THORNTON
Leading Pure Water Analytics

200CRS
Conductivity/Resistivity
Instrument

Instruction Manual

METTLER TOLEDO

IMPORTANT SAFETY INFORMATION

Please read and observe the following:

INSTALLATION: This instrument must be installed by trained instrumentation personnel in accordance with relevant local codes and instructions in this manual. Observe all instrument specifications and ratings.

SHOCK HAZARD: Make sure power to all wires is turned off before proceeding with installation or service of this instrument. High voltage may be present on the input power and relay wires.

RELAY CONTROL ACTION: Relays will always de-energize on loss of power, equivalent to normal state, regardless of relay state setting for powered operation. Configure any control system using these relays with fail-safe logic accordingly.

PROCESS UPSETS: Because process safety conditions may depend on consistent operation of this instrument, take appropriate action to maintain conditions during sensor cleaning, replacement or sensor or instrument calibration.

This manual includes safety information with the following designations and formats:

WARNING: POTENTIAL FOR PERSONAL INJURY.

CAUTION: possible instrument damage or malfunction.

NOTE: important operating information.

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CHAPTER 1: GETTING STARTED

INTRODUCTION

Thank you for ordering the 200CRS instrument from Thornton, Inc. The 200CRS is an analytical and process control instrument for measuring solution properties. It is user friendly, flexible and highly accurate. The 200CRS processes the signal from one sensor. A 1 line x 16 character Liquid Crystal Display (LCD) module conveys measuring data and setup information. The display is backlit for viewing in all lighting conditions. The menu structure allows the operator to modify all operational parameters by using keys on the front panel. A menu-lockout feature, with password protection, is available to prevent the unauthorized use of the meter. The 200CRS is configured with two relays for process control.

The 200CRS instrument is equipped with a communication interface that can be configured as either an RS422 or an RS232. This interface provides real-time data output and complete instrument configuration capabilities for central monitoring via Personal Computer or Programmable Logic Controller. For coverage of communications, see Manual 84364.

FEATURES

Display: 1 line x 16 character backlit LCD.

Measurements: resistivity, conductivity, °C, °F, total dissolved solids.

Measurement Channels: 1.

Signal Inputs per channel: 2 (total of 2 signals for measurement).

Measurement Cycle Time: 1 second (4 measurements processed per second).

Configuration: all setup information is stored in non-volatile memory.

Setpoints (alarms): 2 independent alarms programmable as high or low limits.

Relays: 2 with programmable delay time and hysteresis.

Outputs: 2 analog outputs (4-20mA), rescalable to 0-20mA.

Communications: RS232/RS422 interface, bi-directional.

Security: keypad lockout with password.

Calibration: complete instrument, output, and sensor calibration. Calibration can be NIST traceable.

Watchdog Timer: with a power supply monitor, to prevent unexpected instrument lockup.

Built-In Diagnostics: several self tests performed automatically and can be initiated at any time.

OVERVIEW OF OPERATION

When power is applied to the 200CRS, the initialization process begins. The instrument will perform a number of self-tests. Any problems detected during these tests will be reported by a displayed message.

Next, all setup parameters (setpoints, states, relay conditions, etc.) are restored from a non-volatile memory.

The meter will then begin the measurement process. A complete measurement cycle is performed once per second and consists of the following:

1. Measures from one sensor and computes two measurements.

2. Check setpoints against the measurements.

3. Control the relays.

4. Update analog output signals.

5. Transmit measurement data over the communication port.

6. Display data (if not displaying menu).

At any time during this process, the menus can be accessed by pressing one of the menu keys. The display of a menu will not affect the measurement process.

INSTALLATION & SETUP PROCEDURE

The following guideline shows the steps necessary to install a 200CRS meter and begin operation.

1. Follow the meter installation procedure for physically mounting the meter, as outlined in Chapter 2. The meter may be mounted in a panel, on a pipe, or on a wall.

    Optional: sealed rear cover is required for wall and pipe mounting. Drill holes as needed for conduit or cable grips, install the cover, and wire the meter before wall or pipe mounting.

2. Make all necessary electrical connections to the meter after panel mounting. The wiring procedure is outlined in Chapter 2.

3. Required wiring: input power and sensor cables.

4. Optional wiring: relays, analog outputs, and serial port.

5. Set appropriate input line frequency to reduce measurement noise. See AC POWER FREQUENCY in Chapter 4.

6. Instrument calibration is performed at the factory to specifications. Re-calibration is not necessary. If QA/QC practice requires it, meter calibration may be verified as outlined in Chapter 8.

7. Connect the sensor to the patch cord.

8. Enter sensor constant from the label of the cell as outlined in ENTERING/EDITING CELL CONSTANTS in Chapter 9. DO NOT PERFORM A SENSOR CALIBRATION.

9. Select the desired measurements for the sensor as shown in SELECTING A MEASUREMENT TYPE in Chapter 4.

10. Optional: program the analog outputs as shown in Chapter 7. DO NOT PERFORM AN OUTPUT CALIBRATION.

11. Optional: program the setpoints as shown in Chapter 5.

12. Optional: program the relays as shown in Chapter 6.

13. Optional: program other features such as averaging method, special temperature compensation, security/password, etc, as needed.

CHAPTER 2: INSTALLING THE 200CRS

UNPACKING

Each 200CRS is packed in an individual biodegradable carton. Customers are advised to retain the packaging in the event that the instrument must be returned to Thornton for service or calibration. Open the carton carefully to insure that the product is not damaged or dropped.

This carton should contain:

     1 - 200CRS Instrument

     1 - Set, panel mounting gasket & screws

     1 - 84413 Instruction Manual

     1 - Certificate of Calibration

     1 – 84415 Installation Instruction

INSTALLATION

The 200CRS can be mounted in a panel, on a pipe or attached to a wall.

Panel Mounting Cutout and Installation

The panel cutout should measure 7.56 inches wide by 3.78 inches high (192 mm X 96 mm). Drill four holes for the #10 mounting screws. See Figure 14.3 for panel cutout size and mounting screw hole spacing. When mounting multiple instruments on the same panel, note the front flange dimensions in Figure 14.2 in order to allow enough space between instruments.

Panel cutouts should be clean and free of burrs and sharp edges. The proper dimensions allow an instrument to slide freely into the cutout.

Install the panel gasket (supplied with instrument) on the instrument as shown in Figure 14.5. Slide the instrument into the cutout and secure it with the mounting screws.

CAUTION: Do not over-tighten the screws as this may crack the case.

If the rear cover is used in a panel-mounted installation, the 200CRS unit must be installed in the panel opening before the rear cover is installed.

Wall Mounting

The 200CRS can be easily mounted to a wall when the rear cover is installed. The flanges on the ends of the cover contain holes for screws to fasten the assembly to the wall. A template for drilling mounting holes is included in the wall mount kit.

Pipe Mounting

The 200CRS can be mounted to a pipe with the pipe mounting accessory kit (shown in Figure 14.7.) The assembly procedure is shown in Figure 14.6.

ELECTRICAL CONNECTIONS

All electrical connections are made at terminal blocks at the rear of the 200CRS case which can accept 12 to 28 AWG wire (0.08 to 3.31 mm^2).

WARNING: MAKE SURE POWER TO ALL WIRES IS TURNED OFF BEFORE PRO-CEEDING WITH THE INSTALLATION. HIGH VOLTAGE MAY BE PRESENT ON THE INPUT POWER WIRES AND RELAY WIRES.

CAUTION: To prevent electrostatic discharge (ESD) from damaging the instrument during installation, the installer must be electrically grounded i.e., wear a conductive wrist strap connected to earth ground.

CAUTION: Run signal and power wiring in separate conduit or wire bundles to prevent electrical noise pickup.

Input Power and Relay Connections

Terminal block TB4 contains connections for the input line power and relay contacts. Table 2.1 shows the wiring sequence.

All relays have "dry contacts"; they are potential-free and require external power to be wired in series with the load and instrument terminals.

TB4 Label	Input Power
L	115V/230 VAC Line
N	115V/230 VAC Neutral
⏚	Earth Ground

TB1 Label	Relay Function
NC1	Relay1: Normally Closed
C1	Relay1: Common
NO1	Relay1: Normally Open
NC2	Relay 2: Normally Closed
C2	Relay 2: Common
NO2	Relay 2: Normally Open

Table 2.1: Input Power & Relay Connections

WARNING: MISWIRING THE AC POWER MAY DAMAGE THE INSTRUMENT AND WILL VOID ALL WARRANTIES

Setting Input Voltage
for 115 VAC or 230 VAC

The input voltage for a 200CRS can be set for either 115 VAC or 230 VAC operation. The input voltage is preset at the factory and is indicated on the serial number labeled on the side of the unit. Jumpers on the printed circuit board can be changed to change the input voltage. See Figure 14.9. W4 jumper pins are located between the power transformer and the fuse. For 115 VAC operation jumper pins 1-2 and 3-4 must be used. For 230 VAC operation only a jumper on pins 2-3 must be installed. The jumpers can be accessed by removing two screws from the back panel and carefully lifting the panel off.

WARNING: IF THE INPUT VOLTAGE JUMPERS ARE CHANGED YOU MUST LABEL THE UNIT WITH THE NEW VOLTAGE REQUIREMENT. ALSO, THE FUSE MUST BE CHANGED TO THE PROPER TYPE TO AVOID RISK OF FIRE HAZARD

Fuse requirements:

For 115 VAC: 1/8 Amp, SB, 250 VAC

For 230 VAC: 1/16 Amp, SB, 250 VAC

NOTE: If the line power frequency is changed, select the correct setting (see AC POWER FREQUENCY in Chapter 4).

Setting Input Voltage for 24 VDC

The 200CRS can be operated from a 24 VDC power supply instead of the typical 115 VAC or 230 VAC source.

Remove any AC power connections from terminal block TB4.

1. Move circuit board jumper W6 to the 24V position (left two pins) as shown in Figure 14.9.

2. Connect + 24V DC power to the connection labeled PS+ on terminal block TB3. Connect the power supply ground to the connection labeled PS- on TB3.

WARNING: AC POWER CONNECTIONS MUST BE REMOVED WHEN USING THE +24V POWER INPUT.

NOTE: The 24 VDC input is not fused within the meter. An external fuse is recommended.

CAUTION: The 24 VDC power must be isolated from earth ground and from other instruments.

Output Connections

Connections for all outputs are made to terminal block TB2. The serial port can be configured as an RS232 port (shown in Table 2.2.) or an RS422 port (shown in Table 2.3).

TB2 Label	RS232 Function
GND	Ground
TXD+	Not Used
TXD-	Transmit Data
RXD+	Not Used
RXD	Receive Data

Table 2.2: RS232 Connections

TB2 Label	RS422 Function
GND	Ground
TXD+	Transmit Data Positive
TXD-	Transmit Data Negative
RXD+	Receive Data Positive
RXD	Receive Data Negative

Table 2.3: RS422 Connections

Each analog output has + and - connections. Analog outputs are self-powered with maximum load resistance of 500 ohms.

CAUTION: Do not connect analog outputs to circuits supplying power.

CAUTION: Do not connect analog output cable shield(s) to the adjacent GND terminal. Connect shields only to the earth ground terminal next to AC line power.

TB2 Label	Analog Output Function
AO2-	Output 2 (-)
AO2+	Output 2 (+)
AO1-	Output 1 (-)
AO1+	Output 1 (+)

Table 2.4: Analog Output Connections

Sensor Patch Cord Connections

The sensor is connected to terminal block TB3. A set of six terminals, Channel A, is used for the sensor. A Patch cord for the 200CRS has a connector on one end and tinned leads on the other end. The connector should be protected from water. The tinned leads are numbered to match the numbers on TB3. Table 2.5. shows the wiring pattern for sensors.

NOTE: Patch cord wire #7 (blue) is not used with this meter. Do not remove clear shrink tubing.

CAUTION: Protect the patch cord-to-sensor connection from water.

CAUTION: Miswiring patch cords may damage sensors and will void all warranties. All wires (except blue) must be connected. Each sensor patch cord wire is numbered to match a number on the rear label. To verify wire color and number, check table below.

TB3 Label	Wire Color	Sensor Function
+5V	-	no connection
GND (6)	Black	
SIG5 (5)	Red	Channel A
SIG4 (4)	Green	Sensor
SIG3 (3)	White	Connections
SIG2 (2)	Clear	
SIG1 (1)	Wht/Blue	

Table 2.5: Sensor Connections- See Fig. 14.10 for terminal layout.

*CAUTION: In ultrapure water installations with all-plastic piping, especially semiconductor wet benches, it is recommended to connect a jumper from the AC LINE earth ground terminal on TB4 to sensor ground terminal GND (6) on TB3 for Channel A. This will prevent possible instrument damage due to electrostatic charges that build up in plastic piping systems. Do not use a ground jumper with higher conductivity water or with metal piping.

Alternative 3-Lead Sensor Connections

Tinned-lead cells with 1000 Pt or 500 Ni-Fe RTDs may be used with the 200CRS. These sensors, with integral leadwire and no connector, enable the lead to pass through small openings. The sensor/instrument separation is limited to less than 30 feet (15 m).

Somewhat lower accuracy may result. Consult the factory for details. Connections are given in Table 2.6. Jumpers should be 22 gauge to match the conductor size in the cable, for secure terminal connections.

TB3 Label	Wire Color
Channel A Sensor Connections	
GND (6)	Black or Clear (Shield)
SIG5 (5)	Jumper to GND (6)
SIG4 (4)	White
SIG3 (3)	Jumper to SIG1 (1)
SIG2 (2)	
SIG1 (1)	Red

Table 2.6: Alternative Sensor Connections

With 2_8 Series Dot Two sensors there is no label with factory-supplied precision cell constants. Only nominal values are entered into the 200CRS. With all tinned-lead sensors, when meter calibration is desired, the cell must be disconnected and a patch cord installed in its place to accept a calibrator.

CHAPTER 3: USING THE 200CRS

APPLYING POWER TO THE 200CRS

After applying power to the meter, the display will show an introduction message for three seconds and then begin making measurements. This message shows the model number and the software version number as follows:

61XX   Ver X.X

While the message is being displayed the instrument is performing self-diagnostics. Various circuits are tested during this process and any failure will be noted with a message. The diagnostics can be repeated at any time via the menus.

The default measurement display is the conductivity reading from the cell on channel A as shown below:

A1.76μS

All 200CRS meters are calibrated from the factory and normally require no further calibration. If QA/QC practice requires it, the instrument can be calibrated after installation. See Chapter 8 for more information on meter calibration.

THE DISPLAY

The 200CRS uses a 1 line by 16 character alphanumeric display to convey all measurement and setup information. This instrument will display one or two measurements, each with unit of measure. A typical display of measurement data is:

A1.76μS

This display indicates that channel A is measuring 1.76μS/cm. The display of the other measurements can be achieved by pressing the UP or DOWN keys.

In the menus, an underline cursor and flashing characters (bold) will indicate a field that can be changed. A typical menu appears as follows:

SP1=1**7**.00 M High

This menu indicates that setpoint #1 is programmed at a value of 17.00 M (million) and is set as a high limit. The cursor is under the digit "7" indicating that the UP and DOWN keys can be used to change it. The RIGHT and LEFT keys will move the cursor to the next or previous field.

Display Contrast Adjustment

The contrast quality of the display can change with ambient temperature. The display contrast is adjusted from the factory for operation at standard room temperature (25°C). If the meter is operated at an ambient temperature that is much different then it may be necessary to make an adjustment. A potentiometer is accessible from the back side of the instrument to change the contrast. Use a small slotted screwdriver to gently turn the potentiometer. A counter-clockwise turn will increase the contrast and a clock-wise turn will decrease the contrast. The rear panel is shown in Figure 3.1.
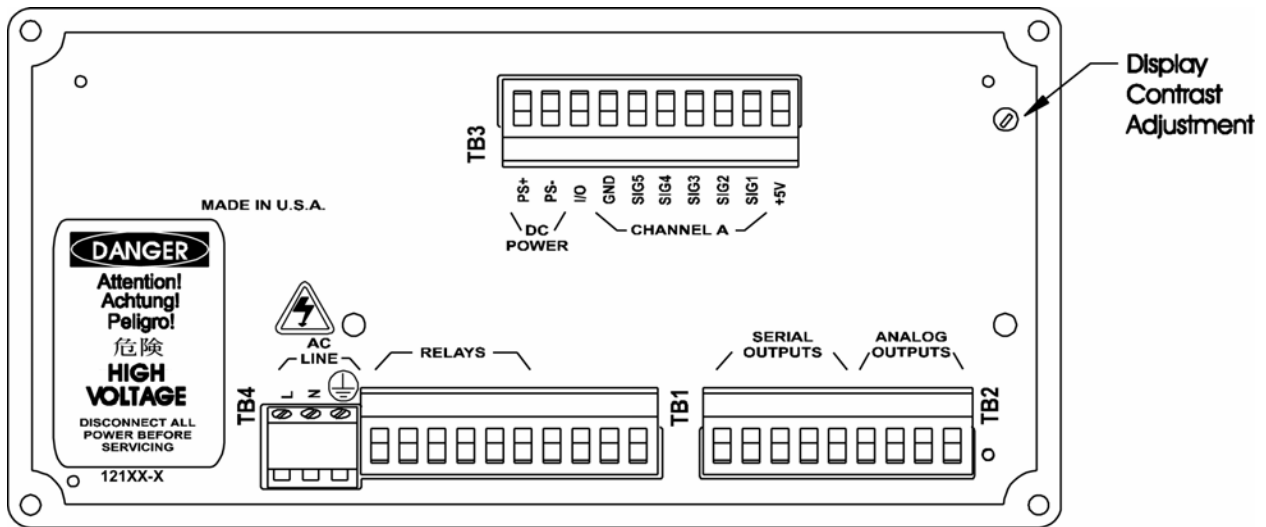
Figure 3.1: 200CRS Rear Panel

THE KEYPAD

The 200CRS is equipped with an 11-key keypad as shown in Figure 3.2.
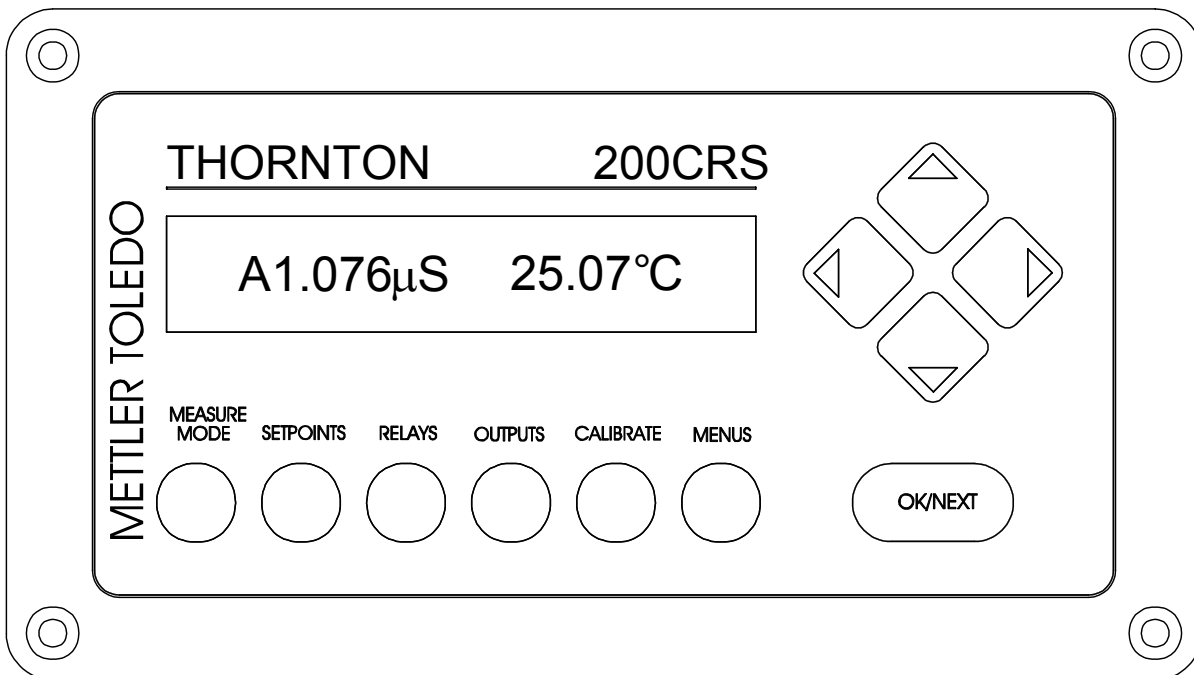

Figure 3.2: 200CRS Front Panel

The keypad has 6 keys that provide direct access to specific menus as follows:

1. **MEASURE MODE -** menus to change measurement modes.

2. **SETPOINTS -** menus for programming setpoints.

3. **RELAYS -** menus for programming relays.

4. **OUTPUTS -** menus for programming outputs.

5. **CALIBRATE -** menus to perform calibration.

6. **MENUS -** all other menus (cell constants, security, compensation, averaging, etc.).

The other keys are referred to as control keys and are used to make changes within a menu.

1. **OK/NEXT** Key - used to accept a selection and proceed to the next menu level.

2. **UP** Key - up arrow is used to scroll up through a list of options.

3. **DOWN** Key - down arrow is used to scroll down through a list of options.

4. **LEFT** Key - left arrow is used to move the cursor to the left within a menu.

5. **RIGHT** Key - right arrow is used to move the cursor to the right within a menu.

USING THE MENUS

There are six menu keys across the bottom of the 200CRS front panel. The first five of these keys (MEASURE MODE, SETPOINTS, RELAYS, OUTPUTS, AND CALIBRATION) are used to enter specific menus. These menus allow the modification of parameters most frequently used by the operator. The sixth key labeled MENUS allows access to all other menus for various functions such as setting compensation methods, security levels, etc.

The UP and DOWN arrow keys scroll vertically through the menus. Part or all of the display changes to the next option whenever an UP or DOWN arrow key is pressed. A field is defined as a section of the display that can be changed. The changeable characters of the field will also blink. The LEFT and RIGHT arrow keys move the underline cursor across the display from one field to the next. Pressing the OK/NEXT arrow key

causes the instrument to accept the options that are displayed and move to the next menu.

Numbers are set one digit at a time using the arrow keys. The LEFT and RIGHT arrow keys are used to position the underline cursor below the digit to be changed. The UP and DOWN arrow keys are then used to change the value of the digit. Each digit can be scrolled through the values:. (decimal point), 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9 The first digit of any number can also be set to a negative sign (-).

To exit the menus either scroll completely through a set of menus with the OK/NEXT key or press any of the six menu keys at any time. The meter will display a prompt asking if the recent changes should be saved.

Save Changes **Yes**

To save the changes press the OK/NEXT key with "Yes" on the display. To discard the changes use the UP or DOWN arrow keys to change "Yes" to "No", then press the OK/NEXT arrow key.

If the instrument is displaying a menu and a key is not pressed for two minutes, *the instrument will automatically exit the menus without saving any changes*. When performing a calibration the operator may need to wait for a measurement to stabilize, so the menu time-out feature is automatically disabled.

Menu Example

Press the MEASURE key and the display will show:

A=**S/cm**   (AUTO)

This menu indicates that the Channel A primary measurement is set for conductivity (S/cm) with auto ranging. The section **"S/cm"** is the field to be changed and will be flashed as long as the cursor is under it. Pressing the UP arrow key will change the **"S/cm"** to **"Ω-cm"**. The RIGHT arrow key will move the cursor to the **"(AUTO)"** field.

A=**Ω/cm**   (AUTO)

The OK/NEXT key is used to accept the entry and move to the next menu. When the last menu

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level is reached, the following message is displayed:

Save Changes **Yes**

Pressing the OK/NEXT key will save the changes and exit the menus. The UP and DOWN arrow keys can be used to change the "Yes" to "No". Pressing the OK/NEXT key with "No" will discard the changes and exit the menus.

INSTALLING A SENSOR

Each conductivity sensor is equipped with a conductivity probe and temperature sensor. Each of these elements has a calibration constant (or cell constant) that must be programmed into the meter for proper operation. These factors are printed on the sensor's cable as well as the Certificate of Calibration supplied with each sensor. The label may look like this:

RES M=1.0034 TEMP M=1.0015

RES M is the conductivity cell constant, and TEMP M is the temperature sensor constant. See ENTERING/EDITING CELL CONSTANTS in Chapter 9 for information on entering cell constants.

MEASUREMENT DESIGNATIONS

The 200CRS instrument will measure two fundamental signals during each measurement cycle. These measurements are the conductivity and temperature of the cell.

The 200CRS can process and display two calculated measurements. They are referred to as A primary, a secondary.   The measurements are designated by a single letter as follows:

Note the upper case letters are used to indicate the primary measurement and lower case letters are used to indicate the secondary measurement.

Each of the two:

1. A = channel A primary measurement

2. a = channel A secondary measurement

Calculated measurements can be one of the following:

1.   Resistivity

2.   Conductivity

3.   Total Dissolved Solids (TDS)

4.   Degrees C

5.   Degrees F

DISPLAYING MEASUREMENTS
Changing the Display
of Measurements

The 200CRS display can show either one or two measurements at a time. The display of measurements can be changed by using the UP or DOWN arrow keys. Pressing one of these keys will cause the meter to change the display mode (show an alternative set of data).

The display modes for two measurements per line are:

Mode #1: A primary (three significant digits displayed for the parameter):

A1.76μS

Mode #2: A secondary (three significant digits displayed for the parameter).

a25.2°C

Mode # 3: A Primary and A Secondary (four significant digits displayed for each parameter):

A1.764μS   25.10°C

Note that when two measurements are displayed, the secondary measurement indicator (a) is not displayed. This allows for greater precision in the display of the primary measurement.

The default display setting (after a system reset) is mode #3 (A) Primary, (a) Secondary.

The display mode for one measurement per line are:

Mode #1: A Primary:

A 1.765μS/cm

Mode #2: A Secondary:

```
a 25.25 Deg C
```

Setting the Number of Measurements per Display Line

The 200CRS can be set to display either one or two measurements per line.

To change this feature:

Press the MENUS key and the following menu will appear:

```
Menus use arrows
```

Press the UP arrow key until "Display Menus" is displayed.

```
Display Menus
```

Press the OK/NEXT key to access this menu. Use the Up or DOWN keys to toggle the field until "Disp Format" appears. Press OK/NEXT to access this menu.

```
Set: Disp Format
```

Use the UP and DOWN keys to toggle the field between "1" and "2".

```
Measure per Line:  1
```

Press OK/NEXT when done. The meter will ask if changes should be saved.

```
Save Changes Yes
```

Press OK/NEXT key to save the changes and return to the display of measurement data.

Measurement Display Scrolling

The 200CRS has an automatic display scrolling feature for measurement data. With this feature enabled, the display will show channel A primary data for 5 seconds and then show 'a' secondary data for 5 seconds. This process is repeated indefinitely.

To enable or disable this feature:

Press the MENUS key and the following menu will appear:

```
Menus use arrows
```

Press the UP arrow key until "Display Menus" is displayed.

```
Display Menus
```

Press the OK/NEXT key to access this menu

```
Set: Auto Scroll
```

Use the Up or Down arrow keys to toggle the field until "Auto Scroll" appears. Press OK/NEXT to access this menu.

```
Auto Scroll=off
```

Use the UP or DOWN arrow keys to toggle the field from "Off" to "On". Press the OK/NEXT key when done. The meter will ask if changes should be saved.

```
Save Changes Yes
```

Press the OK/NEXT key to save the changes and return to the display of measurement data.

ALARM INDICATIONS

A setpoint can be programmed as either a high limit or low limit. When a measurement is higher than a high point (or lower than a low point), then the setpoint is considered to be in an alarm state. This condition is indicated by flashing the corresponding measurement value in the normal operating display.

CHAPTER 4: MAKING MEASUREMENTS

MEASUREMENT PROCESS

The 200CRS will process two measurements from the channel. The measurements of the channel are referred to as the primary and the secondary measurement. The instrument will process a total of two different measurements per cycle.

Measurements are designated as follows:

A = channel A primary measurement

a = channel A secondary measurement

Note that upper case letters are used to indicate the primary measurement and lower case letter are used to indicate the secondary measurement.

MEASUREMENT TYPES

Each of the two measurements (channel A primary, etc.) can be programmed as one of the following:

1. Resistivity

2. Conductivity

3. Total Dissolved Solids (TDS)

4. Degrees C

5. Degrees F

Resistivity

Resistivity is expressed in ohms-centimeter (Ω-cm). This measurement can be displayed with a multiplier in front of the units. The multipliers are k (kilo or 1,000) and M (Mega or 1,000,000).

The display can be set for a fixed range such as Ω-cm, KΩ-cm (1,000Ω-cm), and M (Mega or 1,000,000). The 200CRS can also be set for auto ranging where the range will be automatically adjusted for the most appropriate display. The range is set via the measure mode menus.

1,000,000 Ω-cm = 1,000KΩ-cm = 1MΩ-cm

Conductivity

Conductivity is usually expressed in siemens per centimeter (S/cm) and is the reciprocal of resistivity. This measurement can be displayed with a multiplier in front of the units. The multipliers are m (milli or 1/1,000) and μ (micro or 1/1,000,000). The 200CRS can also be set for auto ranging where the range will be automatically adjusted for the most appropriate display. The range is set via the measure mode menus.

1 S/cm = 1,000 mS/cm = 1,000,000 μS/cm

Conductivity may also be expressed in siemens per <u>meter</u> (S/m) with a multiplier in front of the units as described above. To clearly distinguish these units in the 200CRS display, the symbol "Σ" is used in place of "S". In operation for example, microsiemens per meter is displayed as $\mu\Sigma$.

Total Dissolved Solids

Total Dissolved Solids (TDS) is another way to measure and display conductivity/resistivity data. TDS is the equivalent of Sodium Chloride (NaCl) required to produce the measured conductivity-- approximately 0.46 ppm TDS per μS/cm. If some other conversion is desired, it is necessary to adjust the cell constant to give direct readout. For example, if a conversion of 0.6 ppm TDS per μS/cm is desired, the cell multiplier to be entered into the 200CRS is 0.6/0.46 x Multiplier on sensor label. See Chapter 9, Entering/Editing Sensor Constants.

TDS is measured in parts per billion (ppb), parts per million (ppm), or parts per thousand (ppk). A TDS reading of 10 ppm is equivalent to 10 milligrams per liter. Because of space limitations, the following abbreviations are used to display TDS units:

PB = parts per billion

PM = parts per million

PK = parts per thousand

Temperature

Temperature can be measured in degrees Celsius (°C) or degrees Fahrenheit (°F). The 200CRS normally works with a 1000 ohm DIN platinum RTD sensor which is built into most Thornton conductivity sensors. Alternatively, the 200CRS can automatically recognize and measure with a 500 ohm Ni-Fe RTD temperature sensor.

SELECTING A MEASUREMENT TYPE

To set or change a measurement type for each of the two measurements:

Press the MEASURE key and the display will show the measurement type assigned to channel A primary. The display may appear as:

$$\boxed{\text{A} = \Omega\text{-cm} \quad (\text{AUTO})}$$

This menu indicates that channel A primary measurement is set for resistivity (Ω-cm) with auto ranging. The section **"Ω-cm"** is the first field to be changed and will be flashed as long as the cursor is under it. Pressing the UP arrow key will change the **"Ω-cm"** to **"S/cm"**.

$$\boxed{\text{A} = \underline{\textbf{S/cm}} \quad (\text{AUTO})}$$

Use the UP and DOWN arrow keys to select the desired measurement type.

For conductivity, both temperature compensated and uncompensated measurement are available. Uncompensated readings are needed to meet pharmaceutical USP <645> requirements. Select units of "S/cm" for compensated measurement or "s/cm U" for uncompensated measurement. Using both primary and secondary parameters, both compensated and uncompensated measurements are available simultaneously. In normal operation, uncompensated measurements are identified by a flashing cursor under the units, for example, "μs". Normal compensated readings are identified by "μS".

Another option for conductivity is to display in units of siemens per <u>meter</u> in accordance with the SI metric system. The menu setting is

$$\boxed{\text{A} = \underline{\textbf{S/m}} \quad (\text{AUTO})}$$

The measurement mode will display it as "μΣ" or "mΣ".

The field on the right side of the display is the range field. Some measurements can be set for a fixed range, others can be set only for auto ranging. For example, conductivity can be set for micro, milli, units, or auto ranging. To change the field, use the RIGHT arrow key to move the cursor under "(Auto)". Use the UP and DOWN arrow keys to select the desired range.

The OK/NEXT key is used to accept the entry for channel A primary and move to the next menu for setting channel "a" secondary.

When the last menu level is reached, the following message is displayed:

$$\boxed{\text{Save Changes } \underline{\textbf{Yes}}}$$

Pressing the OK/NEXT key will save the changes and exit the menus. The UP and DOWN arrow keys can be used to change the "Yes" to "No". Pressing the OK/NEXT key with "No" will discard the changes and exit the menus.

CELL CONSTANTS

The calibration of each measurement is defined by a set of constants known as cell constants. There are two cell constants for each measurement: a **Multiplier Factor** and an **Adder Factor**. They are used to derive an accurate measurement from the sensor's output signal. As an example, the output of a conductivity sensor can be represented by the following equation:

$$R = x/M + A$$

Where:

      R = resistivity value

      x = output from cell

      M = multiplier factor

      A = adder factor

Example: for a typical conductivity sensor the multiplier (M) is 0.10 and the adder (A) is 0. If the sensor output is 120,000 ohms, then the actual resistivity of the solution measured is 1.2 Mohm-cm and is calculated as follows:

R = x/M + A

R = 120,000/0.1 + 0

R = 1,200,000

R = 1.2 Mohm-cm

Note: The adder is always zero for conductivity/resistivity sensors.

The cell constants can be modified via the menus. For more information, see ENTERING/EDITING CELL CONSTANTS in Chapter 9.

TEMPERATURE COMPENSATION

Conductivity, resistivity and TDS measurements are normally compensated for temperature. Compensation will adjust the measurement to give an equivalent reading of the solution at 25°C. For example, the resistivity of ultrapure water at 25°C is 18.18 MΩ-cm. The resistivity of ultrapure water at 30°C is 14.08 MΩ-cm. By compensating the resistivity reading, the value of pure water will continue to read 18.18 MΩ-cm.

The 200CRS can use one of five different compensation methods: standard, linear, cation, Light 84, or none.

For pharmaceutical USP <645> conductivity measurements where uncompensated measurement is required, select None for compensation. For simultaneous uncompensated and compensated measurements, see SELECTING A MEASUREMENT TYPE earlier in this chapter.

Standard Compensation

The standard compensation method includes compensation for non-linear high purity effects as well as conventional neutral salt impurities and conforms to ASTM standards D1125 and D5391.

Linear Compensation

The raw resistance measurement is compensated by multiplication with a factor expressed as a "% per °C" (deviation from 25°C). The range is 0 - 99%/°C with a default value of 2%/°C.

Cation Compensation

Power industry applications for cation conductivity measurements with acidic samples are very accurately compensated with this setting. It takes into account the effects of temperature on the dissociation of pure water with the presence of trace acids. This setting is also the most appropriate choice on the 200CRS for specific conductivity measurements using ammonia or ETA (ethanolamine) treatment.

Semiconductor acid etch rinse operations are also most accurately monitored using this compensation setting.

Light 84 Compensation

This compensation matches the earlier high purity water research results of Dr. T.S. Light published in 1984. It is provided only for use by institutions that have standardized on that work. For all other pure water and general purpose applications, Standard Compensation (using the 1994 high purity water research of Thornton & Light) is recommended.

SETTING COMPENSATION

Enabling the compensating feature is done via the menus as follows:

Press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until "Compensation" menu is displayed.

Compensation

Press the OK/NEXT key to access this menu.

A: Comp = **S**tandard

A blinking cursor will be initially placed under the method of compensation. Use the UP and DOWN arrow keys to scroll through the list of available methods: either "Standard", "Linear", "Cation", "Light84" or "None". Selecting "None" disables

the compensation feature. Press the OK/NEXT key to accept the selection. If "Linear" is selected then another menu will be displayed where the linear value can be entered. This menu will appear as (the actual value may be different):

A: Comp = **2**.000%/°C

Adjust the numerical field as desired using the arrow keys and press the OK/NEXT key when done. After setting the compensation state for channel A, press OK/NEXT key when done. The meter will ask if changes should be saved.

Save Changes **Yes**

Press OK/NEXT key to save changes and return to the display of measurement data.

Compensation Indication

When displaying measurements, the 200CRS will indicate that a measurement is NOT compensated by displaying a flashing underline cursor at the units character. The following display shows that channel A is not compensated. (the character "μ" has a blinking underline cursor).

A1.76μS

AC POWER FREQUENCY

The 200CRS meter was designed to reduce fluctuations in measurements by eliminating noise pickup from the AC power line. The meter can be set to filter either 50Hz or 60Hz power.

Setting 50/60 Hz Operation

To set the appropriate filter, press the MENUS key and the following menu will appear:

Menus use arrows

Press the DOWN arrow key until the "Set Frequency" menu is displayed.

Set Frequency

Press the OK/NEXT key to access this menu.

Frequency = **60**

Use the UP or DOWN arrow keys to set the desired frequency. Press the OK/NEXT key when done. The meter will ask if changes should be saved.

Save Changes **Yes**

Press the OK/NEXT key to save the changes and return to the display of measurement.

CHAPTER 5: USING SETPOINTS

OVERVIEW

A setpoint is a limit or alarming condition applied to a measurement. A setpoint can be programmed as a high limit or a low limit. When the measurement value is higher than a high setpoint, or lower than a low setpoint, a setpoint error condition exists. The meter will indicate this condition by blinking the measurement on the display. The 200CRS can also be programmed to control a relay upon this error condition. Refer to Chapter 6 for more information on relays.

Two setpoints are available and can be assigned to any of the two measurements (A, a). More than one setpoint can be assigned to the same measurement and more than one setpoint can activate a relay.

The following parameters can be programmed for setpoint operation:

1. The assigned signal: which signal (A, a) is monitored by the setpoint.

2. The setpoint value: the measurement value that triggers the setpoint error condition, with multiplier.

3. The setpoint type: High, Low or Off.

4. The assigned relay: which relay will be controlled when a setpoint error occurs (this is optional).

5. Operation on over-range: Whether or not the setpoint will be active when the measurement is outside its range — yes or no.

SETPOINT SIGNAL

The setpoint signal is the measurement that will be monitored by the setpoint. The signal can be either:

1. A - Channel A primary

2. a - Channel a secondary

SETPOINT VALUE

The setpoint value is the limit that will trigger a setpoint error condition. This number is entered as a four digit number with a multiplier. The multipliers are:

"µ" (micro) = multiply value by 0.000001 (10^{-6}).

"m" (milli) = multiply value by 0.001 (10^{-3}).

"-" (blank) = multiply value by 1

"K" (kilo) = multiply value by 1,000 (10^{3}).

"M" (Mega) = multiply value by 1,000,000 (10^{6}).

For example, a setpoint value of 18.18M is equivalent to 18,180,000.

When programming the setpoint values with TDS units, the following multipliers should be used (parts per million is the basis):

m = parts per billion

_ = parts per million

K = parts per thousand

SETPOINT TYPE

The setpoint type can be "High", "Low" or "Off". A setpoint error condition is true when the measurement is above the high or below the low limit.

ASSIGNED RELAY

The assigned relay will change state according to the setpoint condition. When a setpoint error condition exists, the assigned relay will change state. If the relay is normally closed, then it will be opened.

Default settings after a system reset: Setpoints are disabled, no signals assigned, no relays assigned and values are zero.

PROGRAMMING A SETPOINT

Press the SETPOINTS key to access the first setpoint menu. This menu is used to assign a measurement to each of the two setpoints.

> SP**1** on signal: A

The cursor is under the setpoint number field. Use the UP and DOWN arrow keys to select the desired setpoint number (1 or 2). Use the RIGHT arrow key to move the cursor to the signal field. Then use the UP and DOWN arrow keys to select the desired signal. The signal can be set to "-" which indicates that the setpoint is not assigned (disabled).

To change the assigned signal of another setpoint, move the cursor back to the setpoint number. Change the setpoint number, then move the cursor back to the assigned signal field.

SP1=**.0**000 _off

Press the OK/NEXT key when done to proceed to the next menu.

The cursor is initially under the setpoint number field. Select the desired number then move the cursor to the numerical field. Set the desired value and multiplier.

Examples of numerical entries:

Desired Value	Menu Entry
10.34	10.34_
1,456	1.456K
18,180,000	18.18M
567,456	567.5K
.003	.0030_ or 3.000m
.000000055	.0550μ

Move the cursor over to the setpoint type field. To turn the setpoint on, select High, Low. Press the OK/NEXT key when done to proceed to the next menu.

The next menu is used to assign a relay to the setpoint. This is optional. The menu will appear as:

SP1 use Relay #_

After selecting the desired setpoint number, move the cursor to the relay field. The choices are: 1 - 2 and "_". The "_" indicates that there are no relays assigned to the setpoint.

Note: The 200CRS is equipped with only 2 relays and will allow settings of only #1 or #2.

Press the OK/NEXT key when done to proceed to the next menu.

SP**1** over-range **Yes**

This menu selects whether the setpoints will be active when the measurement is out of range, which could be due to process upset, loss of fluid at the sensor, disconnected sensor leads, etc. These conditions are indicated by asterisks in the normal display mode. Use the arrow keys to select Yes or No for each setpoint.

Press the OK/NEXT key when done. The meter will ask if changes should be saved.

Save Changes **Yes**

Press the OK/NEXT key to save the changes and return to the display of measurement data.

Example: Setup a Setpoint

Program setpoint #2 with the following conditions:

1. Assigned to channel A secondary signal ("a").

2. A value of 18,200,000 (18.2 MΩ-cm)

3. Set as a high limit

4. Use relay #2

5. Disabled when out of range

Press the SETPOINTS key

Use the arrow keys to select setpoint #2 and signal "a". The display will appear as follows:

```
┌─────────────────────────────────┐
│        SP2 on signal: a         │
└─────────────────────────────────┘
```

Press the OK/NEXT key:

Use the arrow keys to set the value at 18.20M and the state to high. The display will appear as follows:

```
┌─────────────────────────────────┐
│       SP2=18.20 M  High         │
└─────────────────────────────────┘
```

Press the OK/NEXT key:

Use the arrow keys to set the relay number to 2. The display will appear as follows:

```
┌─────────────────────────────────┐
│        SP2 use Relay #2         │
└─────────────────────────────────┘
```

Press the OK/NEXT key:

Use the arrow keys to set the over-range to No, resulting in the following display:

```
┌─────────────────────────────────┐
│       SP2 over-range  No        │
└─────────────────────────────────┘
```

Press the OK/NEXT key. The meter will ask if changes should be saved.

```
┌─────────────────────────────────┐
│       Save Changes  Yes         │
└─────────────────────────────────┘
```

Press the OK/NEXT key to save the changes and return to the display of measurement data.

CHAPTER 6: USING RELAYS

DESCRIPTION

The 200CRS is equipped with two relays. Each relay can be programmed to activate when a setpoint is exceeded (defined as a setpoint error condition). The programmable parameters for a relay are:

1. Delay Time: up to 999 seconds

2. Hysteresis Value: up to 99%

3. State: relay operation can be normal or inverted

ELECTRICAL CONNECTIONS

The units are equipped with two relays, each one has a common connection, a normally open connection and a normally closed connection.

DELAY TIME

Delay time is the length of time that the setpoint must be exceeded continuously (in a setpoint error condition) before activating the relay. When the setpoint error condition occurs, the delay timer is started. If during the delay time the setpoint error condition no longer exists, the delay timer is reset and the relay will not be activated. The maximum delay time is 999 seconds (16 minutes and 39 seconds).

HYSTERESIS

The hysteresis or deadband value is entered as a percentage of the setpoint value. For a high setpoint, the measurement must fall more than this percentage point below the setpoint value before the relay is deactivated. With a low setpoint, the measurement must rise at least this percentage above the setpoint value before the relay is deactivated.

For example: a high setpoint is set at 100 and the measurement is currently above this value so the setpoint error condition exists. If the hysteresis value is 10% then the measurement must fall below 90 before the relay is deactivated.

RELAY STATE

The relay can be programmed for normal or inverted operation. When the relay is in the inverted state, the relay operation is reversed. When there is no setpoint error condition the relay is activated. The normally open contacts are closed.

WARNING: RELAYS WILL ALWAYS DE-ENERGIZE ON LOSS OF POWER, EQUIVALENT TO NORMAL STATE, REGARDLESS OF RELAY STATE SETTING. HOWEVER, THE SETTING IS RETAINED ON RESTORATION OF POWER.

Default settings after the system reset:

1. Relay is disabled.

2. Delay is 0 seconds.

3. Hysteresis is 0%

4. Relay state is normal

PROGRAMMING A RELAY

To enable or modify a relay:

Press the RELAYS key. The first relay menu is used to set the delay time.

R**1** Delay= 000 sec

In this menu, the cursor is initially under the relay number. Use the UP and DOWN arrow keys to select the desired relay number (1 or 2). Use the RIGHT arrow key to move the cursor to the delay time field. Then use the UP and DOWN arrow keys to set the delay time (000 to 999 seconds).

To change the delay time of another relay, move the cursor back to the relay number. Change the relay number, then move the cursor back to the relay time field.

Press the OK/NEXT key when done to proceed to the next menu.

R**1** Hyster = 00%

Select the desired relay number then move the cursor to the hysteresis value field. Enter the hysteresis value (00 to 99%).

Press the OK/NEXT key when done to proceed to the next menu.

R**1** State = Normal

Select the desired relay number, then move the cursor to the relay state field. Use the DOWN arrow key to select either Normal or Invert. Press the OK/NEXT key when done. The meter will ask if changes should be saved.

Save Changes **Yes**

Press the OK/NEXT key to save the changes and return to the display of measurement data.

Example: Setup a Relay

Program relay #2 with the following conditions:

1. Delay of 60 seconds.

2. A hysteresis of 10%.

3. Inverted state.

Press the RELAYS key.

Use the arrow keys to select relay #2 and set a delay time of "060". The display will appear as follows:

R**2** Delay = **060** sec

Press the OK/NEXT key.

Use the arrow keys to set the hysteresis value to "10%". The display will appear as follows:

Press the OK/NEXT key.

R**2** Hyster = **10%**

Use the arrow keys to set the state to inverted. The display will appear as follows:

R**2** State = **Invert**

Press the OK/NEXT key. The meter will now ask if changes should be saved.

Save Changes **Yes**

Press the OK/NEXT key to save the changes and return to the display of measurement data.

CHAPTER 7: USING ANALOG OUTPUTS

DESCRIPTION

An analog output is an isolated current signal that is proportional to a measurement. The 200CRS's two analog outputs have a minimum value of 4mA and a maximum value of 20mA (the signal can be re-calibrated to 0-20mA when needed, see ANALOG OUTPUT CALIBRATION later in this chapter). Each output can be scaled to a range of a measurement signal.

To use analog outputs, the following parameters must be programmed:

1. Assigned Signal - The analog output will be proportional to the value of the assigned signal. Any of the two measurements (A, a) can be assigned to the output.

2. Minimum Value - This is the measurement reading that will correspond to an output of 4mA.

3. Maximum Value - This is the measurement reading that will correspond to an output of 20mA.

The analog outputs can be programmed for their minimum and maximum values. This programming process is independent from any measurement. See PROGRAMMING THE ANALOG OUTPUTS later in the chapter for details.

ELECTRICAL CONNECTIONS

Connections to the analog output signals are made at terminal block TB2. Each analog output channel has a signal line (labeled AO1+ or AO2+) and a return line (labeled AO1- or AO2-). Table 2.4 shows the electrical connections.

The minimum can be re-calibrated down very close to zero mA when needed. See ANALOG OUTPUT CALIBRATION later in this chapter.

The analog outputs are isolated from line power, sensors and earth ground. Each analog output channel can drive a resistive load up to 500 ohms.

PROGRAMMING THE ANALOG OUTPUTS

To setup an analog output channel, press the OUTPUTS key:

> Output: **A**nalog

Press the OK/NEXT key to access this menu. The next menu is used to assign a measurement signal to the output. The choices are: A, a, and _. The selection of "_" is used to disable the output by not assigning a signal to the output. The output will remain at 4mA when it is disabled. The menu may appear as:

> Aout**1** signal = A

In this menu the cursor is initially under the output number. Use the UP or DOWN keys to select the desired output number (1 or 2). Press the RIGHT arrow key to move the cursor under the assigned field.

> Aout1 signal = **A**

Use the UP or DOWN arrow keys to change the assigned measurement. Press the OK/NEXT key to accept it and proceed to the next menu.

> Aout**1** Min=.0000_

This menu is used to set the measurement value that will correspond to a 4mA output. Press the RIGHT arrow key to move the cursor under the number field and set the desired value. The last position in this menu is the multiplier which can be one of the following:

"**μ**" (micro) = multiply value by 0.000001 (10^{-6}).

"**m**" (milli) = multiply value by 0.001 (10^{-3}).

"**_**" (blank) = multiply value by 1.

"**K**" (kilo) = multiply value by 1,000 (10^{3})

"**M**" (Mega = multiply value by 1,000,000 (10^{6})

When programming the analog output scaling limits with TDS units, the following multipliers should be used (parts per million is the basis):

m parts per billion

_ parts per million

K parts per thousand

After setting the desired value, press the OK/NEXT key to accept minimum value and proceed to the next menu.

```
Aout1  Max=1.000_
```

This menu is used to set the measurement value that will correspond to an output of 20mA. Repeat the process as described above. Press the OK/NEXT key to accept the maximum value and proceed to the next menu.

```
1: If err set Max
```

Using an arrow key, select max or min as the fail safe mode for the output signal on overange or failure conditions. The output will go to 20mA if set for max; to 4mA (or 0mA if re-calibrated) if set for min. The meter will ask if changes should be saved.

```
Save Changes  Yes
```

Press the OK/NEXT key to save the changes and return to the display of measurement data.

Example: Setup an Analog Output

Set analog output #2 with the following parameters:

1. Assigned to channel A primary measurement

2. Minimum value of 1.000 M ohms

3. Maximum value of 20.00 M ohms

Press the OUTPUTS key. The display will show:

```
Output:  Analog
```

Press the OK/NEXT key.

Use the arrow keys to select analog output #2 and assign measurement A to this output. The display will appear as follows:

```
Aout2  signal = A
```

Press the OK/NEXT key.

Use the arrow keys to set the minimum value to 1.000 M ohms. The display will appear as follows:

```
Aout2  Min=1.000M
```

Press the OK/NEXT key.

Use the arrow keys to set the maximum value to 20.00 M ohms. The display will appear as follows:

```
Aout2  Max=20.00M
```

Press the OK/NEXT key.

```
2: If err set Max
```

Press the OK/NEXT key.

```
Save Changes  Yes
```

Press the OK/NEXT key to save changes and return the display of measurement data

ANALOG OUTPUT CALIBRATION

The analog output signals have been factory calibrated to specifications. They may be re-calibrated in a two-step process where 4mA and 20mA levels are adjusted. A current meter is connected in series with the output. The arrow keys are then used to adjust the current output for the appropriate level (4mA, then 20mA). The 4mA end of the signal can be calibrated down to zero mA, where needed. With a 500 ohm resistor across the output terminals, a 0-10 VDC signal may also be obtained.

For NIST traceability, the outputs can be calibrated with any NIST calibrated current meter.

Procedure: Connect the meter in series with the output signal.

Press the CAL key and the display will show:

```
                  Calibrate  Sensor
```

Use the UP and DOWN keys to change the display until the "Analog" option is displayed:

```
                  Calibrate  Analog
```

Press the OK/NEXT key to proceed to the next menu.

```
                  Cal Analog Ch1
```

Use the UP and DOWN keys to the desired output number (1). Press the OK/NEXT key to proceed to the next menu.

```
                  1:Adj 4mA=10641
```

Use the UP and DOWN keys to adjust the output current for a 4mA level (as measured by the current meter). The number displayed is an arbitrary value proportional to the analog output signal, near 10,000 for 4 mA, near 0.000 for 0 mA and near 55,000 for 20 mA. Adjusting a more significant digit of this number will change the output signal level faster. Adjust a less significant digit for closer resolution.

Press the OK/NEXT key when done adjusting the 4mA or 0mA output. The next menu is for adjusting the 20mA output.

```
                  1:Adj 20mA=54091
```

Adjust the 20mA level in a similar manner. Press the OK/NEXT key when done adjusting the 20mA. The meter will ask if changes should be saved.

```
                  Save Changes  Yes
```

Press the OK/NEXT key to save the changes and return to the display measurement data.

CHAPTER 8: METER CALIBRATION

OVERVIEW

The 200CRS meter is factory calibrated within specifications. It is not normally necessary to perform meter re-calibration unless extreme conditions cause an out of spec operation shown by Calibration Verification (see CALIBRATION VERIFICATION later in this chapter). Periodic verification/re-calibration may also be necessary to meet Q.A. requirements. The 200CRS meter is re-calibrated by installing a known resistance value in place of the cell and using the calibration menus to complete the process. The meter is equipped with three internal ranges of measurement on each channel. Each range is calibrated separately. The three ranges are referred to as:

1. High Resistance (Res Hi) used to measure resistivities greater than (conductivities less than) those given in the table below.

Cell Constant	Resistivity	Conductivity
0.1 /cm	>750 kΩ-cm	<1.33 μS/cm

2. Low Resistance (Res Lo) for all other measurements.

3. Temperature (Temp) is used to measure all temperature signals.

Each of these measurement ranges may be calibrated with a 1-point process (use one known resistance value) or a 2-point process (use two known resistance values). A 2-point process will provide the most accurate calibration over the full range.

Recommended calibration points (optional):

1. High resistance (Res Hi): 1st point at 100.0KΩ, 2nd point at 4.000 MΩ.

2. Low Resistance (Res Lo): 1st point at 20.00 KΩ, 2nd point at 1000.0Ω.

3. Temperature (Temp.): 1st point at 1,000Ω, 2nd point at 1,400Ω.

Standards for these calibrators are readily available in Thornton NIST-Traceable calibrators which plug directly into patch cables. If decade boxes are used, connect per Figure 14.12, shown for channel A.

NOTE: To display the actual value of a calibration device, use the Calibration Verification menu as described in the next section.

WARNING: INSTALLING A CALIBRATION DEVICE ON A CHANNEL MAY TRIGGER ALARM STATES AND RELAYS.

CALIBRATION VERIFICATION

The calibration verification menu can be used to quickly confirm the meter's performance. A calibration or verification device is installed on the channel and this menu is used to display the actual resistance value of the calibrator or verifier. The verification menu can be found in two locations, either in the calibrate menu or under the menus option. When using the calibrate menu, press the CALIBRATE key, then select "verify calibration". This option is included on two separate menu trees to allow the calibration menu to be locked yet still allow operators to verify calibrations.

Press the MENUS key and the following menu will appear:

Menus use arrows

Press the DOWN arrow key until the "Verify Calibrate" menu is displayed.

Verify Calibrate

Press the OK/NEXT key to access this menu.

Verify   Cal: Ch **A**

Press the OK/NEXT key when set. The meter will now display the actual values of the calibrator. A typical display may appear as:

```
A10.04MΩ 1.003KΩ
```

The first number is the measured value of the resistivity input and the second number is the measured value of the temperature input. Compare these numbers with the values printed on the label of the verifier/calibrator as well as on the Certificate of Accuracy supplied with it. Press any key to end this menu.

CALIBRATION PROCEDURE
High Resistance Range Calibration

Step 1: Select the Meter Calibration

Press the CALIBRATE key and the display will show:

```
Calibrate  Sensor
```

Use the UP and DOWN keys to change the display until it reads:

```
Calibrate  Meter
```

Press the OK/NEXT key to proceed to the next menu.

Step 2: Meter channel is displayed

```
Cal  Meter Ch A
```

Press the OK/NEXT key to proceed to the next menu.

Step 3: Select the signal to calibrate:

```
Cal A  #1: Res Hi
```

Use the UP and DOWN keys to select the signal to be calibrated. The choices are: "Res Hi", ":Res Lo", or "Temp" or "Verify". Press the OK/NEXT key when ready to proceed to the next menu.

Step 4: Enter the calibrator value:

```
A Res Hi=100.00K
```

This menu is used to enter the value of the calibrator (printed on the label as well as the Certificate of Accuracy supplied with the calibrator). The display will show a nominal value but the actual value of the calibrator must be entered. Use the UP and DOWN keys to change the digit. Use the RIGHT and LEFT arrow keys to move the cursor to the next digit. The last character on the display is the multiplier, which appears after the value on the calibrator.

For Reference:

The available multipliers are "μ" = micro, "m" = milli, "k" = kilo, "M" = mega and "_" = one. The numerical entry is multiplied by the value of the multiplier as follows:

"μ" (micro) = multiply value by 0.000001 (10^{-6}).

"m" (milli) = multiply value by 0.001 (10^{-3}).

"_" (blank) = multiply value by 1.

"K" (kilo) = multiply value by 1,000 (10^{3})

"M" (Mega) = multiply value by 1,000,000 (10^{6})

When the value of the calibrator is entered, press the OK/NEXT key when ready to proceed to the next menu.

Step 5: Install the calibrator:

```
A= 100.3K Ω  OK?
```

The instrument will display the value of the calibrator as measured by the meter. it is important to wait for this displayed measurement to stabilize. The reading may fluctuate slightly but the changes should be no more than ± 1 digit (least significant). For example, in the display above the reading may fluctuate from 100.2 to 100.4KΩ. It is recommended that you wait at least 30 seconds to be certain that the measurement has settled.

To discontinue the calibration, press any of the menu keys. To proceed with the calibration process (after the readings have stabilized), press the OK/NEXT key.

Step 6: Perform the calibration:

The calibration process may take a few seconds to complete. When the instrument is done, the following message will be displayed.

```
         Done,   press OK
```

Step 7: Proceed to the 2nd calibration point:

Press the OK/NEXT key to complete the calibration of the first point. The meter will display the following menu:

```
         Do point  #2   Yes
```

Use the UP and DOWN arrow keys to change the "Yes" to "No" and Press the OK/NEXT key to save the new calibration factor and return to the measurement mode. Otherwise, press the OK/NEXT key to perform calibration for a 2nd point. The meter will display the following menu, requesting the value of the 2nd calibration point:

Step 8: Enter the calibrator value (point #2)

```
         A   Res Hi=4.0000M
```

Enter the value of the 2nd calibrator and press the OK/NEXT key when ready to proceed.

Step 9: Wait for the signal to stabilize:

Install the calibrator on the selected channel. As with the 1st calibration point, the meter will now display the measured value of the calibrator as follows:

```
         A=4.001MΩ   OK?
```

When the reading has stabilized, press the OK/NEXT key.

Step 10: Perform the calibration (point #2):

The calibration process may take a few seconds to complete. When the instrument is done, the following message will be displayed:

```
         Done, press  OK
```

Press the OK/NEXT key. The meter will ask if the changes should be saved.

```
         Save Changes  Yes
```

Press the OK/NEXT key to save the changes and return to the display of measurement data.

The calibration process is complete for the high range of a channel. Repeat this process for the low range if necessary.

Reminder: due to entered cell constants and temperature compensation, the meter will only read the exact connected calibrator value in the "Verify" mode.

Temperature Calibration

Note: If using 2_8 series Dot Two cells with Ni-Fe 500 ohm RTD, substitute a decade box with 500 ohms for $0°C$ and 735 ohms for $100°C$ in place of the calibrators in the following procedure.

Using $0°C$ (1000 ohm) and $104°C$ (1400 ohm) calibrator, do a two point temperature calibration. Attach the $0°C$ (1000 ohm) calibrator to Channel A via the patch cord. Press the CALIBRATE key on the 200CRS. The display will show the following:

```
         Calibrate  Sensor
```

Use the up arrow key to toggle to:

```
         Calibrate  Meter
```

Press the OK/NEXT key:

```
         Cal Meter Ch A
```

Press the OK/NEXT key:

```
         Cal  A  #1: Res Hi
```

Press the up arrow key until "Temp" appears.

```
        Cal  A  #1:  Temp
```

Press the OK/NEXT key.

```
        A  TEMP  =1.0000K
```

Change the displayed value with the arrow keys to match the exact temperature resistance value on the connected calibrator. For example:

```
        A=  999.4 TΩ     OK?
```

Wait for 15 seconds for this reading to stabilize. This is the value the meter is reading before calibration. Press OK/NEXT and the calibration will be performed:

```
        Done, press OK
```

Press the OK/NEXT key.

```
        DO point #2?  Yes
```

Press the OK/NEXT key,

```
        A  TEMP  =1.4000K
```

Disconnect the 0°C (1000 ohm) calibrator from Channel A and attach a 104°C (1,400 ohm) calibrator (104°C) onto Channel A. Change the displayed value with the arrow keys to match the exact temperature resistance value on the connected calibrator. For example:

```
        A TEMP=1.4002K
```

Press the OK/NEXT key.

```
        A=  1.4002KTΩ OK?
```

Wait for 15 seconds for this reading to stabilize. This is the value the meter is reading before calibration. Press OK/NEXT and the calibration will be performed:

```
        Done,  press OK
```

Press the OK/NEXT key.

```
        Save Changes  Yes
```

To accept the calibration value, press OK/NEXT. Normal operation will resume.

CHAPTER 9: SENSOR CALIBRATION

ENTERING/EDITING CELL CONSTANTS

Upon the installation of a cell, the cell constant must be entered into the meter. The same menu is also used to edit the constants. Channel A has two cell constant types: one for the resistivity/conductivity sensor and one for the temperature sensor. These constants are referred to as "A Cell" and "A Temp", respectively. Each of these types has a multiplier and adder cell constant. Only the Multiplier factor is used for conductivity/resistivity and temperature. The Adder factor is left at zero.

The procedure to enter and edit the constants is as follows:

Press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until "Edit Sensor Cal " menu is displayed.

Edit Sensor Cal

Press the OK/NEXT key to access this menu

A Cell M=.10000_

The cursor is initially under the channel/type field. Use the UP arrow key to select the desired type (either "A Cell", "A Temp").

The next field selects either the multiplier, M, or the adder, A, factor.

A Cell **M**=.10000_

Use the RIGHT arrow key to move the cursor to the number field. Use the arrow keys to modify the number desired. The last position in the menu is a unit multiplier which should be left at "_" (blank); although μ (micro), m (milli), K (Kilo) and M (mega) are also available.

After setting the desired value, the RIGHT arrow key can be used to move the cursor back to the channel/type field (1st field) so that the other constants can be entered and edited. The changes are recorded when you proceed to a different constant.

Pressing the OK/NEXT key will accept all set values. The meter will ask if changes should be saved.

Save Changes **Yes**

Press the OK/NEXT key to save the changes and return the display of measurement data.

CALIBRATION OVERVIEW

Best performance is normally obtained by entering the factory-documented cell constants per ENTERING/EDITING CELL CONSTANTS at the beginning of this chapter. However, if the sensor's performance is not acceptable then it can be calibrated. It is important to ensure that the meter is properly calibrated and that a very accurate standard solution is available before performing a sensor calibration.

Sensors can be calibrated with either a one-point or two-point calibration process. With a two-point process, the sensor must be put in two different solutions (or temperature values). Under most circumstances only a 1 point calibration process is needed.

The solution must be known with very high accuracy (either resistivity, conductivity, °C or °F) before the sensor can be calibrated. Calibration is accomplished by entering the known solution value into the meter and instructing the meter to perform a calibration.

When a one-point calibration process is performed, the meter will compute a new sensor Multiplier factor. With a two-point process, the meter will compute new Multiplier and Adder factors.

Sensor calibration cannot be done if the measurement is set for non-temperature compensated conductivity using the MEASURE MODE key (see SELECTING A MEASUREMENT TYPE in Chapter 4). If necessary, temporarily set

the instrument for compensated measurement for the calibration. (Calibration can be done, if desired, with Compensation set to "None", accessed by the MENUS key)

CALIBRATION PROCEDURE

Press the CALIBRATE key and the display will show:

Calibrate **S**ensor

Press the OK/NEXT key to proceed to the next menu.

Cal Sensor Ch **A**

Press the OK/NEXT key.

Cal Ch A #1: **Res**

Use the UP arrow key to select the measurement to be calibrated. The choices are: Res, Con, °C and °F. Press the OK/NEXT key when set.

The next menu will allow the known value of the signal (or solution) to be entered.

A Res   = **1**8.180 M

Enter the known value. Be certain to set the proper multiplier. In this example, the multiplier is "M" for Megohms. Press the OK/NEXT key when done.

The meter will now display the reading of the signal to be calibrated. For example, a typical display for calibrating resistivity may appear as:

A= 18.15MΩ   OK?

When the reading has stabilized, press the OK/NEXT key to perform the calibration. The calibration process may take a few seconds to complete. When the instrument is done, the following message will be displayed:

Done, press **OK**

Press the OK/NEXT key. The meter will display the menu for performing the second calibration point.

Do point #2 **No**

If doing a two-point calibration, then use the UP key to change the "No" to "Yes". Press the OK/NEXT key to perform the 2nd calibration point or to exit the menus.

NOTE: Performing a sensor calibration will modify the cell constants shown in the "Edit Sensor Cal" menu such that they will not match the constants written on the cell label.

CHAPTER 10: SECURITY/LOCKOUT

SECURITY FEATURES

All menus, or only specific ones, can be protected from unauthorized use by using the lockout feature. When enabled, the menu(s) will be inaccessible unless the proper five digit password is entered. Each menu key on the front panel can be locked out individually. The functions that can be locked are:

1. MEASURE MODE: locks the measure mode key

2. SETPOINTS: locks the setpoint key.

3. RELAYS: locks the relays key.

4. OUTPUTS: locks the output key.

5. CALIBRATE: locks the calibrate key.

6. MENUS: locks the menu key.

7. DISPLAY: locks the arrow keys such that the display mode for measurements cannot be changed.

The password can be changed at any time, although the current password must be entered before the change is allowed. The password and lockout state is retained through a power-down sequence and a system reset.

All units shipped from the factory are set with the password of "00000". It is suggested that this password be changed to another five digit sequence before using the lockout feature.

CHANGING THE PASSWORD

To change the password, press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until the "Change Password" menu is displayed.

Change Password

Press the OK/NEXT key to access this menu. The next menu will request the current password.

Old Pass = **00000**

After setting the current password, press the OK/NEXT key. If the current password is not properly set, then the following message will be displayed before exiting the menus:

Invalid Password

If the password was properly entered, then the meter will request the new password:

New Pass = **00000**

After setting the new password, press the OK/NEXT key. The meter will ask if changes should be saved.

Save Changes **Yes**

Press the OK/NEXT key to save the changes and return to the display of measurement data.

ENABLING THE LOCKOUT

To enable the lockout, press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP key until the "Set/Clr Lockout" menu is displayed.

Set/Clr Lockout

Press the OK/NEXT key to access this menu. The next menu will request the current password.

Password = **00000**

After setting the password, press the OK/NEXT key. If the correct password has been entered, then the following menu will allow the enabling or disabling of the lockout feature.

```
Enable Lockout N
```

If "N" is selected then the lockout is disabled and the meter will exit the menus. If "Y" is selected the next menu will allow each menu to be individually locked out.

```
Lock Measure  Y
```

The first field lists the functions to be locked. Use the UP and DOWN arrow keys to access the list. The choices are: MEASURE, SETPOINT, RELAYS, OUTPUTS, CALIBRATE, MENUS, DISPLAY. When the desired function is selected, move the cursor to the next field to change the state. A "Y" indicates that this function is locked and an "N" indicates that the function is not locked. use the LEFT arrow key to move the cursor back to the function field to select another key for lockout. When done setting all the functions, press the OK/NEXT key. The meter will ask if changes should be saved.

```
Save Changes  Yes
```

Press the OK/NEXT key to save the changes and return to the display of measurement data.

NOTE: If the lockout feature is used, it is recommended that the MENUS key also be locked to prevent any indirect changes to the meter's setup.

ACCESSING A LOCKED MENU

If the lockout feature is enabled and a key is pressed that is also locked, the following message will be displayed:

```
Password = 00000
```

If the proper password is entered, then access to that menu will be allowed. This menu key will operate as normal. When the menu is exited, the lockout will be re-enabled.

CHAPTER 11: OTHER FUNCTIONS

AVERAGING

The 200CRS has various levels of measurement averaging or damping, each for specific applications. The options are: low, medium, high and special. The channel can be assigned an averaging level. The assigned averaging will apply to both the primary and secondary measurements of the channel.

Low averaging is useful in applications that require a fast response to changes in the system. Medium and high averaging help to reduce display fluctuations. The Special averaging setting is recommended for most applications. This method provides the most reduction in display fluctuations, while retaining fast response.

Special (Spec) averaging is self-adjusting. If a large change in the measurement is detected, then the meter will respond immediately to the change (does not use any averaging). Small changes to the measurement (i.e., system noise less than 1%) will be highly averaged. If measurement noise can exceed 1%, then special averaging should not be used.

To set the averaging, press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until the "Set Averaging" menu is displayed.

Set Averaging

Press the OK/NEXT key to access this menu.

A: Average = High

The cursor is initially under the channel field. Use the RIGHT arrow key to move the cursor to the level field. The display will appear as:

A: Average = **High**

Use the UP and DOWN arrow keys to change the averaging level. Press the OK/NEXT key when done. The meter will ask if changes should be saved.

Save Changes **Yes**

Press the OK/NEXT key to save the changes and return to the display of measurement data.

SYSTEM RESET

CAUTION: A system reset will set all operational parameters to their default conditions and may require extensive reprogramming.

1. A Primary Measurement Mode:
   Conductivity (fixed at μS/cm)

2. A Secondary Measurement Mode:
   Temperature (DegC)

3. Display Mode:
   Mode #3 (A) primary (a) secondary

4. Setpoints (all):
   Off, value = 0, no relay assigned, active on over-range

5. Relays (all):
   Delay = 0, hysteresis = 0, state = normal

6. Serial Port:
   Data output off.

7. Analog Outputs:
   no signal assigned, min = 0, max = 0

8. Manual temperature:
   None

9. Compensation Method:
   Standard method.

10. Cell Constants:
    resistivity multiplier = 0.1, temperature multiplier = 1.0, all adders = 0.

11. Auto Display Scroll: Off.

A system reset will not change the password, lockout state, meter calibration, analog output calibration, or line power frequency.

To reset the meter, press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until "System Reset" is displayed.

System Reset

Press the OK/NEXT key to access this menu.

Reset Unit?   **Yes**

Press the OK/NEXT key to perform the reset. The meter will display a confirmation message for three seconds then exit the menus.

Unit is Reset

SETTING A MANUAL TEMPERATURE

A manual temperature is a fixed value that can be used instead of the actual temperature measurement from a sensor. This feature is useful when a cell does not have a temperature sensor built-in or if it is desirable to compensate a measurement based on a fixed temperature.

To set a manual temperature, press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until the "Set temperature" menu is displayed.

Set Temperature

Press the OK/NEXT key to access this menu.

A: T=25.00°C Off

The cursor is initially under the channel field. Use the RIGHT arrow key to move the cursor to the temperature value field. The display will appear as follows:

A: T=**2**5.00°C Off

Set the desired temperature value then use the RIGHT arrow key to move the cursor to the "Off" field. Use the UP key to toggle this field to "On".

Press the OK/NEXT key when done. The meter will ask if changes should be changed.

Save Changes **Yes**

Press the OK/NEXT key to save the changes and return to the display of measurement data

SENDING DATA TO A PRINTER OR COMPUTER

The 200CRS can be set to output measurement data automatically to a printer or computer at a fixed time interval. The time interval can be set from 1 second up to 255 seconds. The data is transmitted as a string of ASCII characters, terminated with a carriage return character. All four measurements are contained in the string. To use this feature, the baud rate, parity, and output timer must be set as follows:

Setting the Baud Rate and Parity

Press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until the "Set Serial Port" menu is displayed.

Set Serial Port

Press the OK/NEXT key to access this menu. A typical menu may appear as:

Baud=9600 P=Even

The cursor is initially under the baud rate setting. Press the UP or DOWN arrow keys to change the baud rate. Use the RIGHT arrow key to move the cursor to the parity field. The parity setting can be switched between even parity and no parity.

Press the OK/NEXT key when done. The meter will ask if changes should be saved.

```
          Save Changes  Yes
```

Press the OK/NEXT key to save the changes and return to the display of measurement data.

Setting the Data Output Timer

Press the OUTPUTS key.

```
          Output:  Analog
```

Press the UP-arrow key until "Serial" is displayed. Press the OK/NEXT key to access this menu.

```
          Output off >001s
```

Press the UP arrow key to toggle the serial output from "Off" to "On". Setting the serial out feature to "On" enables the automatic data output. Use the RIGHT arrow key to move the cursor to the time field.

```
          Output On >001s
```

Use the arrow keys to set the desired time interval in seconds.

Note: Entering a value greater than 255 seconds will automatically set the timer interval to 255 seconds.

Press OK/NEXT when done. The meter will ask if changes should be saved.

```
          Save Changes  Yes
```

Press the OK/NEXT key to save the changes and return to the display of measurement data.

For details on communications output, refer to Manual 84424.

CHAPTER 12: TROUBLESHOOTING

OFF-LINE SELF-DIAGNOSTICS

A number of diagnostic and self test functions are available via the menus. The following functions can be tested:

1. ROM: the program memory is tested for any changes in its contents. If one or more bits have changed, then the test has failed.

2. RAM: the data memory is tested for reading and writing.

3. AOUT1: analog output channel #1 is tested by setting the output current from 0mA to 20mA in 1mA steps.

4. AOUT2: analog output channel #2 is tested by setting the output current from 0mA to 20mA in 1mA steps.

5. A/D: the analog to digital converter circuit (used for making measurements) is tested for functionality.

6. COMM: the communication port is tested for its ability to receive and transmit data. A jumper wire is connected from the transmit line to the receive line before conducting the test.

7. NVRAM: the non-volatile memory is tested for functionality. This memory is used to hold setup information in case of a power down condition (or low line voltage).

8. DISPLAY: the display is tested by writing various patterns. This is a visual test conducted by the operator.

To perform any of these tests, press the MENUS key and the following menu will appear:

Menus use arrows

Press the UP arrow key until the "Diagnostic" menu is displayed.

Diagnostic Menu

Press the OK/NEXT key to access this menu.

Test?   ROM

The cursor is under the first field which indicates the test to be conducted. The choices are: ROM, RAM, AOUT1, AOUT2, A/D, COMM, NVRAM, DISPLAY, KEYPAD or exit. Use the RIGHT arrow key to select the desired test. Press the OK/NEXT key to perform the test. Select "Exit" to exit this menu.

The test results are displayed with the following messages (for example, the ROM test):

ROM: Passed **Ok**

or

ROM: Failed **Ok**

ON-LINE DIAGNOSTICS
Error, Over-range & Sensor Error Indication

A measurement that cannot be properly measured or computed or is over-range is considered to be in an error state. The display will show asterisk characters "*" in place of the allocated digits.

An example:

A ******µS ******°C

In this display, both measurements could not be measured or computed properly.

Such error conditions can be caused by a disconnected or mis-wired sensor, no sample at the sensor, too high or too low sample conductivity or resistivity for the sensor and instrument to measure, sensor failure, etc.

NOTE: If the temperature measurement is not working properly and it is needed for temperature compensated conductivity or resistivity, both will show asterisks even if the conductivity signal is otherwise OK. A manual temperature setting may allow continued operation in this case.

"Check Setup" Message

The 200CRS constantly checks the condition of the setup data (setpoints, compensation methods, etc.). If the meter detects an unauthorized change in this data (i.e., corrupted data) then a message will be displayed every few seconds as follows:

> Check Setup

This message can be cleared by entering and exiting any menu.

TROUBLESHOOTING

Problem	Possible Cause
1. Display is blank	• no power to unit • blown fuse • loose display cable • display contrast potentiometer needs adjustment • display cable improperly connected • circuit board failure
2. Wrong readings	• sensor improperly installed • incorrect measurement multiplier entered • incorrect cell constant entered • meter improperly calibrated • temperature compensation is incorrectly set or disabled • sensor patch cord is defective • defective sensor • measurement circuit board failure • circuit board failure
3. Keypad not functioning	• keypad cable connector loose or broken • defective keypad
4. Readings fluctuate too much	• wrong line power frequency selected • cell and/or cable installed too close to equipment that generated high levels of electrical noise
5. Data not sent out to serial port	• serial port wiring is wrong • wrong baud rate and/or parity • automatic data output not enabled • data output timer set too high

RECOVERY PROCEDURE

If the meter is unable to make valid measurements, then the following procedure may help to resolve the problem.

1. Check sensor patch cord wiring. Look for loose wires at the terminal block or incorrect wiring.

2. Perform a system reset as outlined in SYSTEM RESET in Chapter 11.

3. Re-enter the cell constants as shown in ENTER/EDITING CELL CONSTANTS in Chapter 9. Set the desired measurement mode and multiplier as shown in SELECTING A MEASUREMENT TYPE in Chapter 4.

4. Re-calibrate the meter as outlined in Chapter 8.

5. Check that the proper compensation method is selected.

CHAPTER 13: SERVICE & MAINTENANCE

FUSE REPLACEMENT

The 200CRS is protected from accidental voltage overloading, short circuits, and related damage by a 1/8 amp time-delayed fuse (for 115 VAC units only). The 230 VAC unit uses a 1/16 amp time-delayed fuse. The fuse is located on the printed circuit board (PCB) inside of the case.

WARNING: FOR CONTINUED PROTECTION AGAINST RISK OF FIRE, REPLACE ONLY WITH FUSE OF THE SPECIFIED TYPE AND CURRENT RATING.

To replace the fuse:

1.   Disconnect all power to the 200CRS unit before proceeding.

2.   Remove the two screws from the center of the rear panel.

3.   Slowly pull the rear panel assembly out of the unit, no more than 1".

4.   Disconnect the two ribbon cables connecting the case to the PCB.

5.   The fuse is located near the transformer. Remove the old fuse and replace it with one with the same rating as indicated above.

6.   Position the PCB near the case and connect the two cables to the PCB. Make sure each cable is properly seated and oriented.

7.   Gently push the rear panel assembly back into the case. Make sure the four mounted posts align with the holes in the assembly.

8.   When the assembly is properly seated, re-install the two mounting screws.

9.   Reconnect power to the meter.

REDUCING 200CRS PATCH CORD LENGTH

200CRS patch cords are available in standard lengths listed with Accessories. Occasionally it is necessary to reduce standard cord lengths to accommodate system design. The following procedure outlines cable termination to assure accurate system operation. The 200CRS patch

cords include two (2) drain (bare) wires. It is essential that these wires never make contact with each other. Place insulating tubing over these wires.

CAUTION: If the wires are touching, it will cause the readings to be inaccurate. Be sure that the wires never make contact with each other.

Tools required:

Cable cutters, wire strippers, insulating tubing, soldering iron & solder, wire markers (optional).

Procedure:

1.   Measure the cable from the end connector to the desired length and cut.

2.   Strip outer jacket and shield 2-1/2 inches from the end.

3.   Cut at the jacket the blue, orange, yellow and all white wires that are outside the inner shield. DO NOT CUT the drain (bare) or the wires enclosed inside the inner shield.

4.   Strip inner shield all the way to the jacket.

5.   Strip all leads 1/4 inch and tin the inner shield.

6.   Place insulating tubing over the inner drain (bare) wire. Tuck the insulating tubing under the jacket. THIS WIRE MUST NEVER TOUCH THE OUTER SHIELD OR OUTER DRAIN WIRE.

7.   Solder the outer drain (bare) wire to the black wire.

8.   Place insulating tubing over the outer drain (bare) and black wires. Tuck the tubing under the jacket. THIS WIRE MUST NEVER TOUCH THE INNER SHIELD OR INNER DRAIN WIRE.

9.   Place wire markers on leads if desired.

10.   Wire the cable to the 200CRS as indicated. See Figure 14.10.

SPARE PARTS LIST

Description	Recommended Quantity	Part #
1. Fuse:		
For 90-130VAC		
(Type 2AG, 1/8 Amp SB, Littlefuse® #218.125, 5 x 20mm)	1	35088
For 180-250VAC		
(Type 2AG, 1/16 Amp SB, Littlefuse® #218.063, 5 x 20mm)	1	35091
2. Display Assembly	1	06235
3. Power Selection Jumper(s):		
For 115VAC	2	25242
For 230VAC	1	25242
4. Panel Mounting Kit (gasket, screws, nuts)	-	02181
5. Plug-in Connectors		
TB-1 & TB-3 (10-pin)	2	22626
TB-2 (9-pin)	1	22617

ACCESSORIES

Description	Part #
Complete Calibrator Kit (includes 1864-01, -02, -03, -04)	1865-03
High Resistivity/Low Conductivity Calibrator Kit (includes 1864-01, -02)	1865-01
Low Resistivity/High Conductivity Calibrator Kit (includes 1864-03, -04)	1865-02
Calibrator 4MΩ & 1400Ω (104°C)	1864-01
Calibrator 100KΩ & 1000Ω (0°C)	1864-02
Calibrator 20KΩ & 1400Ω (104°C)	1864-03
Calibrator 1000Ω & 1000Ω (0°C)	1864-04
Calibrator, 1.8MΩ & 1097Ω (25°C)	1865-04
Back Cover for IP65 Rating	1000-62
Pipe Mounting Kit for 1-1/2 to 4" pipe (requires back cover, above)	1000-63
Adapter plate, 800 Series to 200 Series	1000-64
Patch Cord, 1 ft	1001-66
Patch Cord, 5 ft	1005-66
Patch Cord, 10 ft	1010-66
Patch Cord, 15 ft	1015-66
Patch Cord, 25 ft	1025-66
Patch Cord, 50 ft	1050-66
Patch Cord, 100 ft	1110-66
Patch Cord, 150 ft	1115-66
Patch Cord, 200 ft	1120-66
Manual, Communications (RS232, RS422)	84424

CHAPTER 14: TECHNICAL ILLUSTRATIONS

MENU TREES

OVERALL DIMENSIONS

PANEL CUTOUT

EXPLODED ASSEMBLY

PANEL MOUNTING

PIPE MOUNTING

PIPE MOUNTING BRACKET

SEALED IP65 REAR ASSEMBLY

PRINTED CIRCUIT BOARD LAYOUT

REAR PANEL WIRING & PATCH CORDS

CALIBRATORS
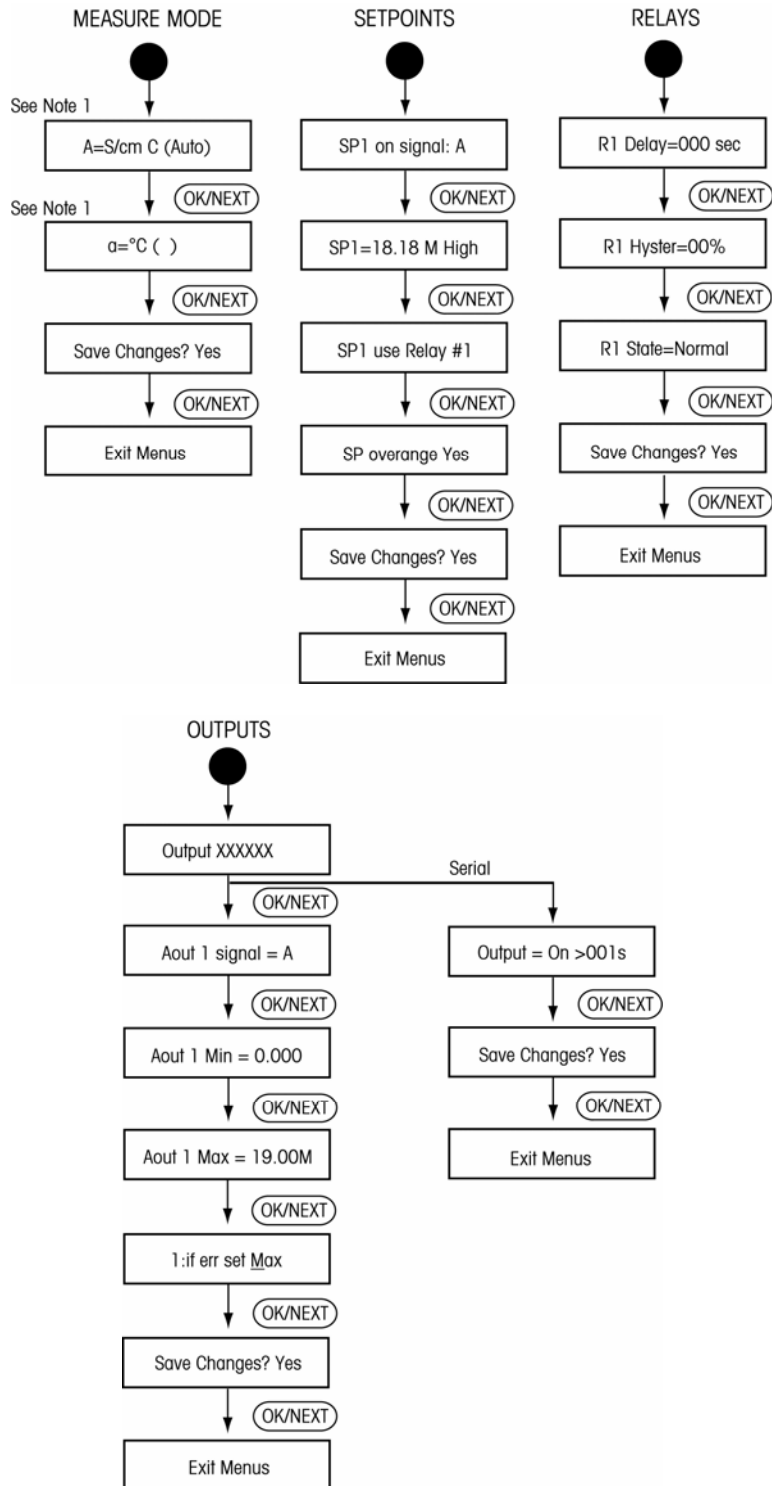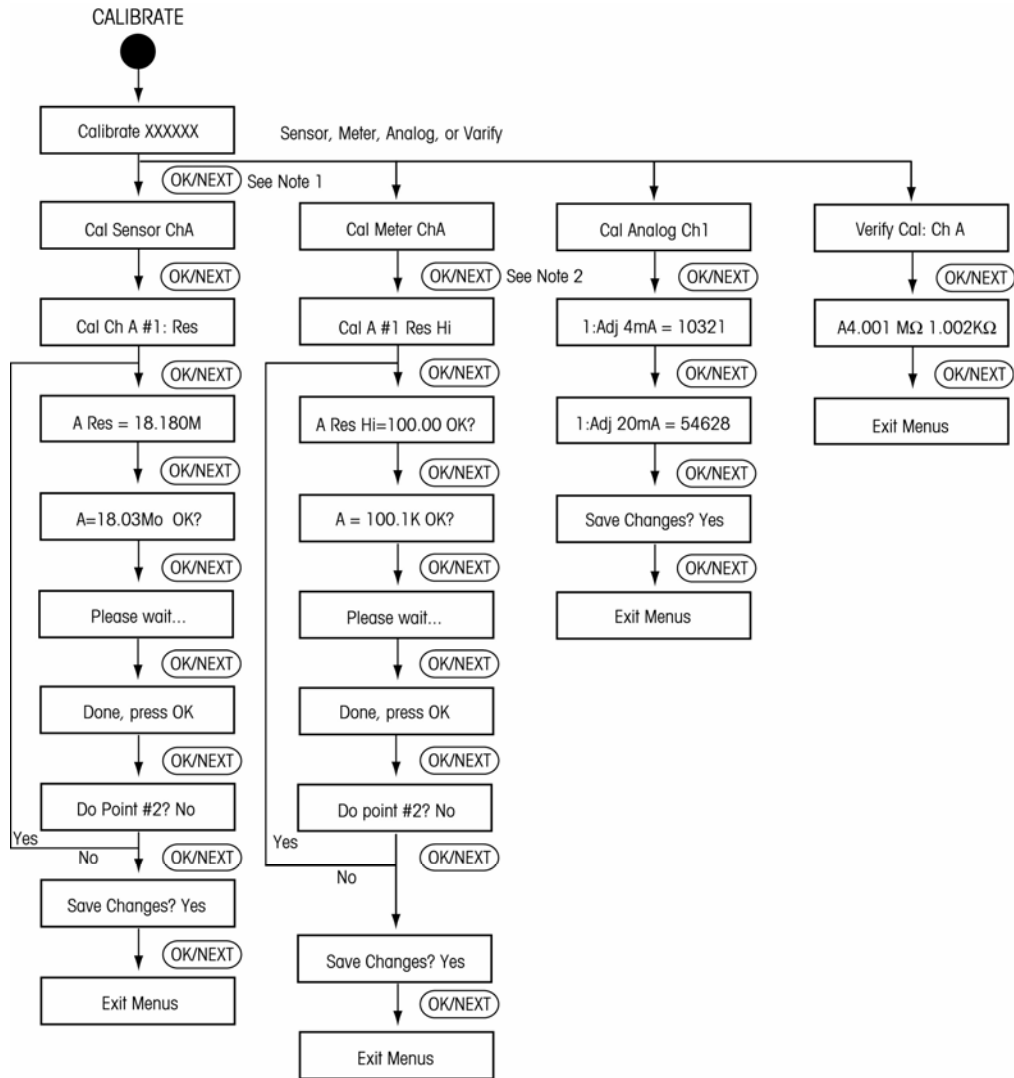
METER CALIBRATION CONNECTIONS USING DECADE BOX
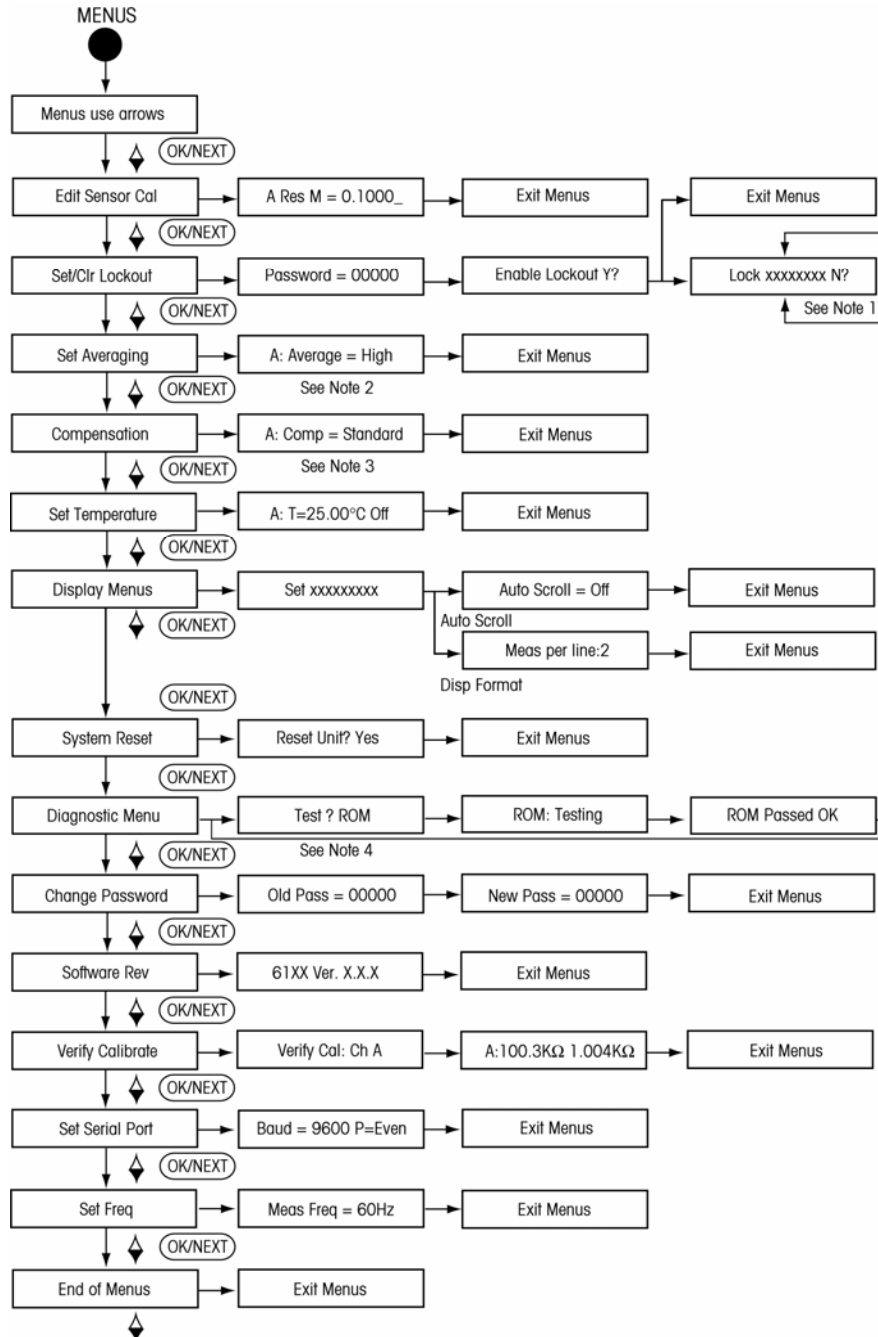
MENU TREES

Figure 14.1a: Menu Trees

MENU TREES (Continued)

NOTE: 1. Choices for this menu are: Res, Con, °C, °F
2. Choices for this menu are: Res, Hi, Res Lo, Temp.

Figure 14.1b: Calibrate Menu Tree

MENU TREES (Continued)

Notes:
1. Choices for this menu are: Measure, Display, Menus, Calibrate, Relays, Outputs, or Setpoint.
2. Choices for this menu are: High, Medium, Low or Spec.
3. Choices for this menu are: Standard, Linear, Cation, Light 84, or None
4. Choices for this menu are: ROM, RAM, Aout #1, Aout #2, A/D, Comm, NVRAM, Display or keypad

Figure 14.1c: Menus Menu Tree

OVERALL DIMENSIONS
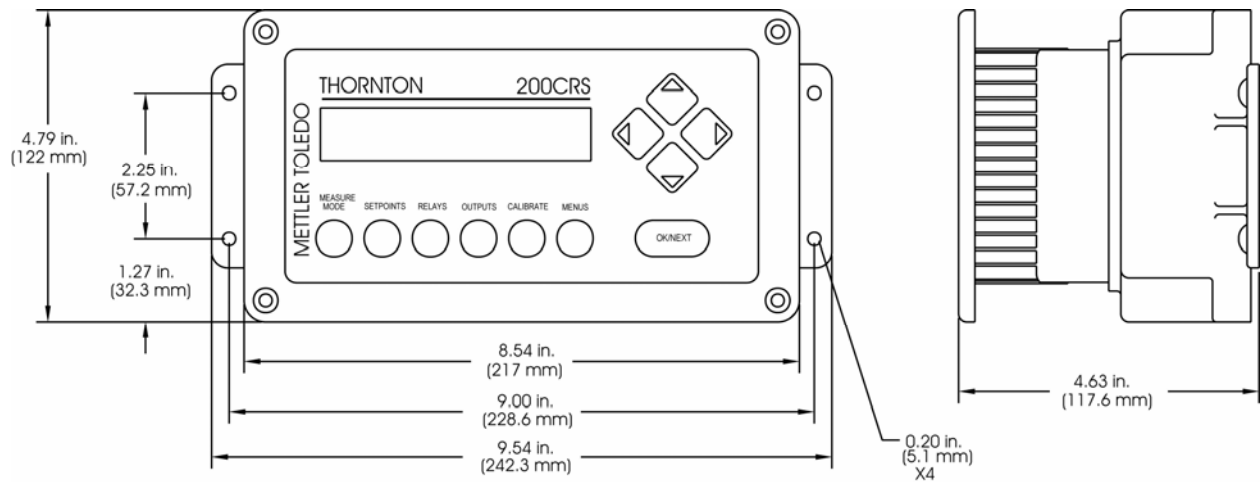

Figure 14.2a: Panel Mounting Dimensions

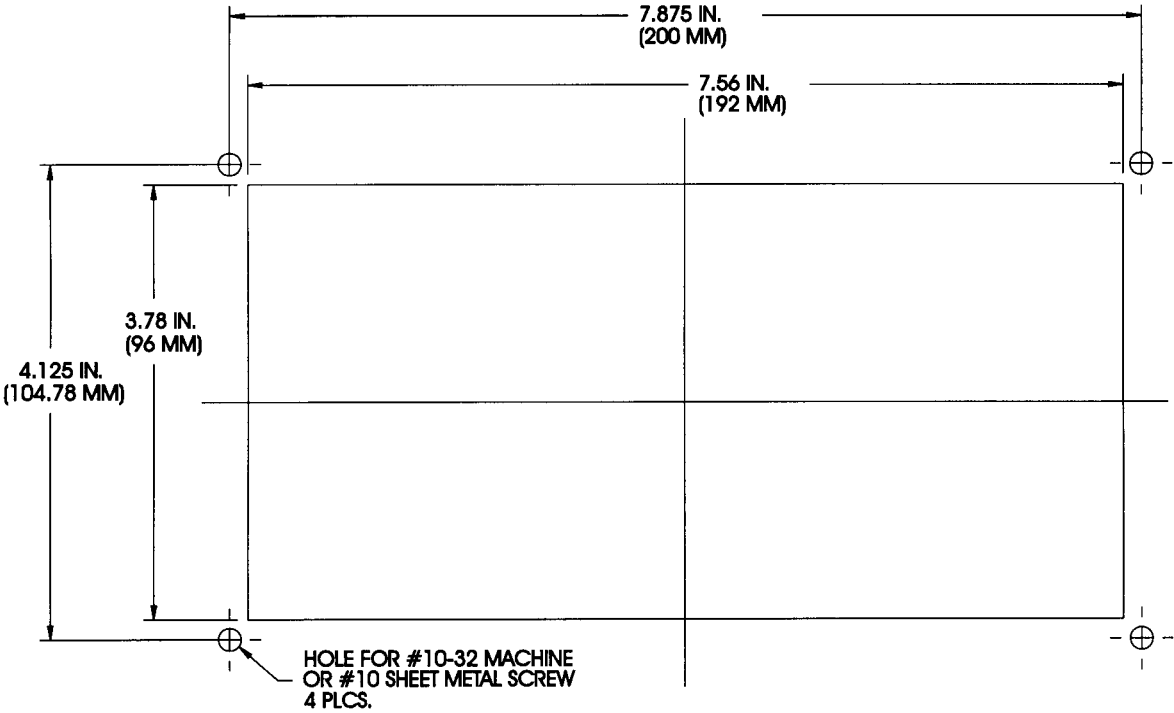*Figure 14.2b: Wall Mounting Dimensions (with accessory rear cover installed)*

PANEL CUTOUT

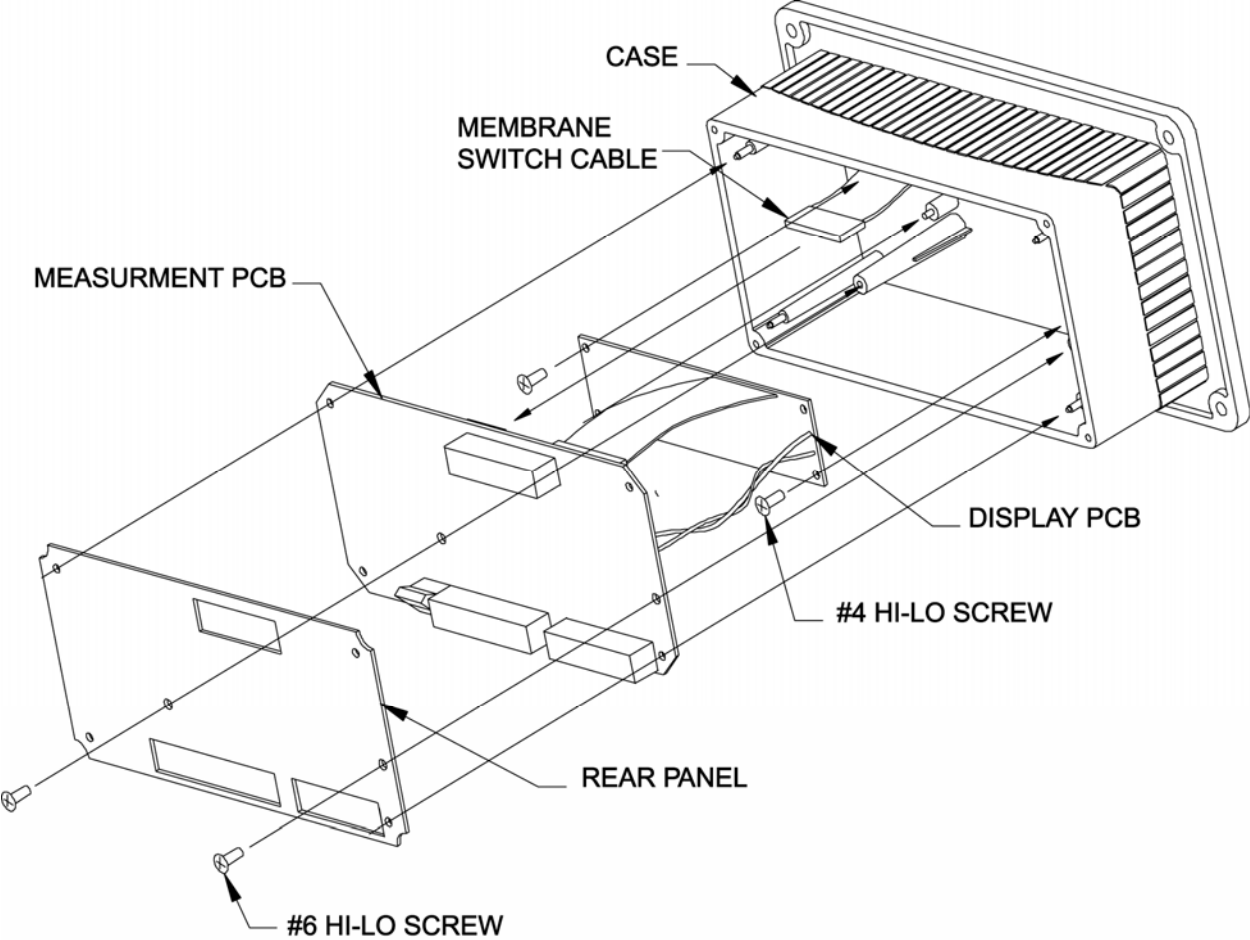*Figure 14.3: Panel Cutout*

EXPLODED ASSEMBLY

CASE

MEMBRANE
SWITCH CABLE

MEASURMENT PCB

DISPLAY PCB

#4 HI-LO SCREW

REAR PANEL

#6 HI-LO SCREW

Figure 14.4: Exploded Assembly
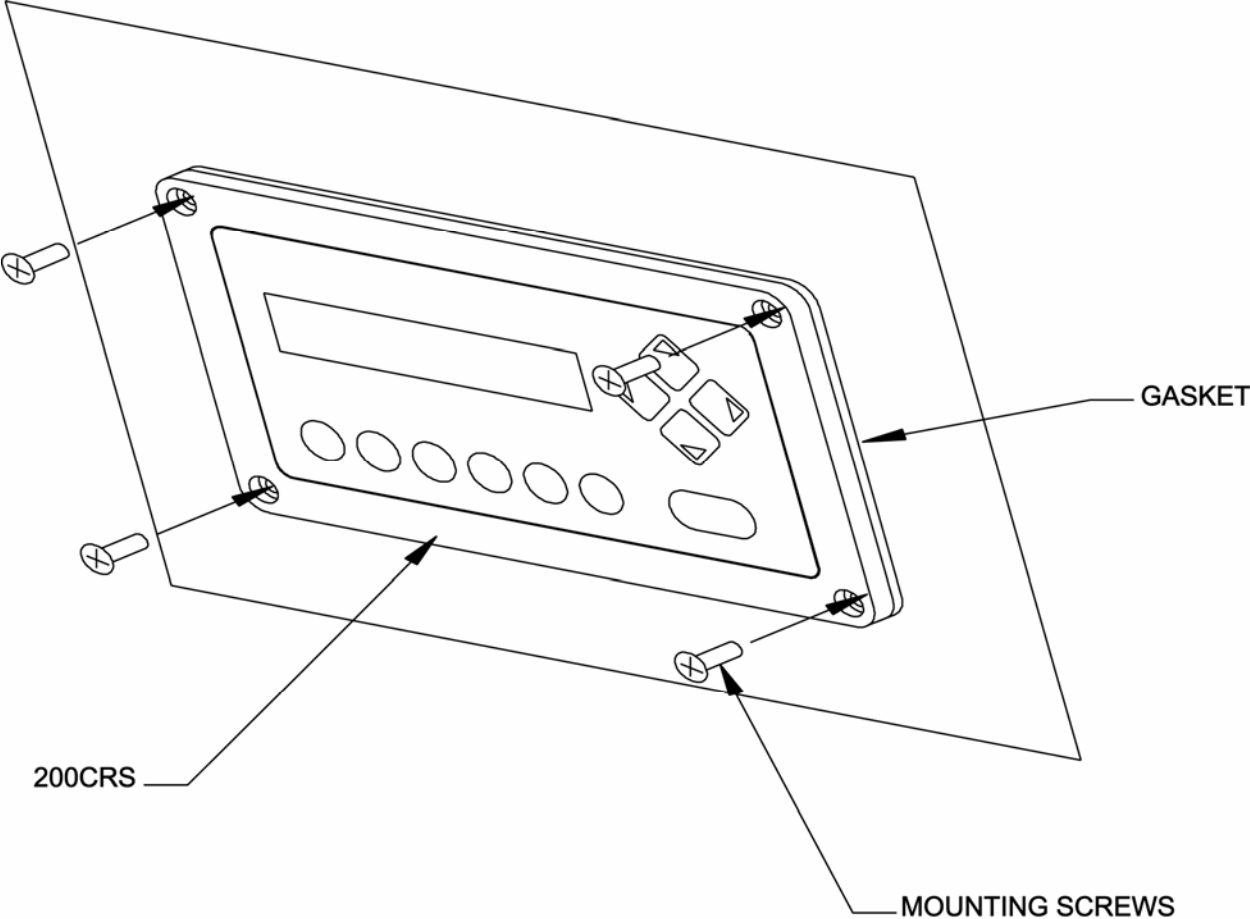
PANEL MOUNTING

Figure 14.5: Panel Mounting
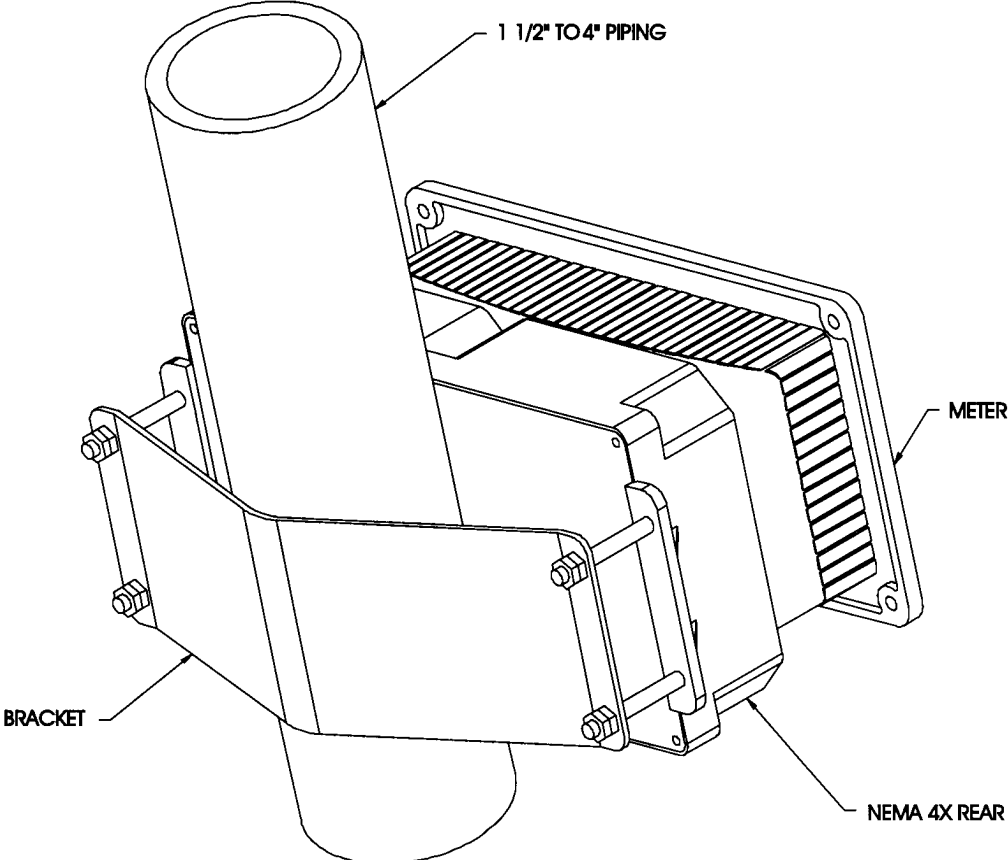
PIPE MOUNTING

Figure 14.6: Pipe Mounting
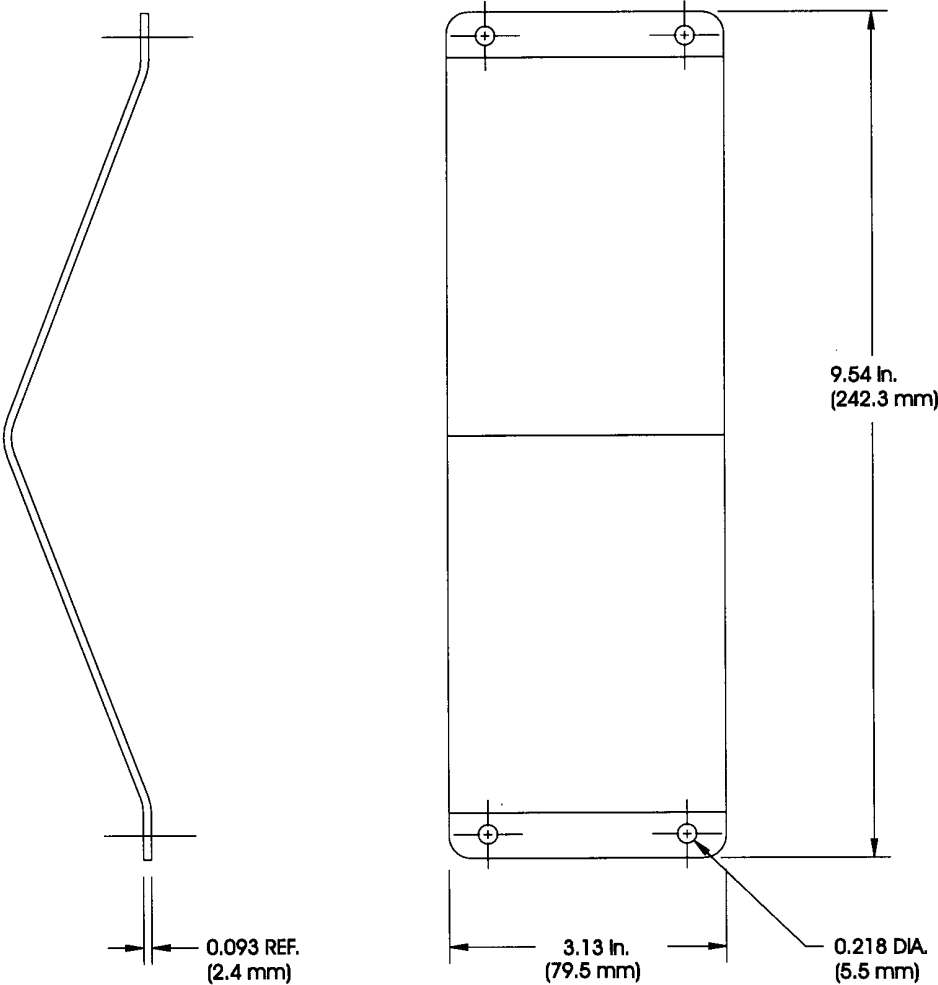
PIPE MOUNTING BRACKET

Figure 14.7: Pipe Mounting Bracket

SEALED IP65 REAR COVER ASSEMBLY

Figure 14.8: Sealed IP65 Rear Cover Assembly

PRINTED CIRCUIT BOARD LAYOUT

24VDC SETTING FOR
INSTRUMENTS MANUFACTURED
BEFORE NOV. 2005

24V   AC LINE
W6

220VAC

110VAC

FUSE 0.063A

FUSE 0.125A

JUMPER

JUMPER

24VDC SETTING FOR
INSTRUMENTS
MANUFACTURED
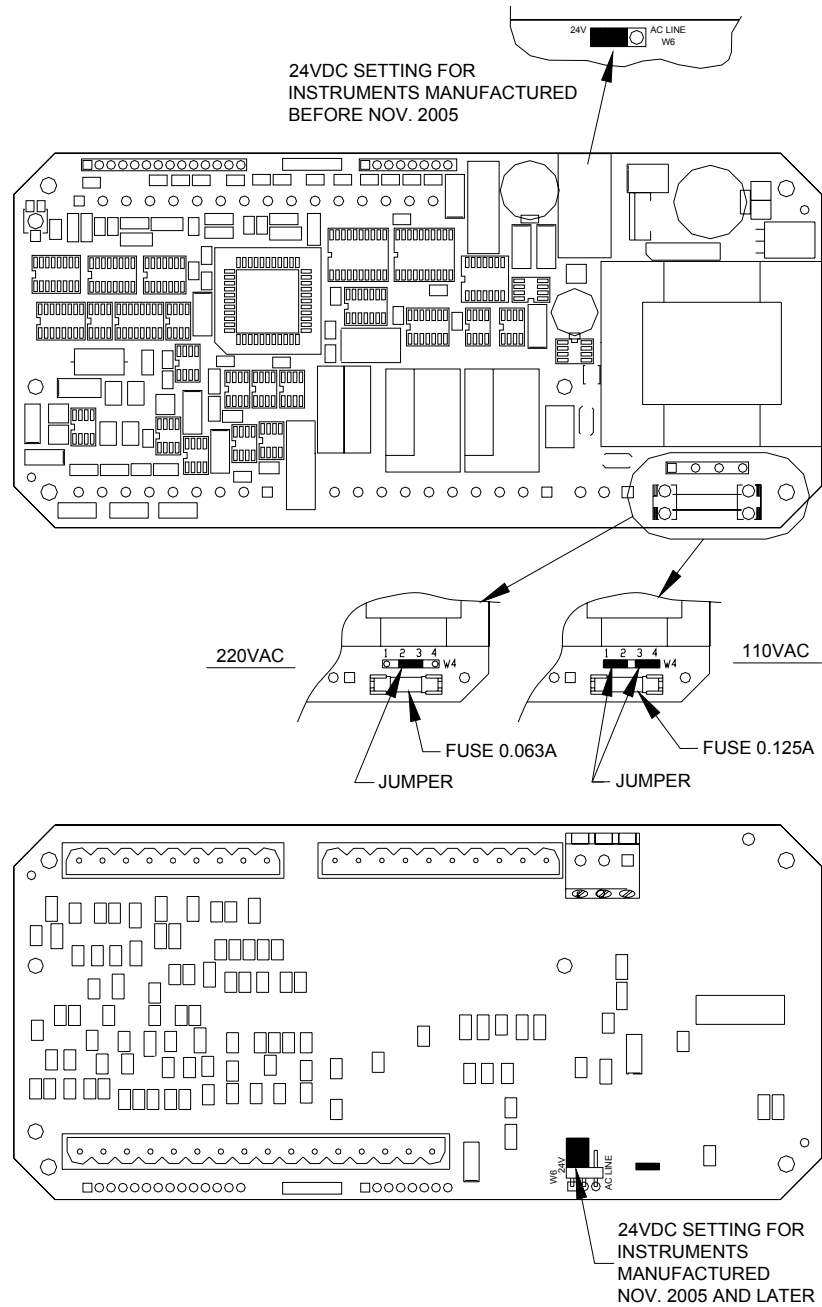NOV. 2005 AND LATER

Figure 14.9: Printed Circuit Board Layout

REAR PANEL WIRING & PATCH CORDS

SENSOR PATCH CORD

1 FT.	(0.3M)	- #1001-66
5 FT.	(1.5 M)	- #1005-66
10 FT.	(3 M)	- #1010-66
25 FT.	(7.6 M)	- #1025-66
50 FT.	(15.2 M)	- #1050-66
100 FT.	(30.5 M)	- #1110-66
150 FT.	(45.7 M)	- #1115-66
200 FT.	(61 M)	- #1120-66

2.5 IN. (63 MM) LEADS

0.37 IN. (9MM) DIA. NOM.

0.87 IN. (22 MM)

(REF.) CONNECTOR PIN #	WIRE COLOR	WIRE NUMBER	SENSOR WIRING TO 200CRS TERMINAL STRIP
1	WHITE/BLUE	1	SIG-1
2	INNER DRAIN	2	SIG-2
3	WHITE	3	SIG-3
4	GREEN	4	SIG-4
5	RED	5	SIG-5
6	BLACK	6	GND
7	OUTER DRAIN	6	GND
8	BLUE	7	NO CONNECTION

200CRS REAR PANEL

N/C   SENSOR A   N/C

TB3

PS+ PS- I/O GND SIG5 SIG4 SIG3 SIG2 SIG1 +5V

DC POWER   CHANNEL A

MADE IN U.S.A.

Attention! Achtung! Peligro!

危険

HIGH VOLTAGE

ISCONNECT ALL POWER BEFORE SERVICING

121XX-X

AC LINE

RELAYS

SERIAL OUTPUTS   ANALOG OUTPUTS

TB4   TB1   TB2

L N

AC LINE POWER — HOT NEUTRAL GROUND

RELAY 2
RELAY 1

ANALOG OUT 1
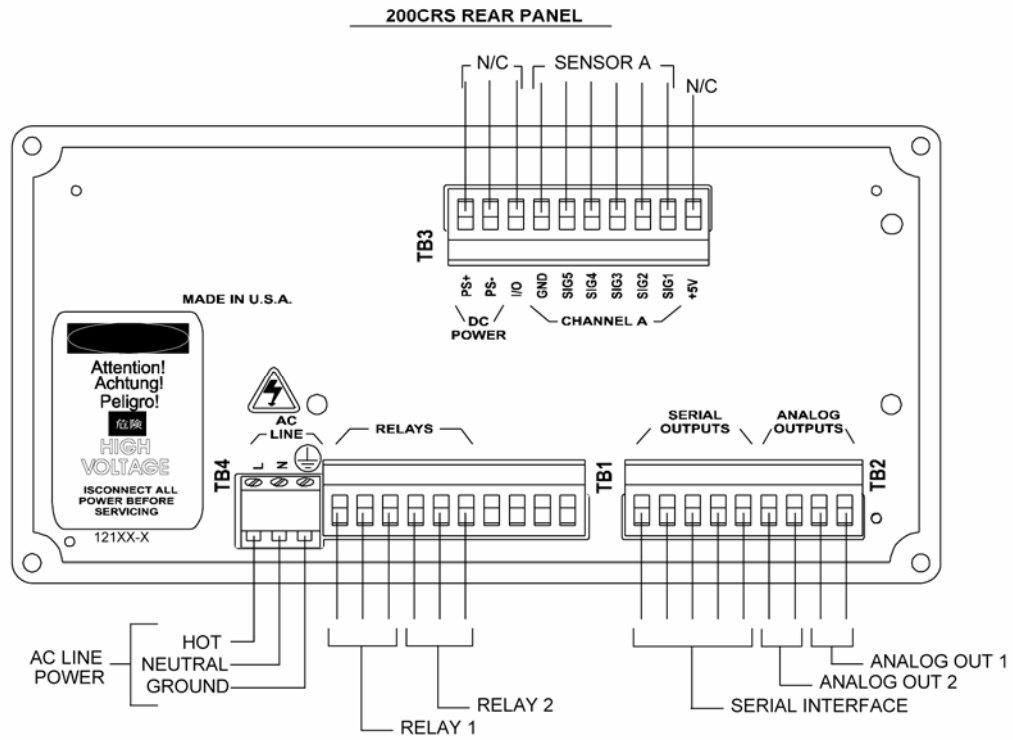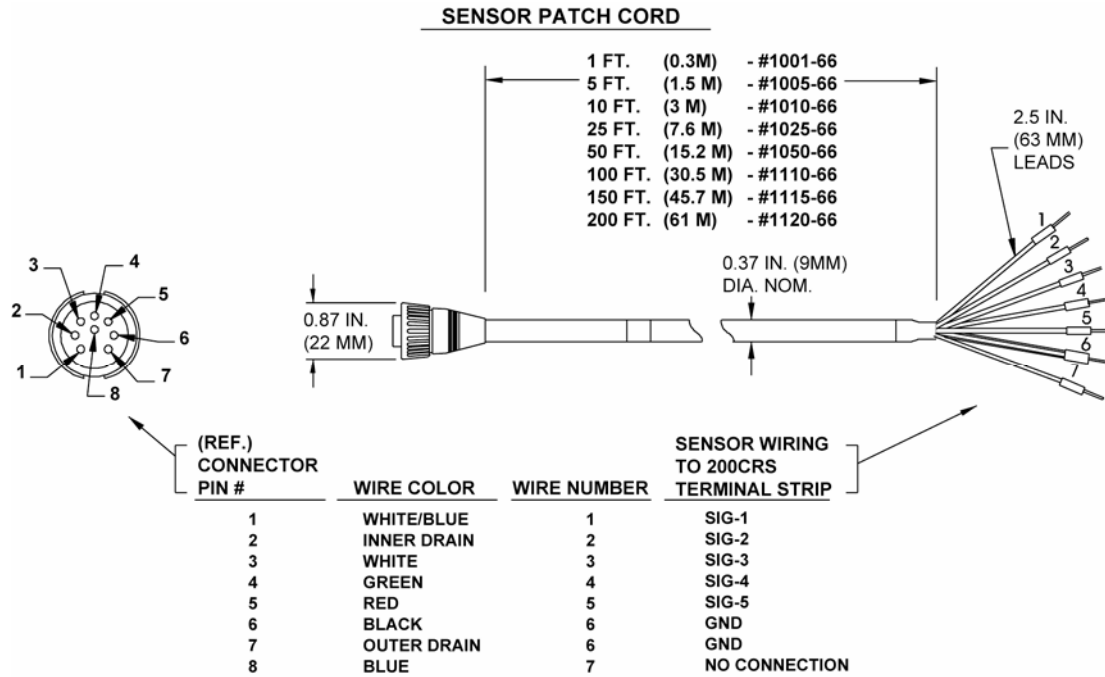ANALOG OUT 2
SERIAL INTERFACE

Figure 14.10: 200CRS Rear Panel Wiring & Patch Cords – see Chapter 2 for special wiring to measure ultrapure water in plastic pipe.
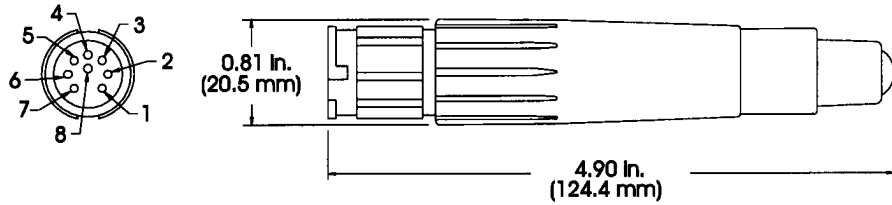
CALIBRATORS

Figure 14.11: Calibrators
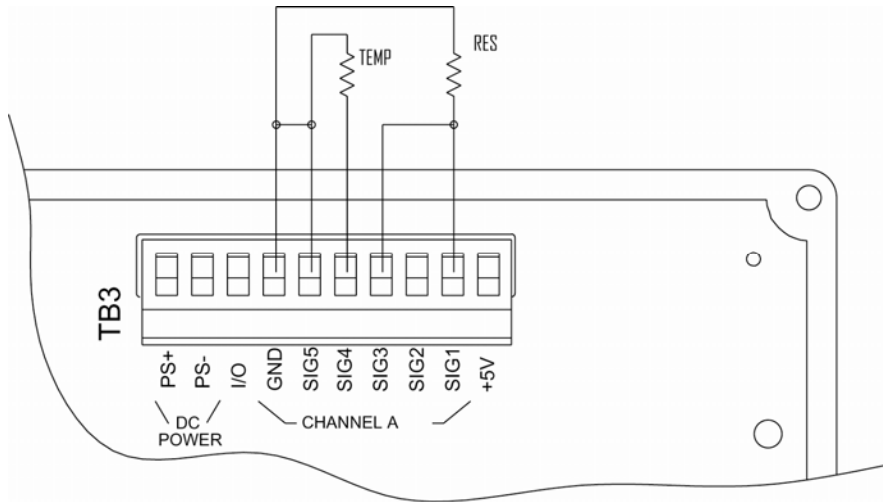
METER CALIBRATION CONNECTIONS USING DECADE BOX

Figure 14.12: Using Decade Box

200CRS SPECIFICATIONS

Functional

Cond/Resis Ranges:	0.002 μS/cm to 600μS/cm (using 0.01 and 0.1 cm-1 sensors)
	1667 Ω-cm to 500.0 M Ω -cm
	TDS: (ppk/ppm/ppb) covers equivalent conductivity range
Concentrations Ranges:	Not Available
Temperature	-40 to 200°C (-40 to 392°F)
Resolution:	0.001 μS/cm, 0.001 M Ω -cm, 0.010°C
Sensor Inputs:	From Thornton conductivity sensors with Pt1000 RTD, via appropriate patch cord(s) or integral sensor cable (depends on sensor used).
Temperature Compensation:	Automatic, referenced to 25°C for resistivity, conductivity, and TDS. Field selectable for Standard, Linear, Light84, Cation and None (Non-temperature compensated measurement)

Outputs

Setpoints/Alarms:	Two controlled setpoints. Any relay can be activated by either setpoint.
Relays:	Two electro-mech SPDT, rated at 5 amp, 250 VAC or 30 VDC resistive load;Relays have individually adjustable delay and hysteresis (deadband).
Analog output Signals:	Two powered 4-20 mA outputs (recalibratable to 0-20 mA), 500 ohm load maximum, freely scalable to any parameter and range; isolated from input and from ground. Not for use with externally powered circuits.
Serial output:	RS232, maximum distance of 50 feet (15 m); RS422, maximum distance of 4000 feet (1220 m); field selectable up to 19.2 kbaud.

Performance

Accuracy:	$\pm$ 0.5% of reading or $\pm$0.5 ohm, whichever is greater; $\pm$ 0.25°C
Repeatability:	$\pm$ 0.1% of reading, $\pm$ 0.13°C
Update Rate:	All measurements and outputs, once per second
Ratings/approvals:	Meets CSA/NRTL and CE requirements, UL listed
Analog output accuracy:	$\pm$ 0.05 mA within 15-30°C ambient

Environmental

Storage temperature:	-40 to 70°C (-40 to 158°F)
Operating temperature:	-10 to 55°C (14 to 131°F)
Humidity:	0 to 95% RH, non-condensing

Enclosure

Display:	16 character backlit LCD (4.8 x 9.6 mm)
Keypad:	11 flush, tactile feedback keys
Material:	ABS-PC polymer alloy
Panel cutout:	3.78 x 7.56" (96 x 192 mm) DIN
Wall mount:	Available with accessory back cover
Pipe mount:	For 1-1/2 to 4" pipe, available with accessory kit and
Weight:	1.9 lb. (0.9 kg)
Rating:	NEMA4X, IP65 panel mount and accessory back cover
Sensor cable length, max:	200 feet (61 m) with appropriate patch cable

Power

Line:	90-130 VAC or 180-250 VAC, 50-60 Hz, 12W maximum; or 12-30 VDC, 300 mA steady state, 600 mA inrush. DC power must be isolated from earth ground and from other instruments
Memory retention:	On power loss, all programmed values are retained in non-volatile memory without batteries.

200CRS Models

Part Number	Relays	Analog Outputs	Voltage
6122-1	2 SPDT	2	110 VAC (24 VDC)
6122-2	2 SPDT	2	220 VAC (24 VDC)

CE-DECLARATION OF CONFORMITY

Mettler-Toledo Thornton, Inc., 36 Middlesex Turnpike, Bedford, MA 01730, USA declares that the 200CRS Conductivity/Resistivity Instruments, Models 6122-1 and 6122-2 meet the intent of Directive 89/336/EEC for Electromagnetic Compatibility and Directive 73/23/EEC for Low Voltage.

Compliance was demonstrated to the following specifications:

EN 55011 Emissions   Radiated and Conducted, Class A

EN 50082-1 Immunity

IEC 61010-1 Safety

CSA AND NRTL/C CERTIFICATION

Mettler-Toledo Thornton, Inc., 36 Middlesex Turnpike, Bedford, MA 01730, USA has obtained Certification of Compliance from the Canadian Standards Association for the 200CRS Conductivity/Resistivity Instruments, Models 6122-1 and 6122-2. These models bear the NRTL/C and CSA marks, signifying that the products have been evaluated to the applicable ANSI/UL and CSA Standards for use in the U.S. and Canada. NRTL, i.e. Nationally Recognized Testing Laboratory, is a designation granted by the U.S. Occupational Safety and Health Administration (OSHA) to laboratories which have been recognized to perform certifications to U.S. Standards.

Class

Class 2252 01 - Process Control Equipment, Ordinary-Locations
Class 2252 81 - Process Control Equipment

Applicable Requirements

CSA-Std C22.2	No.	0-M1982	General Requirements - Canadian Electrical Code, Part-II
		0.4-M1982	Bonding and Grounding of Electrical Equipment (Protective Grounding)
		142-M1987	Process Control Equipment
UL-Std	No.	916	Energy Management Equipment

UL Listing

Mettler-Toledo Thornton, Inc., 36 Middlesex Turnpike, Bedford, MA 01730, USA has obtained Underwriters Laboratories' Listing for 200CRS Conductivity/Resistivity Instruments. They bear the UL Listed mark signifying that the products have been evaluated to the applicable UL standards for electrical process control equipment, UL3121-1.

WARRANTY

This Warranty is given expressly and in lieu of all other warranties, express or implied. The Buyer agrees that there is no warranty of merchantability and that there are no other warranties, express or implied, which extend beyond the description on the face of this agreement.

Mettler-Toledo Thornton, Inc. (hereinafter referred to as The Company) warrants to the original Buyer each electrode, component, or instrument manufactured and/or sold by The Company to be free from defects in material and workmanship in normal use and service for a period of one (1) year from shipment, unless expressly stated otherwise by the product packaging or expressly agreed to in advance by the Company. The obligation of The Company under this warranty is limited to repair or replacement of the defective product at The Company's discretion. All warranty claims shall be returned to The Company pursuant to The Company's Returned Goods Authorization program. Shipping costs (including return shipping) are the responsibility of The Buyer. The Company assumes no responsibility for any direct or indirect costs associated with removal of defective products, or re-installation of replacement products. The Company shall not be responsible for damage to any electrode, component, or instrument resulting from misuse, negligence, accident or resulting from repairs, alterations, or installations made by any person or firm not duly authorized by The Company. No agent is authorized to assume for The Company any liability except as above set forth. The Company warrants that services will be performed in a workmanlike manner in conformity with standard industry practice. Should any nonconformity be detected within 30 days after the work is completed and prompt notification is made by Buyer in writing to the Company, Company will supply the necessary service, direction, or consultation to correct the nonconformity.

Returned Goods Policy: A Returned Material Authorization (RMA) number must accompany all returned goods. This authorization is obtained by calling our Technical Service (800) 510-7873 or (781) 301-8600. All transportation costs on authorized returns must be prepaid. Authorized replacement parts sent prior to receipt and evaluation of merchandise being returned will be invoiced in full. Credit will be issued only after the returned part is received and evaluated by factory personnel. The Company is not responsible for products returned without proper authorization.

Factory Restocking Charge: Items returned to The Company more than 30 days after shipment will be subject to a 25 % restocking charge, plus any additional charges for refurbishment to salable condition. The Company will not accept returns more than 90 days after shipment, unless returned under warranty or for non-warranty repair.

Special Products: Cancellation or return of special products will not be accepted.

Disclaimer of Damages:
In no event shall The Company be liable for any type of special consequential, incidental or penal damages, whether such damages arise out of or are a result of breach of contract, warranty, tort (including negligence), strict liability or otherwise. Such damages shall include, but not be limited to loss of profits or revenues, loss of use of the equipment or associated equipment, cost of substitute equipment, facilities, down time costs, increased construction costs or claims of The Buyer's customers or contractors for such damages. The Buyer agrees that in the event of a transfer, assignment, or lease of the equipment sold hereunder The Buyer shall secure for The Company the protection afforded to it in this paragraph.

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