY FORMAT
▶COND FORMAT    ↑
```
and press **ENTER key**.

E. Use ⇩ **and** ⇧ **keys** to view all choices (same as conductivity choices previously described). With the desired choice displayed, press **ENTER key**.

■ **TDS:**

Display format configuration is not required -- it is always 0-9999 ppm.

Selecting Temperature Compensation

Configure the required type of temperature compensation for the selected measurement.

1. With the
```
≡SENSOR
▶DISPLAY FORMAT⇕
```
screen displayed, press ⇩ **key** once to display
```
≡SENSOR
▶T-COMPENSATION⇕
```
.

2. Press **ENTER key** to display
```
T-COMPENSATION?
(LINEAR         )
```
. Use ⇩ **and** ⇧ **keys** to view all choices:

   - **LINEAR (recommended for most aqueous solutions)**
   - NATURAL WATER (not shown for TDS measurement; only use this built-in table for special applications -- consult factory)
   - TEMP TABLE (user-defined temperature table)
   - NONE (measurement values are not compensated)

NOTE: *The factory default for temperature compensation is LINEAR with a 2.00% per ℃ slope and 25.0℃ reference temperature. This provides*

the best results for most aqueous solutions. To enter different slope and reference temperature values for an uncommon solution, refer to subheading "Configuring Selected Temp. Compensation" for details.

3. With the desired choice displayed, press **ENTER key** to enter this selection.

Configuring CONCENTRATION or TDS Measurement (not needed for conductivity)

Only when CONCENTRATION or TDS is selected must the measurement be further configured. If CONDUCTIVITY was selected, disregard this subsection -- no measurement configuration is needed.

CONCENTRATION Measurement Setup

Configure the analyzer with an appropriate table to convert measured conductivity into displayed % concentration. If one of the analyzer's BUILT-IN chemical concentration tables matches the solution being measured, simply select that table. If not, you must create a USER-DEFINED concentration table for the solution being measured.

■ Selecting BUILT-IN Chemical Concentration Table

1. With the `≡SENSOR ▶T-COMPENSATION⇕` screen displayed, press ⇩ **key** once to display `≡SENSOR ▶CONFIG CONC ⇕`.

2. Press **ENTER key** to display `≡CONFIG CONC ▶SELECT TYPE ↓`.

3. Press **ENTER key** again to display `SELECT TYPE? (BUILT-IN )`. Use ⇩ **and** ⇧ **keys** to view the choices (BUILT-IN or USER-DEFINED). "BUILT-IN" configures the analyzer to use one of the built-in chemical concentration tables.

4. With "BUILT-IN" displayed, press **ENTER key**.

5. After the `≡CONFIG CONC ▶SELECT TYPE ↓` screen re-appears, press ⇩ **key** once to display `≡CONFIG CONC ▶SET BUILT-IN ⇕`.

6. Press **ENTER key** to display a chemical table selection screen like `SET CHEMICAL? (NaOH 0-16% )`. Use ⇩ **and** ⇧ **keys** to view the BUILT-IN chemical concentration table choices:

Table A – BUILT-IN CHEMICALCONCENTRATION TABLES

Solution		Concentr.	°C Range	Solution		Concentr.	°C Range
1.	NaOH	0-16%	0-100°C	6.	H_2SO_4	40-80%	0-115°C
2.	$CaCl_2$	0-22%	15-55°C	7.	H_2SO_4	93-99%	0-115°C
3.	HNO_3	0-28%	0-50°C	8.	H_3PO_4	0-40%	0-75°C
4.	HNO_3	36-96%	0-50°C	9.	HCl	0-18%	0-65°C
5.	H_2SO_4	0-30%	0-115°C	10.	HCl	22-36%	0-65°C

7. With the desired BUILT-IN chemical table choice displayed, press **ENTER key** to enter this selection.

■ Creating USER-DEFINED Concentration TABLE

If the solution being measured does not match any BUILT-IN chemical table, create a USER-DEFINED table to convert measured conductivity into displayed % concentration.

NOTE: *A USER-DEFINED table must contain at least two data points (Pt. 1 and Pt. 2) but can have up to ten points. (More points improve measuring accuracy.) Each point must have a conductivity value coordinate (shown as X) and a corresponding % concentration value coordinate (shown as Y). Conductivity values for each successive data point must be larger than the last and always in mS/cm (2000 maximum). Concentration values, shown in the selected XX.XX% or XXX.X% display format, must be different from each other and always in increasing or decreasing order. (The table must be monotonic; as conductivity values increase, concentration values must always increase or decrease.)*

The analyzer default USER-DEFINED concentration table is:

Data Point	*Conductivity Value (X)*	*% Concentration Value (Y)*
Pt. 1	*0 mS/cm*	*0.00%*
Pt. 2	*2000 mS/cm*	*99.99%*

To create your own USER-DEFINED table, edit this default table and, if needed, add more points.

Recommendation: Before entering values, plan ahead and determine the conductivity and corresponding % concentration values for each data point in your table. Use Table B to conveniently organize and note your specific table entry values:

Table B -- VALUES FOR USER-DEFINED CONCENTRATION TABLE

Data Point	Conductivity Value	% Concentration Value	Data Point	Conductivity Value	% Concentration Value
Pt. 1			Pt. 6		
Pt. 2			Pt. 7		
Pt. 3			Pt. 8		
Pt. 4			Pt. 9		
Pt. 5			Pt. 10		

NOTE: *After the analyzer has been calibrated, you can use the uncompensated conductivity MEASURE screen to determine corresponding conductivity values.*

1. With the `≡SENSOR ▶T-COMPENSATION⇕` screen displayed, press ⇩ **key** once to display `≡SENSOR ▶CONFIG CONC ⇕`.
2. Press **ENTER key** to display `≡CONFIG CONC ▶SELECT TYPE ↓`.
3. Press **ENTER key** again to display `SELECT TYPE? (BUILT-IN )`. Use ⇩ **and** ⇧ **keys** to view the choices (BUILT-IN or USER-DEFINED). "USER-DEFINED" configures the analyzer to use your user-defined concentration table.
4. With "USER-DEFINED" displayed, press **ENTER key**.
5. After the `≡CONFIG CONC ▶SELECT TYPE ↓` screen re-appears, press ⇩ **key** twice to display `≡CONFIG CONC ▶USER DEFINED ⇕`.
6. Press **ENTER key** to display `POINT 1 X DATA ▶ 0 mS/cm`. Using this screen and other similar data point screens, enter data to create your table:

NOTE: *To switch between X and Y coordinate screens for a data point, use the* ⇨ ***and*** ⇦ ***keys. To move between data points for an X or Y coordinate, use the* ⇩ ***and*** ⇧ ***keys.***

A. Press **ENTER key** to display
```
X VALUE?
(    0 mS/cm     )
```
.

B. Adjust the displayed Point 1 conductivity value to the desired value and press **ENTER key** to enter it. (Conductivity values for all points must be in mS/cm. Use ⇨ **and** ⇦ **keys** for coarse adjust; ⇧ **and** ⇩ **keys** for fine adjust.)

C. Press ⇨ **key** once to display
```
POINT 1 Y DATA ◀
      0.00%
```
.

D. Press **ENTER key** to display
```
Y VALUE?
(      0.00%     )
```
.

E. Adjust the displayed Point 1 % concentration value to the desired value and press **ENTER key** to enter it. (Use ⇨ **and** ⇦ **keys** for coarse adjust; ⇧ **and** ⇩ **keys** for fine adjust.)

F. Press ⇩ **key** once and ⇦ **key** once to display
```
POINT 2 X DATA ▶
    2 mS/cm
```
.

G. Repeat steps 6A through 6F to enter the conductivity and corresponding % concentration values for each remaining data point in the table.

H. After all X and Y coordinate values are entered for each data point in the table, press **ESC key** once to display
```
CONFIG CONC
EXIT TABLE?
```
.

I. Press **ENTER key** to display
```
CONFIG CONC
SAVE CHANGES?
```
.

J. Press **ENTER key** again to save the table.

NOTE: *If a table contains unacceptable coordinates, the display shows a "CONFIRM FAILURE" message. Pressing* ***ENTER key*** *displays the unacceptable coordinate(s).*

TDS Measurement Setup

Define the conductivity-to-TDS conversion factor:

1. With the `≡SENSOR ▶T-COMPENSATION⇕` screen displayed, press ⇩ **key** <u>once</u> to display `≡SENSOR ▶CONFIG TDS ⇕`.

2. Press **ENTER key** to display `≡CONFIG TDS ▶SELECT FACTOR ↓`.

3. Press **ENTER key** again to display `SELECT FACTOR? (NaCl )`. Use ⇩ **and** ⇧ **keys** to view both choices:
   - **NACL:** Configures analyzer to use the built-in NaCl conductivity-to-TDS conversion factor.
   - **USER DEFINED:** Configures analyzer to use a user-entered conductivity-to-TDS conversion factor.

4. With the desired choice displayed, press **ENTER key** to enter this selection. If the "NaCl" conversion factor was selected, TDS measurement configuration is complete. If you selected "USER DEFINED," you must enter a conductivity-to-TDS conversion factor:

   A. With the `≡CONFIG TDS ▶SELECT FACTOR ↓` screen displayed, press ⇩ **key** <u>once</u> to display `≡CONFIG TDS ▶SET FACTOR ⇕`.

   B. Press **ENTER key** to display `SET FACTOR? (0.492 ppm/uS )`.

   C. Adjust the displayed value to the desired conductivity-to-TDS conversion factor, and press **ENTER key** to enter the value. (Use ⇨ **and** ⇦ **keys** for coarse adjust; ⇧ **and** ⇩ **keys** for fine adjust.)

   D. After the `≡CONFIG TDS ▶SET FACTOR ⇕` screen re-appears, <u>press **ESC key** once</u> to return to the `≡SENSOR ▶CONFIG TDS ⇕` screen.

Configuring LINEAR or TEMP TABLE Temperature Compensation (not needed for other compensation methods)

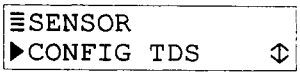
Only when LINEAR or TEMP TABLE is the selected temperature compensation, must the compensation be further configured. If the built-in NATURAL WATER properties table or NONE was selected, disregard this subsection -- no compensation configuration is needed.

LINEAR Compensation Setup

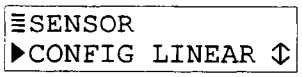
LINEAR compensation factory defaults are 2.00%/°C slope and 25.0°C reference temperature. These values are appropriate for most aqueous solutions. Use chemical handbook tables to find values for uncommon solutions. To enter different values, do the following:

1. With the

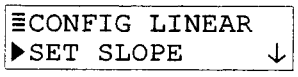

screen displayed, press ⇩ **key** <u>twice</u>.

   (If the


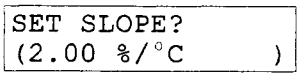
screen is displayed, press ⇩ **key** just <u>once</u>.)

   In either case, the


screen appears.

2. Press **ENTER key** to display


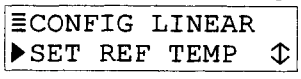
.

3. Press **ENTER key** again to display


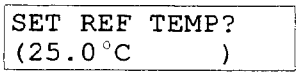
.

4. Adjust the displayed value to the desired % per °C slope, and press **ENTER key** to enter the value. (Use ⇨ **and** ⇦ **keys** for coarse adjust; ⇧ **and** ⇩ **keys** for fine adjust.)

5. After the

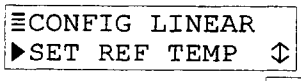

screen re-appears, press ⇩ **key** <u>once</u> to display


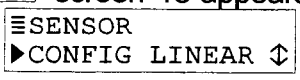
.

6. Press **ENTER key** to display


.

7. Adjust the displayed value to the desired reference temperature, and press **ENTER key** to enter it. (Use ⇨ **and** ⇦ **keys** for coarse adjust; ⇧ **and** ⇩ **keys** for fine adjust.)

8. After the


screen re-appears, press **ESC key** <u>once</u> to return to the


screen.

TEMP TABLE Compensation Setup

When special temperature compensation is required, create your own temperature table to define the temperature compensation curve.

NOTE: *The TEMP TABLE must contain at least two data points (Pt. 1 and Pt. 2) but can have up to ten points. Each data point must have a temperature value coordinate (shown as X) and a corresponding ratio coordinate (shown as Y). Temperature values, shown in the selected temperature display format, must be between 0.0 and 200.0°C (or 32.0 and 392.0°F). Also, each temperature value must be unique. Ratio values, which can be the same, are unitless and must be between 0.00 and 99.99.*

To calculate the ratio coordinate value for each temperature coordinate value, use this equation:

$$\text{Ratio Coordinate Value (for each temp. coordinate)} = \frac{\text{Cond. Value at Ref. Temp.}}{\text{Cond. Value at Noted Temp.}}$$

Example: *Suppose the uncompensated or raw conductivity values are 100 mS/cm at a 25°C reference temperature, 120 mS/cm at 50°C, and 70 mS/cm at 15°C. Using the above equation, the ratio coordinate values for each of the temperatures are:*

For 25°C, ratio value = 100 ÷ 100 or 1.00
For 50°C, ratio value = 100 ÷ 120 or 0.83
For 15°C, ratio value = 100 ÷ 70 or 1.43

The analyzer default TEMP TABLE is:

Data Point	Temperature Value (X)	Corresponding Ratio Value (Y)
Pt. 1	0.0°C	1.00
Pt. 2	100.0°C	1.00

To create your own TEMP TABLE, edit this default table and, if needed, add more data points.

Recommendation: Before entering values, plan ahead and determine the temperature and ratio values for each data point in your table. Use Table C to conveniently organize and note your specific table entry values:

Table C -- VALUES FOR TEMP TABLE							
Data Point	°C Temp. (X)	Raw Cond.Value	Ratio Value (Y)	Data Point	°C Temp. (X)	Raw Cond. Value	Ratio Value (Y)
Pt. 1				Pt. 6			
Pt. 2				Pt. 7			
Pt. 3				Pt. 8			
Pt. 4				Pt. 9			
Pt. 5				Pt. 10			

1. With the `≣SENSOR ▶T-COMPENSATION⇕` screen displayed, press ⇩ **key** twice.

   (If the `≣SENSOR ▶CONFIG TDS ⇕` screen is displayed, press ⇩ **key** just once.)

   In either case, the `≣SENSOR ▶CONFIG T-TABLE⇕` screen appears.

2. Press **ENTER key** to display `POINT 1 X DATA ▶ 0.0°C`. Using this screen and other similar data point screens, enter data to create your table:

   NOTE: *To switch between X and Y coordinate screens for a data point, use the* ⇨ ***and*** ⇦ ***keys. To move between data points for an X or Y coordinate, use the* ⇩ ***and*** ⇧ ***keys.***

   A. Press **ENTER key** to display `X VALUE? ( 0.0°C )`.

   B. Adjust the displayed Point 1 temperature value to the desired value, and press **ENTER key** to enter it. (Use ⇨ **and** ⇦ **keys** for coarse adjust; ⇧ **and** ⇩ **keys** for fine adjust.)

   C. Press ⇨ **key** once to display `POINT 1 Y DATA ◀ 1.00`.

   D. Press **ENTER key** to display `Y VALUE? ( 1.00 )`.

   E. Adjust the displayed Point 1 ratio value to the desired value, and press **ENTER key** to enter it. (Use ⇨ **and** ⇦ **keys** for coarse adjust; ⇧ **and** ⇩ **keys** for fine adjust.)

   F. Press ⇩ **key** once and ⇦ **key** once to display `POINT 2 X DATA ▶ 100.0°C`.

G. Repeat steps 2A through 2F to enter the temperature and corresponding ratio values for each remaining data point in the table.

H. After all X and Y coordinate values are entered for each data point in the table, press **ESC key** once to display

```
CONFIG T-TABLE
EXIT TABLE?
```

.

I. Press **ENTER key** to display

```
CONFIG T-TABLE
SAVE CHANGES?
```

.

J. Press **ENTER key** again to save the table.

NOTE: *If a table contains unacceptable coordinates, the display shows a "CONFIRM FAILURE" message. Pressing* ***ENTER key*** *displays the unacceptable coordinate(s).*

Setting Sensor Signal Filter Time

A time constant (in seconds) can be set to filter or "smooth out" the sensor signal. A minimum value of "0 seconds" has no smoothing effect. A maximum value of "60 seconds" provides maximum smoothing. Deciding what sensor signal filter time to use is a compromise. The higher the filter time, the longer the sensor signal response time will be to a change in the actual process value.

1. With the

```
≡SENSOR
▶CONFIG LINEAR ⇕
```

or

```
≡SENSOR
▶CONFIG T-TABLE⇕
```

screen displayed, press ⇩ **key** once to display:

```
≡SENSOR
▶SET FILTER    ⇕
```

2. Press **ENTER key** to display

```
SET FILTER?
(0 SECONDS     )
```

.

3. Adjust the displayed value to the desired filter time, and press **ENTER key** to enter the value. (Use ⇨ **and** ⇦ **keys** for coarse adjust; ⇧ **and** ⇩ **keys** for fine adjust.)

Selecting Pulse Suppression (on/off)

Sometimes an external interference may occasionally cause the measurement system to provide unstable readings. Common causes include entrained gas bubbles in the process, and electromagnetic interference (EMI or "electrical noise" pulses). The analyzer has a pulse suppression feature to counteract this condition and stabilize readings. Example: Suppose the analyzer reading is steadily showing

1880 mS/cm, then suddenly jumps to 1950 mS/cm for a few seconds, and returns to 1880 mS/cm. By turning on this feature, the analyzer will perceive this as a temporary upset, "suppressing" most of this pulse change and providing a smoother measurement reading.

1. With the
```
≡SENSOR
▶SET FILTER      ⇳
```
screen displayed, press the ⇩ key once to display
```
≡SENSOR
▶PULSE SUPPRESS⇳
```
.

2. Press **ENTER key** to display
```
PULSE SUPPRESS?
(OFF             )
```
. Use **⇩ and ⇧ keys** to view both choices (OFF or ON).

3. With the desired choice displayed, press **ENTER key** to enter this selection.

Changing Top Line Notation on MEASURE Screen

The top line of the two MEASURE screen readouts that separately show measurement and temperature values are factory set to read "COND." This notation can be changed, for example, to "BASIN 1" to tailor the analyzer MEASURE screen to the application. The top line would then be "MEASURE BASIN 1." The notation is limited to eight characters which can be a combination of capital letters A through Z, numbers 0 through 9, and spaces.

1. With the
```
≡SENSOR
▶PULSE SUPPRESS⇳
```
screen displayed, press **⇩ key** once to display
```
≡SENSOR
▶ENTER NOTE      ⇳
```
.

2. Press **ENTER key** to display
```
ENTER NOTE?
([C]OND          )
```
. Create the desired notation within the second line's parenthesis:

   A. Starting with the extreme left character position, use **⇧ and ⇩ keys** to select the desired first character.

   B. Press ⇨ **key** to access the second character position. Use **⇧ and ⇩ keys** to select desired second character.

   C. Repeat procedure until desired notation is displayed.

3. Press **ENTER key** to enter the displayed notation.

Selecting Temperature Element Type

Configure the analyzer for either automatic temperature compensation (uses Pt 1000 ohm RTD built into sensor), or fixed MANUAL temperature compensation. If using MANUAL, you must determine and enter a specific temperature value.

NOTE: *When "PT1000" is selected and a temperature element is not connected, select "MANUAL" for the element type. This prevents (or clears) a "WARNING: CHECK STATUS" message due to the analyzer detecting no temperature element.*

1. With the `≡SENSOR` / `▶ENTER NOTE ⇳` screen displayed, press ⇩ **key** once to display `≡SENSOR` / `▶TEMP ELEMENT ⇳`.

2. Press **ENTER key** to display `≡TEMP ELEMENT` / `▶SELECT TYPE ↓`.

3. Press **ENTER key** again to display `SELECT TYPE?` / `(PT1000 )`. Use ⇩ **and** ⇧ **keys** to view the two choices:

   - **PT1000:** Configures analyzer for use with a Pt 1000 RTD temperature element (used in all OMEGA Model 3700E-series electrodeless conductivity sensors).
   - **MANUAL:** Configures analyzer for fixed manual temp. compensation when not using a temperature element.

4. With the desired choice displayed, press **ENTER key** to enter this selection. If "MANUAL?" was selected, you must set the specific manual temperature compensation value:

   A. With the `≡TEMP ELEMENT` / `▶SELECT TYPE ↓` screen displayed, press ⇩ **key** once to display `≡TEMP ELEMENT` / `▶SET MANUAL ⇳`.

   B. Press **ENTER key** to display `SET MANUAL?` / `(25.0°C )`.

   C. Adjust displayed value to the desired fixed temperature, and press **ENTER key** to enter it. (Use ⇨ **and** ⇦ **keys** for coarse adjust; ⇧ **and** ⇩ **keys** for fine adjust.)

Entering Sensor's OMEGA-certified "T" Factor

OMEGA tests each sensor to provide a unique, certified temperature "T" factor because:

- Temperature greatly affects conductivity measurement accuracy.
- The inherent ohm value of the Pt 1000 RTD temperature element varies slightly from sensor to sensor, affecting temperature measurement accuracy.

By entering the sensor's unique "T" factor, you enable the analyzer to provide the highest possible measuring accuracy for both temperature and conductivity.

1. With the `≣TEMP ELEMENT` / `▶SELECT TYPE ↓` screen displayed, press **⇩ key** once to display `≣TEMP ELEMENT` / `▶SET T FACTOR ⇕`.
2. Press **ENTER key** to display `SET T FACTOR?` / `(1000.0 OHMS )`.
3. Use **⇧ and ⇩ keys** to adjust the displayed value to exactly match the sensor's OMEGA-certified "T" factor, and press **ENTER key** to enter the value.

> **SPECIAL CASE -- ALTERED SENSOR CABLE LENGTH**
>
> Changing the standard 20 ft. (6 m) sensor cable length, by shortening it or adding an interconnect cable, will affect temperature measuring accuracy. The OMEGA-certified "T" factor is based on standard cable length. To compensate for altered cable length measuring error, change the certified "T" factor entry:
>
> - Shortened Sensor Cable: To increase the analyzer temperature reading to match the known solution temperature, decrease the "T" factor by 3.85 ohms for each °C difference.
> - Added Interconnect Cable: To decrease the analyzer temperature reading to match the known solution temperature, increase the "T" factor by 3.85 ohms for each °C difference.
>
> **Example:** Suppose the known solution temperature is 50°C and the analyzer reads 53°C due to interconnect cable resistance. Multiply the 3°C difference by 3.85 ohms to get 11.55. Then increase the sensor "T" factor by adding 11.55 to it and entering that value. If, due to a shortened sensor cable, the analyzer was reading 3°C less than the known solution temperature you would decrease the sensor "T" factor by subtracting 11.55 from it.

4. After the `≣TEMP ELEMENT` / `▶SET T FACTOR ⇕` screen re-appears, press **ESC key** twice to return to the `≣CONFIGURE` / `▶SENSOR ⇕` screen.

3.3 Selecting Temperature Display Format (°C or °F)

The MEASURE screen can be set to display temperature values in °C or °F. In either case, the display resolution for measured temperature is always "XX.X."

1. With the ≡CONFIGURE / ▶SENSOR ⇳ screen displayed, press ⇧ **key** – not ⇩ **key** – twice to display ≡CONFIGURE / ▶SET °C OR °F ⇳.

2. Press **ENTER key** to display SET °C OR °F? / (°C). Use ⇩ **and** ⇧ **keys** to view both choices (°C or °F).

3. With the desired choice displayed, press **ENTER key** to enter this selection.

3.4 Configuring Outputs (1 and 2)

The analyzer provides two isolated analog outputs (#1 and #2). **Configure both outputs in the same way using their respective menu screens.**

Assigning Representative Parameter

Each output can be assigned to represent one of the following:

- Measured conductivity, % concentration, or TDS.
- Measured temperature.

1. With the ≡CONFIGURE / ▶SET °C OR °F ⇳ screen displayed, press ⇧ **key** – not ⇩ **key** – five times to display ≡CONFIGURE / ▶SET OUTPUT 1 ↓.

2. Press **ENTER key** to display ≡SET OUTPUT 1 / ▶SET PARAMETER ↓.

3. Press **ENTER key** again to display SET PARAMETER? / (SENSOR). Use ⇩ **and** ⇧ **keys** to view both choices.

4. With the desired choice displayed, press **ENTER key** to enter this selection.

Setting Parameter Values for 0/4 mA and 20 mA

You can set the parameter values to define the endpoints at which the minimum and maximum output values are desired.

1. With the `≡SET OUTPUT 1` / `▶SET PARAMETER ↓` screen displayed, press ⇩ **key** once to display `≡SET OUTPUT 1` / `▶SET 4mA VALUE ⇳`.
2. Press **ENTER key** to display a screen like `SET 4mA VALUE?` / `(10.22 mS/cm )`.
3. Set the displayed value at which 0/4 mA is desired, and press **ENTER key** to enter the value. (Use ⇨ **and** ⇦ **keys** for coarse adjust; ⇧ **and** ⇩ **keys** for fine adjust.)
4. After the `≡SET OUTPUT 1` / `▶SET 4mA VALUE ⇳` screen re-appears, press ⇩ **key** once to display `≡SET OUTPUT 1` / `▶SET 20mA VALUE⇳`.
5. Press **ENTER key** to display `SET 20mA VALUE?` / `(19.99 mS/cm )`.
6. Set the displayed value at which 20 mA is desired, and press **ENTER key** to enter the value.

NOTE: *If the same values are set for 0/4 mA and 20 mA, the output automatically goes to, and remains at, 20 mA.*

Setting Transfer Value (mA)

Normally, each analog output is active, responding to the measured value of its assigned parameter. During calibration, however, you can transfer (XFER) each output to a preset value to operate a control element by an amount corresponding to that value.

To set a milliamp transfer value for an analog output to suit your application:

1. With the `≡SET OUTPUT 1` / `▶SET 20mA VALUE⇳` screen displayed, press ⇩ **key** once to display `≡SET OUTPUT 1` / `▶SET TRANSFER ⇳`.
2. Press **ENTER key** to display `SET TRANSFER?` / `(20.00 mA )`.
3. Set the displayed value to the desired transfer value, and press **ENTER key** to enter it. (Use ⇨ **and** ⇦ **keys** for coarse adjust; ⇧ **and** ⇩ **keys** for fine adjust.)

Setting Output Filter Time

A time constant (in seconds) can be set to filter or "smooth out" the output signal. A minimum value of "0 seconds" has no smoothing effect. A maximum value of "60 seconds" provides maximum smoothing. Deciding what output filter time to use is a compromise. The higher the filter time, the longer the output signal response time will be to a change in the measured value.

1. With the
```
≡SET OUTPUT 1
▶SET TRANSFER  ⇳
```
screen displayed, press ⇩ **key** once to display
```
≡SET OUTPUT 1
▶SET FILTER    ⇳
```
.

2. Press **ENTER key** to display
```
SET FILTER?
(0 SECONDS      )
```
.

3. Adjust the displayed value to the desired filter time, and press **ENTER key** to enter it. (Use ⇨ **and** ⇦ **keys** for coarse adjust; ⇧ **and** ⇩ **keys** for fine adjust.)

Setting Output Scale Low Endpoint (0/4 mA)

Each output can be set to be 0-20 mA or 4-20 mA.

1. With the
```
≡SET OUTPUT 1
▶SET FILTER    ⇳
```
screen displayed, press ⇩ **key** once to display
```
≡SET OUTPUT 1
▶SCALE 0mA/4mA ⇳
```
.

2. Press **ENTER key** to display
```
SCALE 0mA/4mA?
(4mA            )
```
. Use ⇩ **and** ⇧ **keys** to view both choices (0 mA or 4 mA).

3. With the desired choice displayed, press **ENTER** to enter this selection.

3.5 Configuring Relays (A and B)

The analyzer is equipped with two electromechanical relays (A and B). Each relay can be set to function as a control, alarm, or status relay. Only a control or alarm relay operates in response to the measured value. For details on each relay function, see subsection "Selecting Function Mode."

Configure both relays in the same way using their respective menu screens.

During calibration, control and alarm relays can be held, transferred to present on/off states, or remain active. During normal measurement operation, these relays can be held in their present on/off states for up to 30 minutes by using the "HOLD OUTPUTS" function in the TEST/MAINT menu.

Assigning Representative Parameter

Each control or alarm relay can be assigned to use one of the following for its operation:

- Measured conductivity, % concentration, or TDS.
- Measured temperature.

1. With the ≡SET OUTPUT 1 / ▶SCALE 0mA/4mA ⇕ screen displayed, press **ESC key** once to display ≡CONFIGURE / ▶SET OUTPUT 1 ⇩.
2. Press ⇩ **key** twice to display ≡CONFIGURE / ▶SET RELAY A ⇕.
3. Press **ENTER key** to display ≡SET RELAY A / ▶SET PARAMETER ⇩.
4. Press **ENTER key** again to display SET PARAMETER? / (SENSOR). Use ⇩ **and** ⇧ **keys** to view the choices.
5. With the desired choice displayed, press **ENTER key** to enter this selection.

Selecting Function Mode (alarm, control, or status)

Each relay can be selected to function as a:

- **Dual-alarm relay** (with separate high and low alarm points and deadbands) that operates in response to the selected measured value.
- **Control relay** (with phasing, setpoint, deadband, and overfeed timer) that operates in response to the selected measured value.
- **Status relay** that is not configurable. It is a dedicated system diagnostic-only alarm relay that automatically energizes when the "WARNING CHECK STATUS" message flashes on the MEASURE screen. This occurs when the analyzer detects a sensor or analyzer "FAIL" diagnostic condition (see Part Three, Section 5.1 for details).

1. With the ≡SET RELAY A / ▶SET PARAMETER ⇩ screen displayed, press ⇩ **key** once to display ≡SET RELAY A / ▶SET FUNCTION ⇕.
2. Press **ENTER key** to display SET FUNCTION? / (ALARM). Use ⇩ **and** ⇧ **keys** to view the choices (ALARM, CONTROL, or STATUS).

3. With the desired choice displayed, press **ENTER key** to enter this selection.

Selecting Transfer Mode (relay on or off)

Normally, each control or alarm relay is active, responding to the measured value of its assigned parameter. During calibration, however, you can transfer each relay to a preset on/off state.

To set a relay on/off transfer state for a control or alarm relay to suit your application:

1. With the `≡SET RELAY A` / `▶SET FUNCTION ⇳` screen displayed, press **⇩ key** once to display `≡SET RELAY A` / `▶SET TRANSFER ⇳`.

2. Press **ENTER key** to display `SET TRANSFER?` / `(DE-ENERGIZED )`. Use **⇩ and ⇧ keys** to view both choices (DE-ENERGIZED or ENERGIZED).

3. With the desired choice displayed, press **ENTER** to enter this selection.

Setting Activation (Configuration) Values

The group of configuration settings available to a relay is dependent on its selected function mode (alarm or control). **Relays set for status function mode are not configurable.** Table D describes all relay configuration settings, categorized by relay function mode:

Table D -- RELAY CONFIGURATION SETTINGS

Setting	Description
For Alarm Relay	
Low Alarm	Sets the value at which the relay will turn on in response to decreasing measured value.
High Alarm	Sets the value at which the relay will turn on in response to increasing measured value.
Low Deadband	Sets the range in which the relay remains on after the measured value increases above the low alarm value.
High Deadband	Sets the range in which the relay remains on after the measured value decreases below the high alarm value.
Off Delay	Sets a time (0-300 seconds) to delay the relay from normally turning off.
On Delay	Sets a time (0-300 seconds) to delay the relay from normally turning on.

Table D -- RELAY CONFIGURATION SETTINGS (continued)	
Setting	Description
For Control Relay	
Phase	A "high" phase assigns the relay setpoint to respond to increasing measured value; conversely, a "low" phase assigns the relay setpoint to respond to decreasing measured value.
Setpoint	Sets the value at which the relay will turn on.
Deadband	Sets the range in which the relay remains on after the measured value decreases below the setpoint value (high phase relay) or increases above the setpoint value (low phase relay).
Overfeed Timer	Sets the time (0-999.9 min.) to limit how long the relay can remain "on." For more details on overfeed timer operation, see Part Three, Section 6.
Off Delay	Sets a time (0-300 seconds) to delay the relay from normally turning off.
On Delay	Sets a time (0-300 seconds) to delay the relay from normally turning on.

NOTE: *When a relay is set to function as a status relay, the ▷ symbol at the start of the "ACTIVATION" line denotes that this menu item is not relevant and, therefore, not available.*

Also, it is possible to enter values which always keep a relay active or inactive. To avoid this, be sure that "low" values are lower than "high" values.

The "off delay" and "on delay" settings, available to control or alarm function relays, may be beneficial in eliminating process "overshoot" when there are long process pipe runs or delays in mixing.

To set Relay A configuration values:

1. With the `≣SET RELAY A` / `▶SET TRANSFER ⇳` screen displayed, press ⇩ **key** once to display `≣SET RELAY A` / `▶ACTIVATION ⇳`.
2. Press **ENTER key** to display the first respective relay function "ACTIVATION" screen setting.
3. Use the same basic keypad operations described in previous setup procedures to enter the desired value for the displayed relay activation setting.
4. Repeat this procedure for each relay activation setting.

3.6 Enabling/Disabling Passcode

The analyzer has a passcode feature to restrict access to configuration settings and calibration to only authorized personnel.

- **DISABLED:** With the passcode feature disabled, all configuration settings can be displayed and changed, and the analyzer can be calibrated.

- **ENABLED:** With the passcode feature enabled, all configuration settings can be displayed -- but they cannot be changed -- and the analyzer cannot be calibrated. When you attempt to change a setting by pressing the **ENTER key**, a displayed notification requests passcode entry. A valid passcode entry saves the changed setting and returns the display to the "MAIN MENU" branch selection screen. An incorrect passcode entry causes the display to momentarily show an error notification and return to the "MAIN MENU" branch selection screen. There is no limit on attempts to enter a valid passcode.

The passcode is factory set to "**3 4 5 6**." It cannot be changed.

To enable or disable the passcode feature:

1. With the ≡CONFIGURE / ▶SET OUTPUT 1 ↓ screen displayed, press ⇩ **key** four times to display ≡CONFIGURE / ▶SET PASSCODE ⇕ .

2. Press **ENTER key** to display SET PASSCODE? / (DISABLED) . Use ⇩ **and** ⇧ **keys** to view both choices (DISABLED or ENABLED).

3. With the desired choice displayed, press **ENTER key** to enter this selection.

3.7 Summary of Configuration Settings

Table E lists all configuration settings and their entry ranges/choices and factory defaults, categorized by basic functions.

Table E -- ANALYZER CONFIGURATION SETTINGS (RANGES/CHOICES and DEFAULTS)

Displayed Screen Title	Entry Range or Choices (where applicable)	Factory Default	Your Setting
LANGUAGE Configuration Setting			
LANGUAGE?	ENGLISH, FRENCH, GERMAN, SPANISH, etc.	ENGLISH	
SENSOR Configuration Settings			
SENSOR: SELECT MEASURE?	CONDUCTIVITY, CONCENTRATION, or TDS	CONDUCTIVITY	
SENSOR: DISPLAY FORMAT? (full scale value)	CONDUCTIVITY: µS/cm: 200.0, or 2000 mS/cm: 2.000, 20.00, 200.0, or 2000 S/cm: 2.000 CONCENTRATION: 99.99% or 200.0% TDS: 9999 ppm	CONDUCTIVITY: 200.0 µS/cm CONCENTRATION: 99.99% TDS: 9999 ppm	
SENSOR: T-COMPENSATION?	LINEAR, NATURAL WATER, TEMP TABLE, or NONE	LINEAR at 2.00% per °C with 25.0°C reference temperature	
CONC: SELECT TYPE?	BUILT-IN or USER-DEFINED	BUILT-IN	
CONC: SET CHEMICAL?	NaOH 0-16%,$CaCl_2$ 0-22%, HNO_3 0-28%, HNO_3 36-96%, H_2SO_4 0-30%, H_2SO_4 40-80%, H_2SO_4 93-99%, H_3PO_4 0-40%, HCl 0-18%, or HCl 23-36%	Built-in NaOH 0-16% chemical concentration table	
CONC: EDIT TABLE	Edit default table by entering up to 10 data points with conductivity coordinates (0-2000 mS/cm) and corresponding concentration coordinates (0-99.99%)	Two point default conc. table: Pt. 1: X = 0 mS/cm; Y = 0.00% Pt. 2: X = 2000 mS/cm; Y = 99.99%	
TDS: SELECT FACTOR?	NaCl or USER DEFINED	NaCl	
TDS: SET FACTOR?	0.01-99.99 ppm/µS	0.492 ppm/µS	
LINEAR: SET SLOPE?	0-4.00% per °C	2.00% per °C	
LINEAR: SET REF TEMP?	0-200.0°C or 32-392.0°F	25.0°C or 77°F	
CONFIG T-TABLE	Edit default table by entering up to 10 data points with temperature coordinates (0-200.0°C or 32-392.0°F) and corresponding ratio coordinates (0-99.99)	Two point default temp. table: Pt. 1: X = 0.0°C; Y = 1.00 Pt. 2: X = 100.0°C; Y = 1.00	
SENSOR: SET FILTER?	0-60 seconds	0 seconds	
PULSE SUPPRESS?	OFF or ON	OFF	
ENTER NOTE?	Enter up to eight characters to replace COND	COND	
TEMP ELEMENT: SELECT TYPE?	PT1000 or MANUAL	PT1000	
TEMP ELEMENT: SET T FACTOR?	950-1050 ohms	1000 OHMS	
TEMP ELEMENT: SET MANUAL?	0-200.0°C	25.0°C	
TEMPERATURE Display Configuration Setting			
CONFIGURE: °C OR °F?	°C or °F	°C	

(Table E continued on next page.)

Table E -- ANALYZER CONFIGURATION SETTINGS (RANGES/CHOICES and DEFAULTS -- continued)

Displayed Screen Title	Entry Range or Choices (where applicable)	Factory Default	Your Setting
OUTPUT Configuration Settings			
OUTPUT: SET PARAMETER?	SENSOR or TEMPERATURE	Output 1: SENSOR Output 2: TEMPERATURE	
OUTPUT: SET 4mA VALUE?	CONDUCTIVITY: µS/cm: 0-200.0, or 0-2000 mS/cm: 0-2.000, 0-20.00, 0-200.0 or 0-2000 S/cm: 0-2.000 CONCENTRATION: 0-99.99% or 0-200.0% TDS: 0-9999 ppm TEMP: -20.0 to +200.0°C or -4.0 to 392.0°F	CONDUCTIVITY: µS/cm: 0 mS/cm: 0 S/cm: 0 CONC: 0.00% or 0.0% TDS: 0 ppm TEMP: 0.0°C or 32.0°F	
OUTPUT: SET 20mA VALUE?	CONDUCTIVITY: µS/cm: 0-200.0 or 0-2000 mS/cm: 0-2.000, 0-20.00, 0-200.0 or 0-2000 S/cm: 0-2.000 CONCENTRATION: 0-99.99% or 0-200.0% TDS: 0-9999 ppm TEMP: -20.0 to +200.0°C or -4.0 to 392.0°F	CONDUCTIVITY: µS/cm: 200.0 or 2000 mS/cm: 2.000, 20.00, 200.0 or 2000 S/cm: 2.000 CONC: 99.99% or 200.0% TDS: 9999 ppm TEMP: 100.0°C or 212.0°F	
SET TRANSFER?	0-20 mA or 4-20 mA	All Outputs: 20mA	
SET FILTER?	0-60 seconds	All Outputs: 0 seconds	
SCALE 0mA/4mA?	0 mA or 4mA	All Outputs: 4mA	
RELAY Configuration Settings			
Settings Common To Alarm and Control Relays:			
SET PARAMETER?	SENSOR or TEMPERATURE	Relay A: SENSOR Relay B: TEMPERATURE	
SET FUNCTION?	ALARM, CONTROL, or STATUS	All Relays: ALARM	
SET TRANSFER?	DE-ENERGIZED or ENERGIZED	All Relays: DE-ENERGIZED	
OFF DELAY?	0-300 seconds	0 seconds	
ON DELAY?	0-300 seconds	0 seconds	
Settings For Alarm Relays Only:			
LOW ALARM?	CONDUCTIVITY: µS/cm: 0-200.0 or 0-2000 mS/cm: 0-2.000, 0-20.00, 0-200.0 or 0-2000 S/cm: 0-2.000 CONCENTRATION: 0-99.99% or 0-200.0% TDS: 0-9999 ppm TEMP: -20.0 to +200.0°C or -4.0 to 392.0°F	CONDUCTIVITY: µS/cm: 0 mS/cm: 0 S/cm: 0 CONC: 0.00% or 0.0% TDS: 0 ppm TEMP: 0.0°C or 32.0°F	

(Table E continued on next page.)

Table E -- ANALYZER CONFIGURATION SETTINGS (RANGES/CHOICES and DEFAULTS -- continued)

Displayed Screen Title	Entry Range or Choices (where applicable)	Factory Default	Your Setting
RELAY Configuration Settings (continued)			
Settings For Alarm Relays Only (continued):			
HIGH ALARM?	CONDUCTIVITY: µS/cm: 0-200.0 or 0-2000 mS/cm: 0-2.000, 0-20.00, 0-200.0 or 0-2000 S/cm: 0-2.000 CONCENTRATION: 0-99.99% or 0-200.0% TDS: 0-9999 ppm TEMP: -20.0 to +200.0°C or -4.0 to 392.0°F	CONDUCTIVITY: µS/cm: 200.0 or 2000 mS/cm: 2.000, 20.00, 200.0 or 2000 S/cm: 2.000 CONC: 99.99% or 200.0% TDS: 9999 ppm TEMP: 100.0°C or 212.0°F	
LOW DEADBAND?	CONDUCTIVITY: 0-10% of range CONCENTRATION: 0-10% of range TDS: 0-10% of range TEMPERATURE: 0-10% of range	COND: 0 µS/cm, mS/cm or S/cm CONC: 0.00% or 0.0% TDS: 0 ppm TEMP: 0.0°C or 0.0°F	
HIGH DEADBAND?	CONDUCTIVITY: 0-10% of range CONCENTRATION: 0-10% of range TDS: 0-10% of range TEMPERATURE: 0-10% of range	COND: 0 µS/cm, mS/cm or S/cm CONC: 0.00% or 0.0% TDS: 0 ppm TEMP: 0.0°C or 0.0°F	
Settings For Control Relays Only:			
PHASE?	HIGH or LOW	Relays A and B: HIGH	
SET SETPOINT?	CONDUCTIVITY: µS/cm: 0-200.0 or 0-2000 mS/cm: 0-2.000, 0-20.00, 0-200.0 or 0-2000 S/cm: 0-2.000 CONCENTRATION: 0-99.99% or 0-200.0% TDS: 0-9999 ppm TEMP: -20.0 to +200.0°C or -4.0 to 392.0°F	CONDUCTIVITY: µS/cm: 200.0 or 2000 mS/cm: 2.000, 20.00, 200.0 or 2000 S/cm: 2.000 CONC: 99.99% or 200.0% TDS: 9999 ppm TEMP: 100.0°C or 212.0°F	
DEADBAND?	CONDUCTIVITY: 0-10% of range CONCENTRATION: 0-10% of range TDS: 0-10% of range TEMPERATURE: 0-10% of range	COND: 0 µS/cm, mS/cm or S/cm CONC: 0.00% or 0.0% TDS: 0 ppm TEMP: 0.0°C or 0.0°F	
OVERFEED TIMER?	0-999.9 minutes	0 minutes	
PASSCODE Configuration Setting			
SET PASSCODE?	DISABLED or ENABLED	DISABLED	
TEST/MAINTENANCE Simulation Function Settings			
SELECT SIM?	SENSOR or TEMPERATURE	SENSOR	
SIM SENSOR?	Same ranges as those listed in the "OUTPUT Configuration Settings" category under "SET 4 mA VALUE"	Present measured value of sensor's selected parameter	

SECTION 4
CALIBRATING THE ANALYZER

4.1 Things to Know About Calibration

Each electrodeless conductivity sensor has a unique zero point and offset. Consequently, **always zero the sensor when calibrating it for the first time** (Section 4.2). Zeroing provides the best possible measuring accuracy. Then calibrate for sensor offset using one of the available methods, and periodically thereafter, to maintain best measurement accuracy. Over time, some processes such as heavy slurries may plug the sensor hole, causing minor measurement errors. The time between calibrations, and the rate of measurement drift can vary considerably with each application and its specific conditions.

Calibration Tip! Establish a maintenance program to keep the sensor relatively clean and the measuring system calibrated. The weekly or monthly intervals between performing maintenance will be influenced by the characteristics of the process solution, and can only be determined by operating experience.

Since the inherent ohm value of each sensor's Pt 1000 RTD temperature element varies slightly, OMEGA tests each element to provide a unique, OMEGA-certified temperature "T" factor shown on a label attached to the sensor cable. If this factor was not previously entered during configuration (Section 3.2 under the subheading "Entering Sensor's OMEGA-certified T Factor"), **enter it now before zeroing or calibrating** to provide best possible measuring accuracy.

NOTE: *When the passcode feature is enabled (Section 3.6), you must successfully enter the passcode before attempting to calibrate the analyzer.*

Also, an in-progress calibration can always be aborted by pressing the ESC key. *After the "ABORT: YES?" screen appears, do one of the following:*

- *Press **ENTER key** to abort. After the "CONFIRM ACTIVE?" screen appears, press **ENTER key** to return the analog outputs and relays to their active states, and the display to the MEASURE screen.*
- *Press ⇧ **or** ⇩ **key** to choose "ABORT: NO?" screen, and press **ENTER key** to continue calibration.*

In addition to zeroing and calibrating the sensor for offset, you also can calibrate the mA values for each analog output. Refer to Section 4.6 for details.

Zeroing/Calibration Tip! If a "CONFIRM FAILURE?" screen appears during zeroing/calibration, press **ENTER key** to confirm. Then, use the ⇧ **or** ⇩ **key** to select between "CAL REPEAT?" or "CAL EXIT?" and:

- With "CAL REPEAT?" screen selected, press **ENTER key** to repeat zeroing/calibration.
- With "CAL EXIT?" screen selected, press **ENTER key**. After the "CONFIRM ACTIVE?" screen appears, press **ENTER key** to return the analog outputs and relays to their active states (MEASURE screen appears).

4.2 Zeroing Sensor for First-time Calibration

Zero the sensor if it is being calibrated for the first time. If not, disregard this section and proceed with sensor offset calibration (Section 4.3, 4.4, or 4.5).

1. Make sure that the sensor is dry before zeroing.
2. Press **MENU key** to display ≡MAIN MENU / ▶CALIBRATE ↓.
3. Press **ENTER key** to display ≡CALIBRATE / ▶SENSOR ↓.
4. Press **ENTER key** again to display ≡SENSOR / ▶COND CAL ↓, ≡SENSOR / ▶CONC CAL ↓, or ≡SENSOR / ▶TDS CAL ↓ (displayed screen depends on measurement setup choice).
5. Press ⇩ **key** twice to display ≡SENSOR / ▶ZERO ↓.
6. Press **ENTER key** to display ZERO? / (HOLD OUTPUTS). Use ⇧ **and** ⇩ **keys** to view the three states that the analog outputs (and relays) can be in during zeroing:
   - **HOLD OUTPUTS:** Holds their present values.
   - **XFER OUTPUTS:** Transfers to preset values.
   - **ACTIVE OUTPUTS:** Responds to measured values.
7. With the desired choice displayed, press **ENTER key** to enter this selection.

8. With the "ZERO: IN DRY AIR?" screen displayed and the dry sensor held in air, press **ENTER key** to confirm and start automatic zeroing.

9. After the "ZERO: CONFIRM ZERO OK?" screen appears, press **ENTER key** to end zeroing.

10. After the "ZERO: CONFIRM ACTIVE?" screen appears, press **ENTER key** to return the analog outputs and relays to their active states (MEASURE screen appears).

This completes zeroing the sensor.

4.3 Conductivity Calibration

When the analyzer is set to measure conductivity, two methods are available for sensor offset calibration:

- **COND CAL Method:** This method requires removing the sensor from the process, immersing it into a conductivity reference solution, and entering the solution's °C temperature, linear % per °C slope, and known conductivity value.

- **SAMPLE CAL Method:** This method enables you to keep the sensor installed in the process, but requires obtaining a process sample, determining its value by laboratory analysis or comparison reading, and entering that value.

After the sensor is zeroed (first-time calibration only), calibrate for sensor offset using one of these methods.

COND CAL Method

1. Prepare the conductivity reference solution using your normal method. Its value should be near the typical measured process value for best accuracy. When the value is relatively low (between 200 and 100,000 micro-Siemens/cm), you may want to use the data in Table F on the next page to prepare the reference solution. Add the listed grams of pure, dried NaCl to one liter of high purity, de-ionized, CO_2-free water that is 25°C to obtain the listed conductivity. Solution conductivity can be decreased by dilution with de-ionized water.

Table F -- CONDUCTIVITY REFERENCE SOLUTIONS			
Desired Solution Value			Grams NaCl
µS/cm	mS/cm	ppm (NaCl)*	To Be Added
200	0.20	100	0.10
500	0.50	250	0.25
1000	1.00	500	0.50
2000	2.00	1010	1.01
3000	3.00	1530	1.53
4000	4.00	2060	2.06
5000	5.00	2610	2.61
8000	8.00	4340	4.34
10,000	10.00	5560	5.56
20,000	20.00	11,590	11.59
50,000	50.00	31,950	31.95
100,000	100.00	72,710	72.71

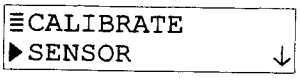
*When using ppm measuring scale for compounds other than NaCl, refer to appropriate chemistry handbook for reference solution formulation.

2. Thoroughly rinse the clean sensor in de-ionized water. Then immerse the sensor in the prepared reference solution. **Important:** Allow the sensor and solution temperatures to equalize. Depending on their temperature differences, this may take up to 30 minutes.

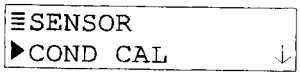
NOTE: *Suspend the sensor to prevent it from touching the container. Simply laying it into the container will produce calibration error. If the sensor is tee-mounted, use a smaller container. Ideally, convert a tee of the same size and material as the mounting tee into a calibration container by sealing two of its ends.*

3. Press **MENU key** to display 

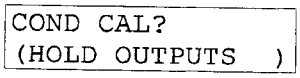
.

4. Press **ENTER key** to display 

.

5. Press **ENTER key** again to display 

.

6. Press **ENTER key** again to display 

.
Use ⇧ **or** ⇩ **key** to view the three states that the analog outputs (and relays) can be in during calibration:

- **HOLD OUTPUTS:** Holds their present values.
- **XFER OUTPUTS:** Transfers to preset values.
- **ACTIVE OUTPUTS:** Responds to measured values.

7. With the desired choice displayed, press **ENTER key** to enter this selection.

8. With the
```
ENTER REF TEMP?
(25.0°C          )
```
screen displayed, use **⇧ and ⇩ keys** to adjust the displayed temperature to match the known temperature of the reference solution. Then press **ENTER key** to enter the value.

9. After the
```
ENTER SLOPE?
(2.00 %/°C       )
```
screen appears, use **⇧ and ⇩ keys** to adjust the displayed % per °C value to match the known slope of the reference solution. Then press **ENTER key** to enter the value.

NOTE: *Measured values are normally compensated using the configured temperature compensation method. When using the "COND CAL" method to calibrate, the measured reference solution is linearly compensated by these entered reference temperature and slope values.*

10. With the sensor in solution and the
```
COND CAL:
SAMPLE READY?
```
screen displayed, press **ENTER key** to confirm. This active
```
XXXX uS/cm
READING STABLE?
```
screen appears showing the measured reference solution value.

11. Wait for the reading to stabilize which may take up to 30 minutes. Then press **ENTER key**. The "PLEASE WAIT" screen may appear if the reading is still too unstable. After the reading has stabilized, this static
```
COND CAL?
(XXXX uS/cm      )
```
screen appears showing the "last measured" value.

12. Use **⇧ and ⇩ keys** to adjust the displayed value to exactly match the known value of the reference solution.

13. Press **ENTER key** to enter the value and complete calibration ("CONFIRM CAL OK?" screen appears).

14. Re-install the sensor into the process.

15. Press **ENTER key** again to display the active measurement reading on the "CONFIRM ACTIVE?" output

status screen. When the reading corresponds to the actual typical process value, press **ENTER key** again to return the analog outputs and relays to their active states (MEASURE screen appears).

This completes the "COND CAL" method of calibration.

SAMPLE CAL Method

The "SAMPLE CAL" method enables the sensor to remain installed in the process. However, you must be able to determine the value of the process sample using a recently calibrated portable meter or laboratory analysis.

1. Press **MENU key** to display `≡MAIN MENU` / `▶CALIBRATE ↓`.
2. Press **ENTER key** to display `≡CALIBRATE` / `▶SENSOR ↓`.
3. Press **ENTER key** again to display `≡SENSOR` / `▶COND CAL ↓`.
4. Press ⇩ **key** once to display `≡SENSOR` / `▶SAMPLE CAL ↕`.
5. Press **ENTER key** to display `SAMPLE CAL?` / `(HOLD OUTPUTS )`. Use ⇧ **or** ⇩ **key** to view the three states that the analog outputs (and relays) can be in during calibration:
   - **HOLD OUTPUTS:** Holds their present values.
   - **XFER OUTPUTS:** Transfers to preset values.
   - **ACTIVE OUTPUTS:** Responds to measured values.
6. With the desired choice displayed, press **ENTER key** to enter this selection.
7. Obtain a sample of the process solution and determine its value using laboratory analysis or a calibrated portable meter.
8. With the `SAMPLE CAL:` / `SAMPLE READY?` screen displayed, press **ENTER key** to confirm. This active `XXXX uS/cm` / `READING STABLE?` screen appears showing the measurement reading.

9. Wait for the reading to stabilize which may take up to 30 minutes. Then press **ENTER key**. The "PLEASE WAIT" screen may appear if the reading is still too unstable. After the reading has stabilized, this static

```
SAMPLE CAL?
(XXXX uS/cm     )
```

screen appears showing the "last measured" value.

10. Use ⇧ **and** ⇩ **keys** to adjust the displayed value to exactly match the known value of the process sample.

11. Press **ENTER key** to enter the value and complete calibration ("CONFIRM CAL OK?" screen appears).

12. Press **ENTER key** again to display the active measurement reading on the "CONFIRM ACTIVE?" output status screen. When the reading corresponds to the actual typical process value, press **ENTER key** again to return the analog outputs and relays to their active states, and the display to the MEASURE screen.

This completes the "SAMPLE CAL" method of calibration.

4.4 % Concentration Calibration

When the analyzer is set to measure % concentration, two methods are available for sensor offset calibration:

- **CONC CAL Method:** This method requires you to immerse the sensor into a prepared % concentration reference solution of known value, or to keep the sensor installed in the process while obtaining a process sample. When keeping the sensor installed, determine the process value by laboratory analysis or comparison reading. In either case, enter the solution or sample % concentration value.

- **COND CAL Method:** This method requires removing the sensor from the process, immersing it into a conductivity reference solution, and entering the solution's °C temperature, linear % per °C slope, and known conductivity value. The conductivity reference solution should have an equivalent, uncompensated value that corresponds with the normal % concentration value of the process.

After the sensor is zeroed (first-time calibration only), calibrate for sensor offset using one of these methods.

CONC CAL Method

1. Press **MENU key** to display `≡MAIN MENU ▶CALIBRATE ↓`.

2. Press **ENTER key** to display `≡CALIBRATE ▶SENSOR ↓`.

3. Press **ENTER key** again to display `≡SENSOR ▶CONC CAL ↓`.

4. Press **ENTER key** again to display `CONC CAL? (HOLD OUTPUTS )`. Use ⇧ **or** ⇩ **key** to view the three states that the analog outputs (and relays) can be in during calibration:
   - **HOLD OUTPUTS:** Holds their present values.
   - **XFER OUTPUTS:** Transfers to preset values.
   - **ACTIVE OUTPUTS:** Responds to measured values.

5. With the desired choice displayed, press **ENTER key** to enter this selection.

6. Depending on the situation, do <u>one</u> of the following:

   ■ When Keeping the Sensor Installed:

   Obtain a sample of the process solution and determine its value using laboratory analysis or a <u>recently calibrated</u> portable meter.

   ■ When Using a Reference Solution:

   A. Prepare a % concentration reference solution using your normal method. To achieve accurate calibration, the reference solution must have the same chemical composition as the process. Also, its value should be near the typical measured process value.

   B. Thoroughly rinse the <u>clean</u> sensor in de-ionized water. Then immerse the sensor in the prepared reference solution. **Important:** Allow the sensor and solution temperatures to equalize. Depending on their temperature differences, this may take up to 30 minutes.

NOTE: *Suspend the sensor to prevent it from <u>touching</u> the container. Simply laying it into the container will produce calibration*

error. If the sensor is tee-mounted, use a smaller container. Ideally, convert a tee of the same size and material as the mounting tee into a calibration container by sealing two of its ends.

7. With the sensor in the process (or reference solution) and the
```
CONC CAL:
SAMPLE READY?
```
screen displayed, press **ENTER key** to confirm. This active
```
XX.XX%
READING STABLE?
```
screen appears showing the measurement reading.

8. Wait for the reading to stabilize which may take up to 30 minutes. Then press **ENTER key**. The "PLEASE WAIT" screen may appear if the reading is still too unstable. After the reading has stabilized, this static
```
CONC CAL?
(XX.XX%          )
```
screen appears showing the "last measured" value.

9. Use ⇧ **and** ⇩ **keys** to adjust the displayed value to exactly match the known value of the process sample (or reference solution).

10. Press **ENTER key** to enter the value and complete calibration ("CONFIRM CAL OK?" screen appears).

11. If the sensor was immersed in a reference solution, reinstall the sensor into the process.

12. Press **ENTER key** to display the active measurement reading on the "CONFIRM ACTIVE?" output status screen. When the reading corresponds to the actual typical process value, press **ENTER key** again to return the analog outputs and relays to their active states (MEASURE screen appears).

This completes the "CONC CAL" method of calibration.

COND CAL Method

When the analyzer is set to measure % concentration but you want to calibrate using a conductivity reference solution, please refer to Section 4.3 under the subsection "COND CAL Method" and follow steps 1 through 15.

4.5 TDS Calibration

When the analyzer is set to measure TDS, only the "TDS CAL" method is available for sensor offset calibration. This method requires you to immerse the sensor into a prepared TDS reference solution of known ppm value, or to keep the sensor installed in the process while obtaining a process sample. When keeping the sensor installed, determine the process value by laboratory analysis or comparison reading. In either case, enter the solution or sample ppm value.

1. Press **MENU key** to display
```
≡MAIN MENU
▶CALIBRATE          ↓
```
.

2. Press **ENTER key** to display
```
≡CALIBRATE
▶SENSOR             ↓
```
.

3. Press **ENTER key** again to display
```
≡SENSOR
▶TDS CAL            ↓
```
.

4. Press **ENTER key** again to display
```
TDS CAL?
(HOLD OUTPUTS       )
```
. Use **⇧ or ⇩ key** to view the three states that the analog outputs (and relays) can be in during calibration:
   - **HOLD OUTPUTS:** Holds their present values.
   - **XFER OUTPUTS:** Transfers to preset values.
   - **ACTIVE OUTPUTS:** Responds to measured values.

5. With the desired choice displayed, press **ENTER key** to enter this selection.

6. Depending on the situation, do <u>one</u> of the following:

   ■ When Keeping the Sensor Installed:

   Obtain a sample of the process solution and determine its value using laboratory analysis or a <u>recently calibrated</u> portable meter.

   ■ When Using a Reference Solution:

   A. Prepare a TDS reference solution using your normal method. To achieve accurate calibration, the reference solution must have the same chemical composition as the process. Also, its value should be near the typical measured process value. When the value is relatively low (between 100 and 72,710 ppm NaCl), you can prepare the reference solution using the information from step 1 and Table F in Section 4.3, subsection "COND CAL Method."

B. Thoroughly rinse the clean sensor in de-ionized water. Then immerse the sensor in the prepared reference solution. **Important:** Allow the sensor and solution temperatures to equalize. Depending on their temperature differences, this may take up to 30 minutes.

NOTE: *Suspend the sensor to prevent it from touching the container. Simply laying it into the container will produce calibration error. If the sensor is tee-mounted, use a smaller container. Ideally, convert a tee of the same size and material as the mounting tee into a calibration container by sealing two of its ends.*

7. With the sensor in the process (or reference solution) and the `TDS CAL:` `SAMPLE READY?` screen displayed, press **ENTER key** to confirm. This active `XXXX ppm` `READING STABLE?` screen appears showing the measurement reading.

8. Wait for the reading to stabilize which may take up to 30 minutes. Then press **ENTER key**. The "PLEASE WAIT" screen may appear if the reading is still too unstable. After the reading has stabilized, this static `TDS CAL?` `(XXXX ppm )` screen appears showing the "last measured" value.

9. Use ⇧ **and** ⇩ **keys** to adjust the displayed value to exactly match the known value of the reference solution or process sample.

10. Press **ENTER key** to enter the value and complete calibration ("CONFIRM CAL OK?" screen appears).

11. If the sensor was immersed in a reference solution, reinstall the sensor into the process.

12. Press **ENTER key** again to display the active measurement reading on the "CONFIRM ACTIVE?" output status screen. When the reading corresponds to the actual typical process value, press **ENTER key** again to return the analog outputs and relays to their active states, and the display to the MEASURE screen.

This completes the "TDS CAL" method of calibration.

4.6 Analog Outputs (1 and 2) Calibration

The analyzer analog outputs are factory-calibrated. However, they can be re-calibrated at any time if desired. Calibrate each output in the same way using its respective menu screens.

NOTE: *When the passcode feature is enabled (Section 3.6), you must successfully enter the passcode before attempting to calibrate the analog outputs.*

When an output is configured to be 0-20 mA, the analyzer will calibrate the 4 mA and 20 mA values (not the 0 mA value). Also, the analyzer adjustment range for output values during calibration is ± 2 mA.

1. Press **MENU key** to display `≡MAIN MENU ▶CALIBRATE ↓`.
2. Press **ENTER key** to display `≡CALIBRATE ▶SENSOR ↓`.
3. Press ⇩ **key** <u>once</u> to display `≡CALIBRATE ▶CAL OUTPUTS ↓`.
4. Press **ENTER key** to display `≡CAL OUTPUTS ▶CAL OUTPUT 1 ↓`.
5. Press **ENTER key** again to display `≡CAL OUTPUT 1 ▶CAL OUT 1 4mA ↓`.
6. Press **ENTER key** again to display `CAL OUT 1 4mA? (XXX )`.
7. The displayed value is "counts" -- not mA -- that dynamically change when the output is adjusted. Use a calibrated digital multimeter to measure Output 1's actual <u>minimum</u> value provided at Terminals 4 and 5 on TB4.
8. Use ⇨ **and** ⇦ **keys** (coarse adjust) and ⇧ **and** ⇩ **keys** (fine adjust) to adjust Output 1's minimum value to read <u>exactly</u> "4.00 mA" on the <u>digital</u> <u>multimeter</u> -- not the analyzer display.
9. Press **ENTER key** to complete calibration of the minimum endpoint value.

10. With the
```
≣CAL OUTPUT 1
▶CAL OUT 1 4mA ↓
```
screen displayed, press ⇩ **key** once to display
```
≣CAL OUTPUT 1
▶CAL OUT 1 20mA⇕
```
.

11. Press **ENTER key** to display
```
CAL OUT 1 20mA?
(XXXX          )
```
.

12. Once again the displayed value is "counts" -- not mA -- that dynamically change when the output is adjusted. Use a calibrated digital multimeter to measure Output 1's actual maximum value.

13. Use ⇨ **and** ⇦ **keys** (coarse adjust) and ⇧ **and** ⇩ **keys** (fine adjust) to adjust Output 1's maximum value to read exactly "20.00 mA" on the digital multimeter -- not the analyzer display.

14. Press **ENTER key** to complete calibration of the maximum endpoint value.

This completes Output 1 calibration.

SECTION 5
TEST/MAINTENANCE

The analyzer has TEST/MAINT menu screens to:

- Check system status for the analyzer, sensor and temperature inputs, and relays.
- Hold the analog outputs.
- Manually reset all relay overfeed timers.
- Provide analog output test signals to confirm operation of connected devices.
- Test relay operation (energize or de-energize) and check status of front panel alarm LEDs (on or off).
- Identify analyzer EPROM version.
- Simulate a measurement or temperature signal to exercise the measurement loop.
- Reset all configuration and calibration values to factory-set defaults.

5.1 Checking Analyzer, Sensor, and Relay Status

With the analyzer's system diagnostic capabilities, you can check the operating status of the analyzer, sensor (measurement and temperature inputs), and relays. The MEASURE screen will flash the "WARNING CHECK STATUS" message when a sensor or analyzer "FAIL" diagnostic condition has been detected. To determine the condition causing the warning, display the "STATUS" screens.

1. Press **MENU key** to display 

.

2. Press ⇩ **key** <u>twice</u> to display 

.

3. Press **ENTER key** to display 

.

4. Press **ENTER key** again to display the "STATUS: ANALYZER OK" screen. This screen confirms that the analyzer is operating properly. If "FAIL" appears, it may mean:
   - EPROM failure (data is not valid).
   - Scaling card not present or not recognized.
   - Analog-to-digital converter not responding.
   - RAM failure.
   - Internal serial communications failure.

5. Press **ENTER key** once to view the "STATUS: SENSOR OK" screen. Then press the **ENTER key** again to view the "STATUS: TEMP OK" screen. If "FAIL" appears on either input status screen, it may indicate:
   - Sensor is disconnected or incorrectly wired.
   - Signal is very noisy or exceeds measuring range.

6. With the "STATUS: TEMP OK" screen displayed, press **ENTER key** once to view the "STATUS: RLY A" screen. Press the **ENTER key** again to view the "STATUS: RLY B" screen. Status indications can be:

Status Indication	Meaning
ACTIVE (Relay energized; LED is on.)	Control Relay: Measured value exceeds setpoint. Alarm Relay: Measured value exceeds low or high alarm point. Status Relay: Existing system diagnostic condition has been detected.
INACTIVE (Relay not energized; LED is off.)	Control Relay: Measured value does not exceed setpoint. Alarm Relay: Measured value does not exceed low or high alarm point. Status Relay: Analyzer has not detected system diagnostic condition.
TIMEOUT (Relay not energized; LED is blinking.)	Control Relay: Overfeed timer has timed out; manually reset it. ***NOTE:*** *TIMEOUT only applies to control relays.*
COUNTING (Relay energized; LED is on.)	Control Relay: Overfeed timer is counting, but has not timed out. ***NOTE:*** *COUNTING only applies to control relays.*

7. To end relay status checking, press **ESC** or **ENTER key**.

5.2 Holding Outputs

The analyzer has a convenient feature to hold the analog outputs, suspending operation of any connected devices.

1. With the ≣TEST/MAINT ▶STATUS ↓ screen displayed, press ⇩ **key** <u>once</u> to display ≣TEST/MAINT ▶HOLD OUTPUTS ↕.

2. Press **ENTER key** to <u>immediately</u> <u>hold</u> the analog outputs ("HOLD OUTPUTS: ENTER TO RELEASE" screen appears, acknowledging hold is operating).

NOTE: *If the keypad is not used within 30 minutes, the analog outputs will automatically change back to their active states and the display will return to the MEASURE screen.*

3. To release the hold and return analog outputs back to their "active" states, press **ENTER key**.

5.3 Resetting Overfeed Timers

When a relay overfeed timer "times out," as indicated by its blinking LED, the timer must be <u>manually</u> reset using TEST/MAINT menu screens. The LED stops blinking after reset.

1. With the ≣TEST/MAINT ▶STATUS ↓ screen displayed, press ⇩ **key** <u>twice</u> to display ≣TEST/MAINT ▶OVERFEED RESET↕.

2. Press **ENTER key** to reset <u>all</u> overfeed timers ("OVERFEED RESET: DONE" screen appears, acknowledging reset has occurred).

3. Press **ESC** or **ENTER key** to return to the previous level of the TEST/MAINT menu branch.

5.4 Providing Output (1 and 2) Test Signals

The analyzer can provide analog output test signals of a desired milliamp value to confirm operation of connected devices. **Test signals can be provided for both outputs in the same way using their respective menu screens.**

1. With the ≣TEST/MAINT ▶STATUS ↓ screen displayed, press ⇩ **key** until you display ≣TEST/MAINT ▶OUTPUT 1 ⇕.
2. Press **ENTER key** to display OUTPUT 1? (XX.XXmA).

NOTE: *The mA test signal for Output #1 is now active. Its value is shown on this screen.*

3. Adjust the displayed value to obtain the desired mA test signal. (Use ⇨ **and** ⇦ **keys** for coarse adjust; ⇧ **and** ⇩ **keys** for fine adjust.)
4. To end the output test signal and return to the previous level of the TEST/MAINT menu branch, press **ESC** or **ENTER key**.

5.5 Testing Relay (A and B) Operation

Relays A and B can be tested to confirm their operation. **Test each relay in the same way using its respective menu screens.**

NOTE: *The front panel alarm LEDs will not operate during this test.*

1. With the ≣TEST/MAINT ▶STATUS ↓ screen displayed, press ⇩ **key** until you display ≣TEST/MAINT ▶RELAY A ⇕.
2. Press **ENTER key** to display RELAY A? (ENERGIZE). Relay A should be energized. Confirm this by checking NO and NC relay output terminals with a continuity meter.
3. Press ⇧ **or** ⇩ **key** once to display RELAY A? (DE-ENERGIZE). Relay A should be de-energized. Confirm this by checking NO and NC relay output terminals with a continuity meter.
4. To end this test and return to the previous level of the TEST/MAINT menu branch, press **ESC** or **ENTER key**.

5.6 Testing Alarm LEDs

Both front panel alarm LEDs can be simultaneously tested.

1. With the ≡TEST/MAINT ▶STATUS ↓ screen displayed, press ⇩ **key** until you display ≡TEST/MAINT ▶ALARM LEDS ⇕.
2. Press **ENTER key** to display ALARM LEDS: ALTERNATE ON/OFF. Both front panel LEDs should continuously blink on and off.
3. To end this test and return to the previous level of the TEST/MAINT menu branch, press **ESC** or **ENTER key**.

5.7 Checking EPROM Version

You can check the EPROM version used in your analyzer.

1. With the ≡TEST/MAINT ▶STATUS ↓ screen displayed, press ⇩ **key** until you display ≡TEST/MAINT ▶EPROM VERSION ⇕.
2. Press **ENTER key** to view the EPROM version.
3. To return to the previous level of the TEST/MAINT menu branch, press **ESC** or **ENTER key**.

5.8 Selecting Type of Simulated Value

You can simulate a measured value to make the relays and analog outputs respond accordingly. First, select the type of simulated value using this subsection. Then, set the desired simulation value following the steps in subsection 5.9.

1. With the ≡TEST/MAINT ▶STATUS ↓ screen displayed, press ⇩ **key** until you display ≡TEST/MAINT ▶SELECT SIM ⇕.
2. Press **ENTER key** to display SELECT SIM? (SENSOR). Use ⇩ **and** ⇧ **keys** to view both choices:
   - **SENSOR:** Depending on the configured measurement, selects the simulated value to be a conductivity, % concentration, or TDS value.
   - **TEMPERATURE:** Selects the simulated value to be a temperature value.
3. With the desired choice displayed, press **ENTER key** to enter this selection.

5.9 Setting Simulation Value

After selecting the type of simulated measurement (subsection 5.8), set the desired simulation value.

1. With the ≡TEST/MAINT ▶SELECT SIM ⇕ screen displayed, press ⇩ **key** until you display ≡TEST/MAINT ▶SIM SENSOR ⇕.

2. Press **ENTER key** to display SIM SENSOR? (XXXX mS/cm).

NOTE: *The value shown on this screen is now active, providing a corresponding mA value for both analog output signals. (Both relays, depending on their configured settings, may also respond to this simulation value.)*

3. Adjust the displayed simulation value to the desired value. (Use ⇨ **and** ⇦ **keys** for coarse adjust; ⇧ **and** ⇩ **keys** for fine adjust.)

4. To end simulation and return to the previous level of the TEST/MAINT menu branch, press **ESC** or **ENTER key**.

5.10 Resetting Configuration Values to Factory Defaults

You can conveniently reset all stored configuration settings, including calibration settings, simultaneously to factory-set defaults.

1. With the ≡TEST/MAINT ▶STATUS ⇩ screen displayed, press ⇩ **key** until you display ≡TEST/MAINT ▶RESET DEFAULTS⇕.

2. Press **ENTER key** to display the "RESET DEFAULTS: ARE YOU SURE?" screen, asking if you really intend to perform this extreme action. (If you want to abort this action, press **ESC key** now.)

3. Press **ENTER key** to reset all stored configuration settings to factory defaults ("RESET DEFAULTS: DONE" screen appears, acknowledging reset has occurred).

4. To return to top level of the TEST/MAINT menu branch, press **ESC** or **ENTER key**.

SECTION 6
RELAY OVERFEED TIMER FEATURE

The useful relay overfeed timer feature, **only available to a relay set for the "control" function**, is decribed in more detail in this section.

6.1 Why Use an Overfeed Timer

Suppose that you configure a control relay with a high phase to operate in response to increasing measured value. The control relay will then turn on whenever the measured value exceeds its preset setpoint. When the measured value decreases below the setpoint by an amount you preset (the deadband setting), the relay will turn off. But what if a damaged sensor or a process upset condition keeps the measured value above the setpoint or deadband setting? The control element (valve, pump, etc.) switched by that relay would then continue to operate. Depending on the application control scheme, this may excessively dispense costly chemical additives or overly drain or divert the process. Also, the control element itself could be damaged due to excessive continuous or unusual operation such as a pump that is running dry. The useful overfeed timer prevents undesirable conditions like these from happening. It restricts how long the relay and its connected control element will remain on regardless of conditions.

6.2 Configuring Relay Overfeed Timers

To set a relay overfeed timer, use its respective configuration menu screen. The time you set to restrict how long the relay stays on (0-999.9 minutes) should be just enough to provide acceptable results. An excessive setting may waste chemicals or the process itself. Initially, set this time as an estimate. Then, by experimenting and observing the response, periodically "fine tune" to optimize the setting.

6.3 Overfeed Timer "Timeout" Operation

When a control relay is on and its overfeed timer "times out," its LED indicator will blink. This indicates that the relay is now off and will remain off until you manually reset the overfeed timer. After reset, the relay LED stops blinking. (Both overfeed timers are reset simultaneously.)

6.4 Resetting Overfeed Timers

To manually reset <u>both</u> relay overfeed timers, please refer to Part Three, Section 5.3.

6.5 Interactions with Other Analyzer Functions

A relay overfeed timer can, and often will, interact with other analyzer functions while those functions are in use. Table G on the next page explains common overfeed timer interactions.

Table G -- RELAY OVERFEED TIMER INTERACTIONS WITH OTHER ANALYZER FUNCTIONS

Function Conditions		Resulting Action of Overfeed Timer
Manually Holding Relay Operation (When Outputs are Held at Start of Calibration)		
Off relay held in "off"	Overfeed timer was off	Overfeed timer remains off. After you change back to ACTIVE from the HOLD mode, the overfeed timer will remain off until the measured value (or a value you simulate) causes the relay to turn on.
On relay held in "on"	Overfeed timer was counting	Overfeed timer continues its "count down" until it turns the relay off. If you release HOLD before the timer "times out," the timer continues its "count down" until it turns the relay off or the timer automatically resets when the measured value (or a value you simulate) causes the relay to turn off. If you release HOLD after the timer has "timed out," it must be manually reset (Part Three, Section 5.3).
On relay held in "on"	Overfeed timer was timed out	Overfeed timer remains off which keeps the relay turned off. You must manually reset the timer (Part Three, Section 5.3).
Manually Transferring Relay Operation (When Outputs are Transferred at Start of Calibration)		
Off relay is transferred to "on"	Overfeed timer was off	Overfeed timer starts its "count down" until it turns the relay off. After you change the "on" relay back to "off," the overfeed timer automatically resets.
On relay is transferred to "off"	Overfeed timer was counting	Overfeed timer automatically resets. After you change the "off" relay back to "on," the overfeed timer starts its "count down" until it turns the relay off, or the timer automatically resets again when the measured value (or a value you simulate) causes the relay to turn off.
On relay is transferred to "off"	Overfeed timer was timed out	
Manually Testing Relay Operation (By Using TEST/MAINT Menu Screens)		
Off relay is changed to "on"	Overfeed timer was off	Overfeed timer starts its "count down" until it turns the relay off. After you change the "on" relay back to "off," the overfeed timer automatically resets.
On relay is changed to "off"	Overfeed timer was counting	Overfeed timer automatically resets. After you change the "off" relay back to "on," the overfeed timer starts its "count down" until it turns the relay off, or the timer automatically resets again when the measured value (or a value you simulate) causes the relay to turn off.
On relay is changed to "off"	Overfeed timer was timed out	
Operating a Relay By Simulating a Value (Using TEST/MAINT Menu Screens)		
Off relay is turned "on" by simulated value	Overfeed timer was off	Overfeed timer starts its "count down" until it turns the relay off. After you change the "on" relay back to "off," the overfeed timer automatically resets.
On relay is turned "off" by simulated value	Overfeed timer was counting	Overfeed timer automatically resets. After you change the "off" relay back to "on," the overfeed timer starts its "count down" until it turns the relay off, or the timer automatically resets again when the measured value (or a value you simulate) causes the relay to turn off.
On relay is turned "off" by simulation value	Overfeed timer was timed out	

PART FOUR - SERVICE AND MAINTENANCE

SECTION 1
GENERAL INFORMATION

1.1 Inspecting Sensor Cable

If a measurement problem exists and you suspect the sensor cable, inspect it for physical damage. If an interconnect cable is used, disconnect the cable at both ends (sensor and analyzer) and, using an ohmmeter, check its wires for continuity and internal shorts.

1.2 Replacing Fuse(s)

The analyzer is equipped with two internal, board-mounted fuses (80 mA and 100 mA type T slow-blow; 5 mm x 20 mm size). The fuses protect the 115 and 230 volt line power circuits.

WARNING:

DISCONNECT LINE POWER TO PREVENT POSSIBLE ELECTRICAL SHOCK.

1. After disconnecting line power, unplug all terminal strip connectors to enable removal of the back panel.
2. Remove the four screws fastening the back panel and remove the panel. The board-mounted fuses are located on the left circuit board.
3. Remove the blown fuse and replace it with a OMEGA fuse (part number 1F1048) or an equivalent.
4. Reinstall the back panel and attach all terminal connectors.

1.3 Replacing Relays

The analyzer relays are soldered into a complex, multi-layered circuit board. To avoid the possibility of damaging this board while attempting to replace a relay, simply return the complete analyzer to the OMEGA Customer Service Dept. or your local factory-authorized service organization for relay replacement.

SECTION 2
PRESERVING MEASUREMENT ACCURACY

2.1 Keeping Sensor Clean

To maintain measurement accuracy, periodically clean the sensor. Operating experience will help you determine when to clean the sensor (typically, monthly intervals). Use the recommended cleaning procedure described in the OMEGA electrodeless conductivity sensor instruction manual.

2.2 Keeping Analyzer Calibrated

Depending on the circumstances of the application, periodically calibrate the analyzer to maintain measurement accuracy.

Maintenance Tip! Upon startup, frequently check the system until operating experience can determine the optimum time between calibrations that provides acceptable measurement results.

Calibrate the analyzer using a method described in Part Three, Section 4.3, 4.4 or 4.5. Calibrating the analyzer with old, contaminated, or diluted reference solution may cause measurement errors. **Do not reuse reference solutions.** Note that the value of a reference solution will change as its temperature changes. Therefore, always allow the temperatures of the sensor and reference solution to equalize while calibrating.

2.3 Avoiding Electrical Interference

Recommendation: Do not run the sensor cable (and interconnect cable, if used) in the same conduit with line power.

Maintenance Tip! Excess cable should not be coiled near motors or other equipment that may generate electrical or magnetic fields. Cut cables to proper length during installation to avoid unnecessary inductive pickup ("electrical noise" may interfere with the sensor signal).

SECTION 3
TROUBLESHOOTING

When experiencing problems, try to determine the primary measurement system component causing the problem (sensor, analyzer, or interconnect cable, if used).

3.1 Checking Electrical Connections

1. Verify that line power exists at the appropriate analyzer TB1 terminals.
2. Check all analyzer cable connections to ensure they are properly connected.

3.2 Verifying Sensor Operation

To verify sensor operation, refer to the procedure in the troubleshooting section of the sensor instruction manual.

3.3 Verifying Analyzer Operation

WARNING:

DISCONNECT LINE POWER TO PREVENT POSSIBLE ELECTRICAL SHOCK.

1. After disconnecting line power and the sensor from the analyzer, connect a 1000 ohm resistor between Terminals 7 (red) and 9 (yellow) on TB3.
2. Connect a 100,000 ohm resistor between Terminals 6 (white) and 10 (green) on TB3.
3. Reconnect line power to the analyzer.

WARNING:

WHEN LINE POWER IS PRESENT, BE CAREFUL TO PREVENT ELECTRICAL SHOCK.

4. Verify that the analyzer conductivity reading is between 5.00 mS/cm and 50.00 mS/cm. Also, verify that the analyzer temperature reading is between -10°C and +10°C.

If these readings are achieved, the analyzer is operating properly, but the interconnect cable (if used) may be faulty.

3.4 Verifying Interconnect Cable Integrity

WARNING:

DISCONNECT LINE POWER TO PREVENT POSSIBLE ELECTRICAL SHOCK.

1. After disconnecting line power, reconnect the sensor directly to the analyzer (purposely bypassing the interconnect cable and junction box, if used).

2. Place the sensor in a container of saturated salt water that is at room temperature.

3. Reconnect line power to the analyzer.

WARNING:

WHEN LINE POWER IS PRESENT, BE CAREFUL TO PREVENT ELECTRICAL SHOCK.

4. Verify that the analyzer conductivity reading is between 150 mS/cm and 350 mS/cm. If the reading is achieved, the interconnect cable and/or junction box connections are probably faulty. Use a digital multimeter to check the interconnect cable for shorted or open wires.

SECTION 4
ANALYZER REPAIR/RETURN

4.1 Customer Assistance

If you need assistance in troubleshooting or repair service, please contact your local OMEGA representative, or the OMEGA Customer Service Department at: 1-800-622-2378

4.2 Repair/Return Policy

All analyzers returned for repair or replacement must be freight prepaid and include the following information:

1. A clearly written description of the malfunction.
2. Name of person to contact and the phone number where they can be reached.
3. Proper return address for shipping analyzer(s) back. Include preferred shipping method (UPS, Federal Express, etc.) if applicable.
4. A purchase order if analyzer(s) is out of warranty to cover costs of repair.

NOTE: *If the analyzer is damaged during return shipment because of inadequate packaging, the customer is responsible for any resulting repair costs. (**Recommendation:** Use the original OMEGA shipping carton or an equivalent.)*

Also, OMEGA will not accept analyzers returned for repair or replacement unless they are thoroughly cleaned and all process material is removed.

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WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

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RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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