Part No. 84263

INSTRUCTION MANUAL

770PC
PROCESS CONTROLLER

thornton

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CHAPTER 1. GETTING STARTED

Thank you for ordering the 770PC from Thornton. The 770PC instrument is user friendly, flexible and highly accurate. It is an analytical and process control instrument for measuring solution properties. The 770PC is a two channel device which can process four different measures simultaneously. A three line vacuum fluorescent display indicates measurements and setup information. A menu structure allows the operator to modify all operational parameters from the 15-key keyboard. The 770PC is equipped with two relays for process control.

A 770PC with patented **Smart Sensors™**, provides highly accurate monitoring and control, measuring multiple parameters with one instrument using different sensors. Each sensor contains a NVRAM (nonvolatile random access memory) which stores: sensor type, calibration data, date of calibration and serial number. The sensor type and stored information are identified by the transmitter, which automatically compensates for manufacturing variables for that particular sensor. The result is improved accuracy for resistance of ±0.3% of meter readings for resistance measurements (see specifications).

Transmitters can be connected on Thornton's 2-wire Local Area Network (LAN), which connects separate dual channel instruments on a single transmission line. Any transmitter can be monitored or reprogrammed by any other transmitter, for process monitoring or control. An RS-232 output provides real-time data with a modem or personal computer.

The following is the current list of parameters measured:

- Resistivity
- Conductivity
- TDS (ppm as NaCl)
- % Rejection
- Temperature
- pH/mV
- Flow Rate (Δ flow)
- Flow Velocity
- % Recovery
- Pressure (ΔP)
- Tank Level
- %HCl
- %NaOH
- $\%H_2SO_4$

1.1. INTRODUCTION

The 770PC and **Smart Sensors** can be operated without a User Manual or special training. Utilizing Thornton's **Smart Sensors**, the 770PC will automatically determine the type of sensor installed, make the appropriate measurement and display the measurement in a conventional manner. The keypad is used to achieve special results. However, with a little extra effort the instrument can be customized to measure and display an amazing variety of data. This section will explain the basic methods of operating the instrument and later sections will elaborate on details.

CHAPTER 1. GETTING STARTED

Read This First

Read all of "**Getting Started**" prior to using this instrument or sensors. The menu-driven software accessed by the keypad controls will guide the user through the various operations.

The following steps must be completed prior to "start up".

- Installation - Section 2.0
- Electrical - Section 2.0.3
- Sensor Installation & Maintenance Section 3.0

1.2. "START UP" - POWERING UP THE 770PC

Install one patch cord for each sensor, connect two sensors, turn on the power and momentarily the unit will begin to display the startup messages: (1) display software version #, (2) measurement software version #. If a **Smart Sensor™** is not connected to a channel, the unit will (3) request its type. After the user describes the non-Smart Sensor, the 770PC will enter normal measurement mode.

The 770PC will query the **Smart Sensor(s)** to determine sensor type and calibration constants. If the 770PC is being used for the first time, the default units and autoranging functions are used to display the measured data in a suitable manner. The 770PC automatically reads the data from the Smart Sensor and displays the measurement.

A "System Reset" will clear all user programming and will return the 770PC to factory default settings. If the 770PC meter does not display the expected measurements, do a "System Reset" as follows:

1: Press **menu,** then press **9** for a system reset

Main **Enter menu no.** **Or NEXT for list**

2. Press **2**

1-Measure Reset **2-System Reset**

3. Press **1**

1-System Reset **2-Return**

The System Reset is now complete. If the measurements do not display as expected, see "Troubleshooting", Section 7.04

1.3. OPERATING MODES

Measurement Mode - measurements are performed and the display is updated at one second intervals.

Menu Mode - a list of program options or calibration parameters is displayed.

Measurements are not displayed in the menu mode, but are transmitted and measured. All functions (e.g. set points, relays, data transmission, etc.) are operating.

Use the **menu** key to enter the menu mode. Press **exit menu** to return to the measurement mode.

1.4. DISPLAY

Each line of the three line vacuum fluorescent display can be programmed to display any of four measurements. The top line contains five characters and will display only the numerical measurement. Its purpose is to allow the viewing of data at a distance. The second and third lines each contain 16 alphanumeric characters which display the measurement type, the measurement value, units, and compensation state (if applicable).

In the measurement mode, the measurement is indicated by one character:

Channel	***Explanation***
"A"	channel A primary
"a"	channel A secondary
"B"	channel B primary
"b"	channel B secondary

Capital letters: "A" & "B" indicate Primary measurement channels for A&B
Lower case letters: "a" & "b" indicate Secondary measurements for channels A&B
When the power and sensor connections are properly installed, the sensors will identify themselves, by sensor type and measurement data, to the transmitter which translates the information into the display format. The Measurement Mode is automatically activated upon start-up.

Each line of the display can be programmed to display a fixed number of digits after the decimal place. This feature is useful when a reading is fluctuating and it is desired to display only the significant digits (see section 5.03)

A Typical Display:

```
      18.18
A  18.18 Mo-cm C
B  59.2 PSI
```

The top line of the display shows a resistivity reading of 18.18 Mohm-cm (Channel A primary). The channel and units for this measurement are not shown. The second line shows the Channel A Primary measurement (indicated by the first character "A") of 18.18 Mohm-cm. This measurement is compensated for temperature as indicated by the character "C" at the end of the line. The third line shows the Channel B Primary measurement (indicated by the character "B") of 59.2 PSI (pressure).

Press **next** to toggle the display to show the alternate measurements. For example, if line 2 shows the Channel A Primary measurement pressing **next** will show the Channel A Secondary measurement.

25.00
a 25.00 Deg C
b 408.3 kPas

Line 1 and 2 display Channel “a” (Secondary Measurement) for resistivity, temperature in degrees Celsius. Line 3 displays Channel “:b” (Secondary Measurement) for pressure in kilo Pascals (metric).

Measurement Types

770 Series Instruments are capable of measuring Primary and Secondary parameters on each of two channels, designated A and B. The user can specify through menus which parameters are primary and which are secondary. In addition, displayed results can be computed from a combination of measurements made on both channels (see section 5.01).

Measurements depend on the type of sensor connected. The following is a list of options.

Conductivity Sensor:

- Conductivity in mS/cm, µS/cm, nS/cm.
- Resistivity in ohm-cm, kohm-cm, Mohm-cm
- Total Dissolved Solids, TDS, in kppm (ppt), ppm, mppm (ppb).
- Temperature in degrees Celsius or Fahrenheit

pH Sensor:

- pH in the range 0 to 14
- Volts, millivolts, or microvolts
- Temperature in degrees Celsius or Fahrenheit

ORP (Oxidation Reduction or Redox Potential) Sensor:

- Measurement in millivolts

Flow Sensor:

- Total flow in gallons, liters, or cubic meters
- Flow rate in gallons/min, liters/min or meter ^{3}/hour, Frequency
- Velocity in feet/second

Pressure Sensor:

- Gauge pressure in PSI, millimeters of mercury, kilo Pascals or voltage
- Δ Pressure

Tank Level Sensor:

- Volume of liquid in cubic meters, liters, gallons or % full

Temperature Sensor:

- Temperature in degrees Celsius or Fahrenheit

Chemical Sensor:

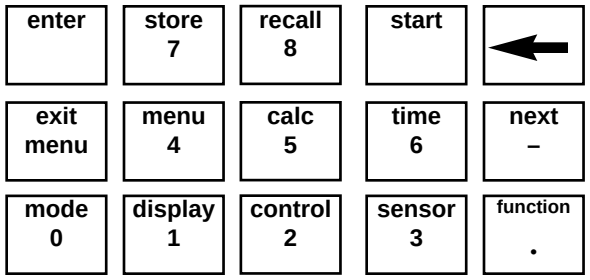
- Resistivity, conductivity, temperature
- %HCl
- %NaOH
- %H_2SO_4

Keypad & Menu Software

CHAPTER 1. GETTING STARTED

The 15 key keypad provides a flexible control with few keystrokes. Here is a brief summary of what the keys do. Try a few of them!
The two most important keys on the keypad are **exit menu** and **menu.**

The **exit menu** key is used to escape from



the menu structure and return to measurement display.

The **menu** key allows the user to enter the main menu structure.

0..9, **•**, and **–** are used to select menu items or to enter data.

‹— (Backspace or Clear) retracts an entered number or moves up one level in the menu.

calc is a feature that will be implemented in the future.

control enters the menu at the Control menu (setpoints, relays and signal outputs).

display enter the menu at Display setup.
enter accepts data entry, a second enter returns to the previous menu

function is used to access special data and information.

menu enters the menu structure from the measurement display.

mode enters the menu at the Measure menu.

next steps through menu options or toggles displayed data.

recall is a feature that will be implemented in the future.

sensor enters the menu at the Range menu.

start is a feature that will be implemented in the future.

store is a feature that will be implemented in the future.
time is a feature that will be implemented in the future.

1.5. NUMERICAL ENTRIES

Numbers may be entered with up to 5 digits (including an optional decimal point, and an optional negative sign). When making a numerical entry press <- to clear the digits entered and press **enter** to accept the number. After pressing **enter,** the number entered will be displayed on the second

line if it is accepted. **"enter" must be pressed again to leave the menu and return to the previous menu.**

1.6. MENUS

Menus are arranged in a tree-like structure which will allow complete control of all 770PC features. Menu options can be cycled through or specific items can be selected. Try pressing various keys to see how the menu mode works. When finished using the menu, press **exit menus** to exit. A tree diagram of the menu structure is located in the back of this manual.

Press **menu,** then press **next** to cycle through all of the top level menu options. To back up, press <-. Use **exit menus** to exit the menu mode. A complete list of all options is located in the Menu Options section of this manual. The top level options for getting started are listed below.

NOTE: If you are entering data the enter key must be pressed twice to return to menu mode.

Press **menu:**

Main
Enter menu no.
Or NEXT for list

Any of the top level menus can be entered by pressing a numerical key from 0 to 9. Pressing next will list the first two options:

Main
0-Measure Menu
1-Display Menu

Current Settings are indicated by an asterisk "*****" preceding the menu number. For example, the menu for setting the range of a resistivity measurement may appear as:

1: Auto *2:Mo-cm
3:Ko-cm 4:o-cm

The "*****" preceding the selection "2:Mo-cm" shows that the meter is set to display resistivity in Mo-cm units. Pressing "**3**" would cause the "*****" to move to "3:Ko-cm".

1.6.1. Top Level Options

0 **measure**: For measurement selection

1 **display**: For display formatting

2 **calibrate**: Begins a calibration sequence

3 **time/averaging**: is used to set the amount of measurement damping or averaging.

4 **comp/temp**: For selection of compensation parameters or temperature source.

5 **range**: For selection of a specific range

5 **range:** For selection of a specific range or autoranging.

6 **control:** For changing setpoint values.

7 **communc**: For obtaining network (LAN) information and accessing the remote control features.

8 **security**: For enabling/disabling the menu lockout feature and changing the password.

9 **other**: For measurement or system reset.

1.7. HELPFUL HINTS

1) Analog option: two 4-20mA outputs or two 0-10 volt outputs. The user must assign the desired parameters to the output signals (See Section 4.0., Output Options).

2) Transmitters can be connected together to form a network system (see Section 6.0, Networking).

3) Relays and Setpoints: two relays and four setpoints are available. The user must assign the desired parameters (see Section 5.0, 770PC Transmitter Operations).

4) Transmitters have two sensor inputs. Two sensors may be connected to the unit. These may be either Thornton **Smart Sensor** or any other sensor whose output is compatible with one of the meter's operating modes. Please contact Thornton Associates for more information.

5) When a menu reads "enter" the **enter** key must be pressed a second time to leave that menu.

6) Pressing **exit menu** will always return to measurement operations.

7) Remote Control Mode is available (see Section 6.0, Networking).

8) Averaging allows a user to program the 770PC to average measurements for stabilized readings (See Section 5.10., Measurement Averaging).

CHAPTER 2. TRANSMITTER INSTALLATION

2.1. UNPACKING

Each 770PC is packed in an individual biodegradable carton. Customers are advised to retain packaging in the event that the instrument must be returned to Thornton Associates for service. Open cartons carefully to insure that products are not damaged or dropped.

Carton contents:

1-770PC Transmitter
1-Manual

2.2. PANEL MOUNTING CUT-OUT AND INSTALLATION

Panels must have openings cut to 3 5/8" X 3 5/8" (92mm x 92mm, 1/4 DIN). Take note of transmitter case dimensions to insure proper spacing on panels for multiple bezel clearance, if more than one transmitter is mounted on a panel.

Panel cutouts must be clean and free of burrs and sharp edges. The proper dimensions allow a transmitter to slide freely into the cutout.

If the NEMA 4X Rear Cover is used in a panel mounted installation, the 770PC unit must be installed in the panel opening before the NEMA 4X Rear Cover is installed.

Install panel gasket, slide the meter into the cutout. From the rear of the meter, insert a long screwdriver into one of the two mounting retaining screws (see 770PC Front Mounted in 1/4 DIN Panel Opening" illustration in the rear of this manual.

CAUTION: Turn the mounting retaining screw counterclockwise until the meter is tight against the panel. Tighten the second mounting retaining screw counterclockwise until tight. Verify that both screws are tight and the meter is firmly mounted to the panel.

2.2.1. Wall/Pipe Mounting & Installation

WARNING: PIPE MOUNTING IS NOT RECOMMENDED IF THE PIPE IS SUBJECT TO VIBRATION.

A versatile Wall/Pipe mounting bracket (part number 15533) is available for various mounting locations. A 3.625" X 3.625" (92mm X 92mm) 1/4 DIN cut-out is provided for installing the instrument on this right angle painted aluminum bracket. Four mounting holes are provided for securing the bracket to a flat surface or around a pipe. Four slots are also provided for fastening with banding tape, worm clamps or other fastening hardware.

Slide the meter into the cutout. From the rear of the meter, insert a long slotted screwdriver into on of the two mounting retaining screws (see 770PC Front Mounted in 1/4 DIN Panel Opening" illustration in the rear of this manual). Turn the mounting retaining screw counterclockwise until the

meter is tight against the panel. Tighten the second mounting retaining screw counterclockwise until tight. Verify that both screws are tight and the meter is firmly mounted to the bracket.

2.3. ELECTRICAL CONNECTIONS

Make all electrical connections to the rear of the transmitter case. Connections must be made with one sensor patch cord (see Section 9.0 How to Order) for each sensor input. Cables provide an interface between the eight pin AMP Smart Sensors connector and the transmitters terminal strip.

LAN, analog outputs, relay contacts and power input connections must be installed as illustrated below.

NOTE: A microprocessor reset switch may be installed on the transmitter. To add a microprocessor reset switch, install a momentary switch between the RESET position and Sensor A or B Analog Ground (AG) position on the rear terminal strip as shown below.

WARNING: MISWIRING PATCH CORDS MAY DAMAGE SENSORS AND WILL VOID ALL WARRANTIES! ALL WIRES 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.

NOTE: For CE-rated models 772-209 and 772-219, see manual supplement 84350.

CHAPTER 2. TRANSMITTER INSTALLATION

Sensor Lead Wiring		Network, Analog Outputs, Relays & Power Wiring	
Sensor B	(8) VCC	RESET	
	(7) -VAN	LAN-	Network
	(6) DA	LAN+	
	(5) CLK2	AOUT1	Analog Outputs
	(4) AG	AGND1	
	(3) SIGB-3	AOUT2	
	(2) SIGB-2	AGND2	
	(1) SIGB-1	NC1	Relay Contacts
		NO1	
Sensor A	(8) VCC	C1	
	(7) -VAN	NC2	
	(6) DA	NO2	
	(5) CLK1	C2	
	(4) AG	L	-Black
	(3) SIGA-3	N	-White
	(2) SIGA-2	⏚	-Green
	(1) SIGA-1		Power Input

Rear Panel Wiring Sequence: 115/230VAC Units

Sensor Lead Wiring		Network, Analog Outputs, Relays & Power Wiring	
Sensor B	(8) VCC	RESET	
	(7) -VAN	LAN-	Network
	(6) DA	LAN+	
	(5) CLK2	AOUT1	Analog Outputs
	(4) AG	AGND1	
	(3) SIGB-3	AOUT2	
	(2) SIGB-2	AGND2	
	(1) SIGB-1	NC1	Relay Contacts
		NO1	
Sensor A	(8) VCC	C1	
	(7) -VAN	NC2	
	(6) DA	NO2	
	(5) CLK1	C2	
	(4) AG	+24V	-Black
	(3) SIGA-3	RET	-White
	(2) SIGA-2	⏚	-Green
	(1) SIGA-1		Power Input

Rear Panel Wiring Sequence: +24VDC Units

For CE-rated models 772-209 and 772-219, see manual supplement 84350.

Patch Cord Color Code:

(1)-Blue	(3)-White	(5)-Green	(7)-Pink
(2)-Yellow	(4)-Orange/Clear	(6)-Black	(8)-Brown

CHAPTER 3. SENSOR TYPES & CALIBRATION

Smart Sensors can be connected to this unit. Thornton's **Smart Sensors** are produced under license from Tektronix, Inc. U.S. Patent 4,672,306. **Smart Sensors** contain a nonvolatile memory integrated circuit (NVRAM) in the cell housing that stores the sensor type, serial number, calibration data, and date of calibration. Sensor types available for use with the 770PC are:

1. **Conductivity (Resistivity)**
2. **pH/ORP**
3. **Pressure**
4. **Flow**
5. **Tank Level**
6. **Temperature**
7. **Voltage**
8. **Frequency**
9. **Chemical**

NOTE: Refer to each specific sensor manual, provided with each sensor, for complete details on installation, troubleshooting and service.

When power is first applied, the 770PC determines the sensor type attached to each channel. If a **Smart Sensor** is detected, calibration data is read. If the unit does not detect a **Smart Sensor** it will ask for the type of cell to be entered from a list shown on the display. The operator must select a sensor type. Thereafter, the unit will read the sensor every second. If a new **Smart Sensor** is installed, the new calibration data will be read. If the sensor is removed or a non-**Smart Sensor** is installed, unit calibration constants will revert to the default settings.

3.1. CELL CONSTANTS

Each sensor is defined by a set of calibration constants, also known as sensor constants. The two constants, a ***Multiplication Factor*** and an ***Adder Factor***, are used to derive an accurate measurement from the sensor's output signal Equations vary by sensor type, as an example, the output of a resistivity sensor can be represented by an equation describing a straight line:

R=x/a1 + a2

Where:

R=resistivity value
a1=multiplier factor
x=output from cell
a2=adder factor

An example: for a 0.1 constant resistivity sensor the multiplier factor (a1) is 0.1 and the adder factor (a2) 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 computed as follows:

R=x/a1+a2
R=120,000/0.1 + 0
R=1,2,000,000
R=1.2 Mohm-cm

NOTE: For many sensors, such as resistivity, the adder factor may be zero.

The calibration constants can be modified

from the menus.

3.2. MEASUREMENT TYPES AND PROCESS

The 770PC has two channel inputs for installing sensors. Up to four measurements can be continuously processed at one second intervals (two measurements from each sensor). Channel display: Each channel (A and B) has a primary measurement indicated by “A” and “B”, and a secondary measurement indicated by “a” and “b” in the “display mode”.

When programming the software in the “menu mode”, the primary measurements are indicated as “Ap” and “Bp”, secondary measurements as “As” and “Bs”.

Each of the four measurements can be assigned a specific measurement parameter from a list that is applicable to the installed sensor. Current measurement parameters available:

Display Mode	Menu Mode	Explanation
“A”	Ap	channel A primary
“a”	As	channel A secondary
“B”	Bp	channel B primary
“b”	Bs	channel B secondary

Conductivity
Resistivity
Conductivity
TDS
Degrees C
Degrees F
% Rejection

pH
pH
Voltage
Degrees C
Degrees F

Pressure
PSI
kpascals
mm Hg
Differential Pressure
Voltage

Flow
Gal/min
m3/hr
total flow
% Recovery
Differential Flow
Liters
Gallons
Liters/min
Feet/second

ORP
millivolts

Tank Level
% Full
total gallons
Liters
PSI

Temperature
Degrees C
Degrees F

Chemical
Resistivity
Conductivity
Degrees C
Degrees F
% NaOH
%HCl
%H_2SO_4

Frequency
Gal/min
m3/hr
total flow
% Recovery
Hz

Voltage
PSI
kpascals
mm Hg
Differential Pressure
Voltage

3.3. COMPENSATION

Measurements, such as resistivity, conductivity and pH, can be compensated for temperature. For example, the resistivity of pure water at 25 degrees C is 18.18 Megohm-cm. Yet the resistivity of ultrapure water at 30 degrees C is 14.08 Megohm-cm. By compensating the resistivity reading, the value of pure water will always read 18.18 Megohm-cm. Compensating a measurement is selected in the menu and is indicated on the display with the letters “C” for a compensated measurement or “U” for uncompensated measurement, shown after the measurement units. The source of temperature compensation can be from:

- The channel making the measurement
- The other channel
- A manually entered value

If the sensor has a temperature sensor (RTD) installed within the sensor housing then “compensate from this channel” can be used. If the sensor on the other channel is a temperature sensor or has an internal RTD, then “compensate from the other channel” can be used. Manual compensation can be entered from the keypad when no temperature remains constant (see section 5.05 and 5.06).

3.4. RESISTIVITY/CONDUCTIVITY MEASUREMENTS

3.4.1. TDS

Total Dissolved Solids (TDS) is another useful way to measure and display conductivity/resistivity data. TDS is the equivalent of Sodium Chloride (NaCl) required to produce the measured resistivity. TDS is measured in parts per billion (ppb) or parts per million (ppm). For this example the display would show a TDS of 10 ppb or 0.01 ppm, where 1 ppm equals 1 milligram per liter.

1: Press **menu,** then press 0 for the measurement menu.

Main
Enter menu no.
Or NEXT for list

2. Select channel A or B, as either channel maybe used for a TDS measurement. Press **1** for channel A.

Measurement Mode
1-Ch A 2-Ch B

3: Press **1**.

Ch A Measurement
1-Prime 2-Second

4: Press **3** to select TDS, notice that the asterisk moves to that selection.

1-Res	2-Con
*3-TDS	9-More

5: Press **exit menu** to exit the menus and return to the display.

NOTE: A sensor installation on channel A should now display that sensor information. If there is any uncertainty about channel A or B primary or secondary programming see Section 5.02 Display Setup.

3.4.2. TDS Multiplier

The default setting with TDS multiplier set at zero provides conversion based on sodium chloride at approximately 0.5 ppm per µS/cm but is non-linear. Changing the TDS multiplier results in that number being multiplied by the sodium chloride factor. For conversion of other materials, see table below. The Total Dissolved Solids (TDS) Multiplier Factor can be used to adjust all TDS measurements when either a one point calibration is used with NaCl, or for measuring solutions other than NaCl.

1: Press **menu,** then press **2** for the calibration menu

Calibrate Menu
1-Ch A 2-Ch B

2: For the purpose of this manual press **1** to select channel A:

A: Calib	1-Edit
2-Do	3-Save/Clr

3: Press **1** to edit the TDS Multiplier.

Edit	1-Cell Con
2-Temp	5-TDS M

4: Press **5** to select the TDS Multiplier .

A: TDS M =.0000
Enter No: XXXX>

5: Enter the TDS Multiplier from the table below:

TDS Multipliers (normalized to NaCl)

KCl:	1.07865
CaCl2:	0.8839
CaCO3:	0.8407
NaOH:	0.3480

6: Press **enter** and the new TDS multiplier value will be displayed on the top line. If the displayed multiplier value is correct, press **enter** to verify the correct value and exit. If the Multiplier number is incorrect, enter a new number and press **enter** twice.

A: TDS M = XXXX
Enter No: >

7: Press **exit menu** to return to the measurement mode

3.5. PH/ORP MEASUREMENTS

3.5.1. Calibration

Due to aging in the process, pH **Smart Sensors** require recalibration after a period of time. The stability of the sensor depends entirely on the nature of the sample solution, pressure temperature, etc. For this reason, calibration intervals should be based on experience with the particular application.

When measuring solution not previously measured, it is advisable to recalibrate frequently. If no significant variation is found, the calibration interval may be increased.

Materials and Equipment Needed for Calibration

For proper calibration, two buffer solutions of adequate accuracy and pH range are necessary. Each buffer solution should be poured into a small beaker to approximately 1" depth to immerse the electrode tip. One buffer solution is usually at or near 7 pH. The buffer solutions should cover the anticipated measurement range. For example, if the measurements are expected to be done in acid media, the second buffer should have a pH value of 4.0. If the media is expected to be alkaline, the second buffer should have a pH value of 9 or 10. The difference between the two calibration buffers should be at least 2.0 pH.

Calibration Procedure

Select the "two point" calibration option from the calibration menu. The buffer solution and the electrode should be at the same temperature. See section 3.08.

NOTE:

- **Stirring the solutions ensures a quicker response.**
- **Do not rub the glass electrode membrane when dry, since it will create electrostatic charges on the glass membrane, which causes a delayed response.**

3.5.2. pH Sensor Diagnostics

The **Additive Factor** (standardize offset) is an indicator of how far the sensor has drifted from the nominal zero starting point, in pH units. It is recalculated after every calibration. Drift in this value is usually due to aging or contamination of the reference electrode portion of the sensor.

An offset of more than ±2.5 pH units is an indication that the sensor should be replaced soon. The Additive Factor "A" can be viewed at any time in the Edit Calibrate menu. However, the value must not be changed in this menu or the sensor will have to be recalibrated.

The **Multiplie**r (slope or span) is an indica-

tion of the sensitivity of the sensor to changes in pH. It has a nominal value near 1 and is recalculated after every 2-point calibration. Reduction in this value is usually due to aging, coating or hot caustic attack of the glass measuring membrane of the sensor.

A sensor with Multiplier value less than 0.80 should be replaced soon. The Multiplier "M" can be viewed at any time in the Edit Calibrate menu. The value must not be changed in this menu or the sensor will have to be recalibrated.

3.5.3 pH Measurements-Advanced Features

The solution temperature coefficient (STC) allows selection of temperature compensation for the ionization of pure waters. This is in addition to the conventional (Nernst) temperature compensation for the sensor which is always active. Solution temperature compensation is used on power plant and other pure water samples less than 30 µS/cm where the changing ionization of water is significant. It references the pH to 25˚C. In all other applications the STC value is left at zero.

For ammonia, phosphate and/or amine-treated power plant samples, the solution temperature coefficient, STC, should be set to 0.033 pH/˚C. For pure makeup water or boiling water reactor samples, the solution temperature coefficient should be 0.016 pH/˚C. The appropriate values for other pure water compositions may be determined by developing temperature vs. pH data for the particular sample with STC

set at 0. The negative slope of this data becomes the STC value.

The solution temperature coefficient, STC, may be changed in the Edit Calibrate menu.

The **Isopotential Point, UP** is left at 7.0 pH for all conventional pH electrodes. Special purpose electrodes with zero potential at values other than 7.0 pH will have this identified in their instruction manuals. A different UP setting will allow proper temperature compensation of these special electrodes. The UP setting is accessed through the Edit Calibrate menu.

3.5.4. Setting UP and STC Factors for pH

To set the UP or STC factors for a special pH application:

1: Press Menu.

Main
Enter menu no.
Or NEXT for list

2: Press 2 for the Calibrate Menu.

Calibrate Menu
1-Ch A 2-Ch B

3: Select the desired channel. For example, press 2 for channel B.

```
B: Calib 1-Edit
2-Do  3-Save/Clr
```

4: Press 1 to enter the Edit Menu.

```
Edit pH:  1-Cell
2-Temp  7-UP  8-SC
```

5: Press 7 to edit UP factor or press 8 to edit the STC factor. For example, press 8 to edit the STC.

```
B: STC = .00000
Enter No: >
```

Enter the new STC factor and press the **Enter** key when done. The new value will appear on the top line. Press **Ente**r again to return to the previous menu.

3.6. PRESSURE MEASUREMENTS

3.6.1. Differential Pressure

If two pressure sensors are installed in a system and a differential pressure calculation is required for the application, use the following procedure:

1: Press **menu,** then press **0** to enter the measurement menu

```
Main
Enter menu no.
Or NEXT for list
```

2: One channel A or B will be required to measure differential pressure. Press **1** to select channel A.

```
Measurement Mode
1-Ch A        2-Ch B
```

3: For the purpose of this example, press **1**.

```
Ch A Measurement
1-Prime   2-Second
```

4: Press **9** to select more

```
1 - PSI     2- KPAS
3-mmHg    *9-More
```

5: Press **5** to select differential pressure.

```
4 - Volt    *5 - Diff
6-Bars       9 - More
```

3.6.2. Tank Level

Tank level is measured with a pressure sensor mounted in the tank. A **Smart Sensor** will automatically identify the sensor. Non-**Smart Sensors** are identified by the maximum pounds per square inch (psi) rating each sensor is calibrated for. Tank size must be programmed into the software in the calibration menu by entering tank height and area.

Tank-Percent Full or amount of Gallons or liters may be measured by the 770PC. By entering the menus and programming this information, these tank level measurements may be obtained.

3.6.3. Percent Full/Gallons/Liters

1: Press **menu,** press **0** for measurement mode

Main
Enter menu no.
Or NEXT for list

2: Press **1** for channel A or **2** for channel B, either channel may be used for a tank level measurement. For the purpose of this manual, press **1**.

Measurement Mode	
1-Ch A	2-Ch B

3: Press **1.**

Ch A Measurement	
1-Prime	2-Second

4: Press **1** for % Full or **2** for actual Gallons measurement. Press **9** to view more selections.

*1-% Full	3-PSi
2- Gals	9-More

Press **4** for cubic meters or **5** for liters.

4-m^3	5-Liters
6-Ft	9 - More

5: Once the measurement selection is made, press <— three times until reaching the Main menu. Press **2** for the calibrate menu.

Main
Enter menu no.
Or NEXT for list

6: Now that Ch A is programmed for % Full, Gallons, or Liters as selected, press **1**:

Calibrate Menu	
1-Ch A	2-Ch B

7: To input the tank size constants press **1**:

A: 1-Edit Calibrate	
2-Do	3-Save/Clr

8: Press **4**

Edit: 1 - Cell Con
4-Tank Constants

9: If a **Smart Sensor** is installed: DO NOT input maximum psi go on to Step 11. Press **1** to input maximum psi if the sensor is not smart.

A: Tank	1- MaxPSI
2-Height	3-Area

10: Enter the maximum psi of the pressure sensor. If an error is made, press <— to clear the entry. Press **enter.**

A:Max PSI=.0000
Enter No: > XXXX

The new maximum will now appear in the display. If the correct maximum psi appears, enter the correct amount. Once the correct number appears in the display, press **enter.**

A:Max PSI=.XXXX
Enter No: >

11: Press **2**.

```
A:Tank    1-Max PSI
2-Height  3-Area
```

12: Enter the internal tank height in feet. If an error is made, press <— to clear the entry. Once the correct data is entered, press **enter.**

```
A:Height=.0000
Enter Ft: > XXXX
```

The new tank height will appear in the display. If the incorrect tank height appears, enter the correct amount. Once the correct number appears in the display, press **enter.**

```
A:Height= XXXX
Enter Ft: >
```

13: Press **3**.

```
A: Tank  1-Max PSI
2-Height 3- Area
```

14: Enter internal tank area in square feet. If an error is made, press <— to clear the entry. Once the correct data is entered, press **enter.**

```
A:Area=.0000
Enter Ft: > XXXX
```

The new tank area will now appear in the display. If the incorrect tank area appears, enter the correct amount.

```
A:Area= XXXX
Enter Ft: >
```

15: Once the correct number appears in the display, press **enter.**

```
A:Tank    1-Max PSI
2-Height  3-Area
```

16: Once the tank area data is programmed into the 770PC, the tank level - % full calibration is complete. Press **exit menu** to leave the menus and return to display mode.

```
      XXXX
A  XXX.X % Full
a  XXXX. Gals
```

3.7. FLOW MEASUREMENTS

The 354 and 355 Series Flow Sensors generate an AC signal, the frequency of which is proportional to the flow rate. Each **Smart Sensor** NVRAM stores the sensor type and calibration constants of that specific sensor.

Each **Smart Sensor** for Flow is calibrated at the factory and that information is stored in the NVRAM circuitry of the sensor. In some instances, calibration of flow sensors is required for specific piping installations. When this is necessary, the factory calibration may be overridden with a new calibration and stored permanently in the sensor circuitry.

Sensors are powered by the 770PC. Measurements may be displayed or transmitted as a flow rate or as totalized flow at the users discretion (see Section 5.01 Measure Menu).

3.7.1. Percent Recovery - Reverse Osmosis

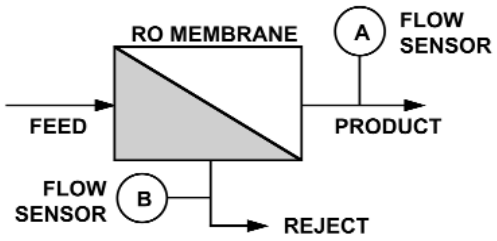
Percent Recovery is the flow ratio of pure water output to feedwater input through a Reserve Osmosis membrane. This is done to help balance the flow of liquid through the membrane. Flow sensors are installed in the product and reject side of the membrane. The 770PC transmitter will perform the calculations required to indicate percent recovery. Two flow sensors must be connected to a 770PC transmitter to achieve a percent recovery measurement.

The formula for obtaining Percent Recovery is:

[Product / (Product + Reject)] X 100 = %

The Product sensor must be installed on the Channel measuring % recovery.

See the schematic diagram below of an RO installation with sensors installed for Percent Recovery:



Channel A secondary measurement can be % recovery

Important:

When preparing the system to perform a percent recovery measurement, the product monitoring sensor must be installed in the same channel that will measure percent recovery. If the product flow sensor is installed in channel A, then percent recovery must be measured in Channel A. Likewise, if the product sensor is installed in channel B then the percent recovery measurement must also be programmed in channel B. The remaining channel may be programmed to display any of the display options available for a flow sensor, i.e.: flow rate or total flow.

To program the transmitter for percent recovery:

1: Press **menu,** then press **0** to access the measurement mode.

Main
Enter menu no.
Or NEXT for list

2: For the purpose of this manual, channel A will be used for the percent recovery measurement. Press **1** for Channel A. This will select channel A to measure and display the percent recovery measurement.

Measurement Mode	
1-Ch A	**2-Ch B**

3: Again, for this example, press **1** for Primary.

Ch A Measurement
1-Prime 2-Second

4: Press **9** for more selections.

1-GPM 2-Gals
3-m3 *9-More

5: Press **6** for % Recovery.

4-m3/hr 5-Hz
*6-%Rec 9-More

6: Press **exit menu** to exit the menus and the transmitter will begin to display the measurements in Percent Recovery.

XXXX
A XXXX %Rec
B XXXX GPM

Channel B may then be programmed as A was above, if Channel B is used for % Recovery. If the transmitter does not display the A Primary measurement in the large characters (line 1), as above, see menu section on programming the display in section 5.02 Display Setup, if that is desired.

3.7.2. Totalized Flow

Totalized flow may be measured in Gallons (Gals), Cubic Meters (m^3), or Liters (Lits). To measure Total Flow, enter the measurement menus.

1: Press **menu,** then press **0** to access the measurement mode.

Main
Enter menu no.
Or NEXT for list

2: For the purpose of this manual, channel A will be used for the total flow measurement. Press **1** for Channel A. This will select channel A to measure and display the total flow measurement.

Measurement Mode
1-Ch A 2-Ch B

3: Again, for this example, Press **1** for Primary.

Ch A Measurement
1-Prime 2-Second

4: Press **2** for Totalized Flow in Gallons, press **3** for Cubic Meters, or 9 to view more selections. The asterisk ***** will change location to identify the desired selection.

1-GPM *2-Gals
3-m^3 9-More

5: If **9** is pressed, a new list of selections will be displayed. Press **9** a second time to get the third list of measurements.

4-m3/hr 5-dGPM
6-%Rec *9-More

6: Press **7** for Total Liters. See the 770PC manual for other measurements.

7-Litr 8-L/min
0-Ft/S *9-More

7: Press **exit menu** to return to the measurement mode.

3.7.3. Flow Rate

Flow rate can be measured as Gallons per minute (GPM), cubic meters/hour (m3/hr), or Liters per minute (L/min).

1: Press **menu:**

Main
Enter menu no.
Or NEXT for list

2: Press **0** for Measure menu.

Measurement Mode	
1-Ch A	**2-Ch B**

3: Press **1** for Channel “A”.

Ch A Measurement	
1-Prime	**2-Second**

4: Press **1** for primary measurement.

***1-GPM**	**2-Gals**
3-m^3	**9-More**

5: Press **1** to select Gallons per minute or 9 for more options. Note that the asterisk indicates the selection of number 1.

***4-m^3/hr**	**5-dGPM**
6-%Rec	**9-More**

6: Press 4 for cubic meters/hour or press **9** for more options.

7-Litr	***8-L/min**
0-Ft/s	**9-More**

7: Press **8** for Liters per minute.

8: Press **exit menu**.

3.7.4. Flow Velocity

Flow can also be measured as a velocity in feet/second. A special calibration constant is used to compute this measurement. The constant can be modified in the calibration menu (see Section 3.12).

1: Press **menu:**

Main
Enter menu no.
Or NEXT for list

2: Press **0** for Measure menu

Measurement Mode	
1-Ch A	**2-Ch B**

3. Press **1** for Channel “A”.

Ch A Measurement	
1-Prime	**2-Second**

4: Press **1** for primary measurement.

1-GPM	**2-Gals**
3-m^3	***9-More**

5. Press **9** for more options.

4-m^3/hr	**5-dGPM**
6-%Rec	***9-More**

6: Press **9** again, for more options.

7-Litr	**8-L/Min**
***0-Ft/s**	**9-More**

7: Press **0** to select the flow velocity in feet/second.

8. Press **exit menu**.

3.8. SENSOR CALIBRATION

All sensors (conductivity, pH, etc.) have two calibration constants that are used to calculate the desired measurement from the sensor's output signal. These constants are referred to as the Multiplier factor (Span) and the Additive factor (zero or offset). To have the meter calibrate the output of a sensor, enter the desired reading and the unit will adjust the sensor constant(s) as necessary. A calibration can be performed on most measurement types. The measurement to be calibrated must be set as the primary signal.

1: Press **menu,** then press **2** for the calibration menu.

Main
Enter menu no.
Or NEXT for list

2: Select a channel:

Calibrate Menu
1-Ch A 2-Ch B

3: Press **2** to perform a calibration.

A:1-Edit Calibrate
2-Do 3-Save/Clr

Two types of calibration are available: a 1-point and a 2-point calibration. For a 1-point calibration only a single factor is computed and one sample of known value is needed. For a 2-point calibration a multiplier and adder (offset) factors are computed, and 2 samples of known value are needed.

4: Select either the 1-point or 2-point calibration, go to the appropriate section below.

#: Calib ????
1-1 pt. 2-2pt.

3.8.1. One Point Calibration

5: Enter the value of the known solution (or desired reading of the sensor), press **enter.**

#: Point Cal
Enter ???? _____

6: Press **next,** the calibration will be performed

Main
Enter menu no.
Or NEXT for list

While this message is being displayed the current measurement will be shown on the top line.

7: After performing the calibration, a new cell constant is computed and will be used for all future measurements. The new cell constant will remain valid until the unit is powered-down or a system reset is performed. If it is desired to save this data beyond these conditions, then it can be saved in the Smart Cell as a user's calibration by pressing key **5** from the next dis-

play.

Cal Done, Press 5 to write to cell

Press **5** to write the data to the Smart Cell or any other key to return to the menu shown in step 4.

3.8.2. Two Point Calibration

5: Set the sensor in the first calibration solution or at the first calibration point.

Enter the value of the first calibration point, press **enter.**

#: 2 Point Cal #1 Enter ???? _____

6: Press **next.**

XXXX #: Press Next to Measure

7: Set the sensor in the second calibration solution or at the second calibration point. The unit will ask for the value of the second solution.

Enter the number, press **enter.**

#: 2 Point Cal #2 Enter ???? _____

8: Press **next**, the calibration will be performed.

XXXX #: Press Next to Measure

9: After performing the calibration, new cell constants are computed and will be used for all future measurements. The new cell constants will remain valid until the unit is powered-down or a system reset is performed. If it is desired to save this data beyond these conditions, then in can be saved in the Smart Cell as a user's calibration by pressing key **5** from the next display.

Cal Done, Press 5 to write to cell

Press 5 to write the data to the Smart Cell or any other key to return to the menu shown in step 4.

3.9. CHANGING SENSOR CALI BRATION CONSTANTS

Sensors have two calibration constants (a multiplier and an additive). If a **Smart Sensor** is used the sensor constants will be read upon initialization.

Default setting of non-**Smart Sensors**:

Sensor Type	Multiplier	Adder
Conductivity	0.1	0
Temperature	1.0	0
Flow/Frequency	1.0	0
Pressure/Volt	1.0	0
pH	1.0	0
Tank Level	1.0	0
Chemical Cell	1.0	0

To modify the sensor calibration constant:

1: Press **menu,** then press **2** for the calibrate menu.

```
Main
Enter menu no.
Or NEXT for list
```

2: Select a channel:

```
Calibrate Menu
1-Ch A        2-Ch B
```

3: Press **1** to edit a sensor constant.

```
A:1-Edit Calibrate
2-Do   3-Save/Clr
```

4: Press **1** and go to step 5 or Press **2** and go to step 6.

```
Edit:  1-Cell Con
2-Temp Constant
```

5: Select one of the sensor constants to be edited:

```
#: Cell  1-Mult
2-Additive
```

A menu will appear with the current sensor constant on the top line and will ask for a new value on the second line. For example, for the multiplication sensor constant the display may appear as:

```
# Cell M= 0.100
Enter No. _____
```

Enter the number, press enter and the new sensor constant will be displayed on the top line. Press **enter** again to return to the previous menu.

6: The display and edit of these constants is similar to the procedure outlined in step 5.

```
#: Temp   1-Mult
2-Additive
```

3.10. ENTERING THE INSIDE PIPE DIAMETER

The flow velocity measurement uses the inside diameter of the pipe to compute this measurement. The inside diameter is expressed in inches.

NOTE: This constant will only appear in the menus when the Flow Level sensor is installed.

1: Press **menu,** then press **2** for the calibrate menu.

```
Main
Enter menu no.
Or NEXT for list
```

2: Select a channel.

```
Calibrate Menu
1-Ch A        2-Ch B
```

3: Press **1** for Edit Calibrate.

```
A:1-Edit Calibrate
2-Do   3-Save/Clr
```

4: Press **6** to edit the pipe ID:

```
Edit:  1-Cell Con
6-Pipe ID
```

5: The following menu will allow you to change this constant.

Pipe ID = XX.XX Enter No. ____

After entering the number (in inches) press **enter** and the new constant should be displayed on the top line. Press **enter** again to return to the previous menu.

3.11. SAVING CALIBRATION DATA

The cell constants can be modified by manually editing the number(s) or performing a calibration. The modified cell constants will remain in effect until the power is turned off or a system reset is performed.

This data can be saved in the Smart Cell as a "User's Calibration". The user's calibration data will automatically be read upon power-up or after a system reset. This data will remain in effect until it is cleared via the menus or another calibration is performed. Because the data is saved in the Smart Cell, the calibration is valid even if the cell is moved to another transmitter.

To save or clear a user's calibration:

1: Press **menu,** then press **2** for the calibrate menu.

Main Enter menu no. Or NEXT for list

2: Select a channel.

Calibrate Menu 1-Ch A 2-Ch B

3: Press **1** for Edit Calibrate.

A:1-Edit Calibrate 2-Do 3-Save/Clr

4: Press **3** to access the user's calibration menu:

A: Calibrate Data 1-Save 2-Clear

5: To clear the calibration data do to step

Press **1** to save the calibration data as a user's calibration. A message will indicate that the data has been saved. Press **next** key to return to the menu in step 3.

Calibrate Data saved to Cell A

6: Press **2** to clear the calibration data. A message will be displayed requesting confirmation. Press key **5** to clear the data.

A: Reset Default Calib? 5-Yes

7: A message will indicate that the data has been cleared. Press **next** key to return to the menu in step 3.

Calib is cleared Press NEXT key

3.12. OPTIONAL +24VDC SENSOR POWER SUPPLY

This module allows the 770PC to operate with sensors that are +24VDC loop powered. The module takes the +5VDC supply on the back of the 770PC meter, and steps it up to +24VDC. The module must be wired to the back of the 770PC, and then the sensor patch cord is wired into the terminal blocks on the 770PC and the power supply.

The power supply is designed to handle the +24VDC requirements of two sensors. If two sensors that require +24 volts are connected to the 770PC, use only one supply

WARNING: DO NOT HOOK UP POWER SUPPLIES TO ONE 770PC. THE CURRENT DRAW ON THE 770PC WILL EXCEED THE RECOMMENDED LIMIT.

3.12.1. Installing the +24V module to the 770PC

If a patch cord is not connected to the channel (or channels) that require a +24VDC power supply, then proceed to section 3.12.2. If a patch cord is connected to the input of the channel that needs the +24v supply, remove the brown (wire #8), pink (wire #7), and orange (wire #4) wires from the terminal block (see figure 1 on the following page).

Note: The 770PC is a two channel device. Position the power supply with the terminal block at the top and install the patch cord for channel B into the top eight terminal connections. Channel A, if used, is installed in the bottom eight terminal connections.

Locate the input wires on the +24VDC module, that are brown (#8) and orange (#4).

Insert the brown wire (#8) into the terminal marked (#8) VCC on the terminal block and tighten. Insert the orange wire (#4) into the terminal (#4) AG and tighten.

Note: Since there are two channels on the back of the 770PC, use the ground and VCC from the same channel. Do not mix grounds and powers from different channels.

3.12.2. Attaching a patch cord to the +24 volt supply

Note: This section assumes the meter has only one sensor that requires a +24VDC supply. If two +24VDC sensors will be installed to the meter, then follow these instructions for both patch cords.

Locate the brown (#8), pink (#7), and orange (#4) wires on the patch cord(s). These wires must be attached to the +24VDC module. The module has a label which describes the connections (See Fig. 2). Connect the brown, pink and orange wires from the patch cord to the terminal block on the +24VDC module. Install the

brown (#8) to (#8) VCC, pink (#7) to (#7)-VAN, and orange (#4) to (#4) AG.

Note: There are terminals for two sensors on the module (i.e. two VCC, two +24V, and two AG terminals). Only one of each is required if only one +24VDC sensor is used.

Attach the other five patch cord wires to the terminal block on the 770PC according to section 2.03. When completed, the back of the 770PC should look like Fig. 1 on the following page (an installation with two +24VDC sensors).

Note: After all the wires are connected there will not be a wire in the (#7)-VAN terminal on the 770PC. This is normal.

The +24VDC module has two pieces of Velcro attached to the bottom. One piece is adhered to the back of the module, the other piece should be attached to the 770PC. The module can then be mounted to the 770PC. Thornton recommends that the +24 volt supply be installed on the exterior side of the meter. If this mounting is not feasible, the module may be installed between the two terminal connectors on the back of the 770PC. If a NEMA 4X rear cover is installed on the 770PC, the power supply may be mounted on an inside wall for complete NEMA 4X protection.

CAUTION: WHEN THE +24VDC POWER SUPPLY IS INSTALLED, THE -5VDC LINE IN THE PATCH CORD NOW HAS +24VDC. DO NOT ATTACH A NON +24VDC SENSOR TO A PATCH CORD THAT HAS BEEN CONVERTED TO +24VDC. ALSO DO NOT HOOK-UP A +24VDC SENSOR TO A PATCH CORD THAT HAS NOT BEEN CONVERTED.

3.12.3. Specifications

Output Voltage	±24VDC
Voltage Regulation	±5% (±1.2 volts)
Current output	50 mA
Output Ripple	100mV p-p
Operating Temperature	-20°C to 70°C
Wire Length	6 in.

CHAPTER 3. SENSOR TYPES & CALIBRATION

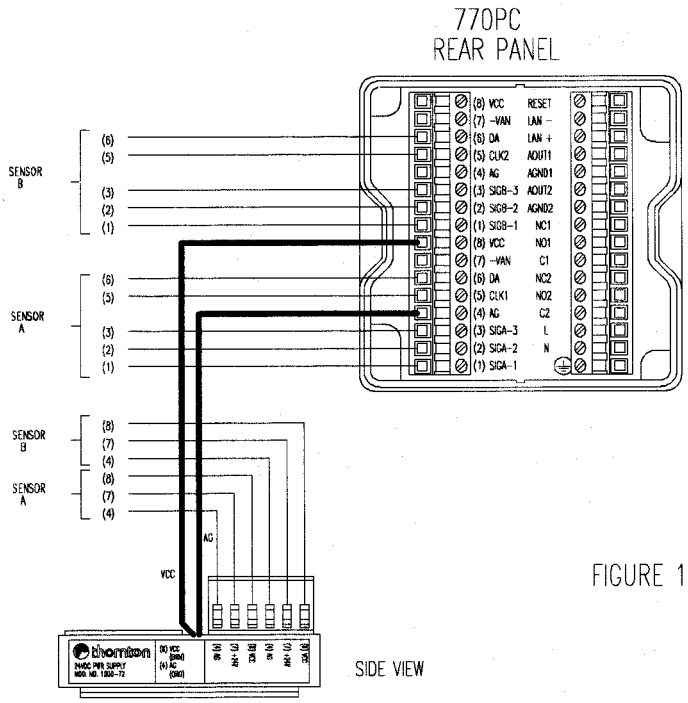


FIGURE 1. 24VDC-Powered Sensor Connections

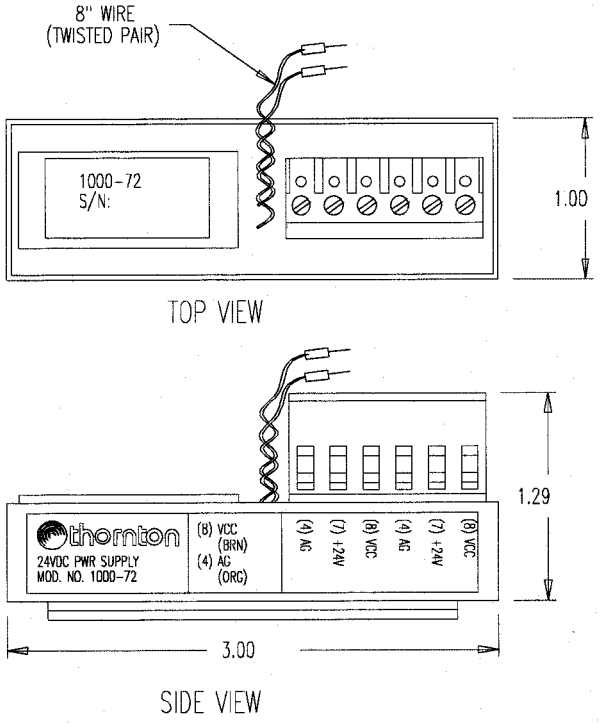


FIGURE 2.

Patch Cord Color Code:

(1)-Blue	(3)-White	(5)-Green	(7)-Pink
(2)-Yellow	(4)-Orange/Clear	(6)-Black	(8)-Brown

CHAPTER 4. OUTPUT OPTIONS

4.1. ANALOG OUTPUT SET UP

The analog output can be set as either a voltage output (0-10 volts) or a current output (4-20 mA). The selection is made by manually changing plug-in jumpers on the Analog Output circuit board (Thornton part number 07288). See analog output conversion diagram in section 10.

Analog Output Channel #1: use jumper block “A out 1”

4-20 mA output: jumper J2
0-10 volts output: jumper J3

Analog Output Channel #2: use jumper block “A out 2”

4-20 mA output: jumper J4
0-10 volts output: jumper j5

4.2. ANALOG OUTPUTS

For 770PC units that have the output option circuit board, either of the two analog output channels can be programmed with the following parameters:

1: **Assigned signal** - any of the four measurements (Ap, As, Bp and Bs) can be assigned to the output. The signal output will be proportional to the value of the assigned signal.

2: **Minimum value** - the measurement reading that will correspond to an output of 4mA (or 0 volts). Whenever the measurement is less than or equal to this number the analog output will be set to its minimum value.

3. **Maximum value** - the measurement reading that will correspond to an output of 20mA (or 10 volts). Whenever the measurement is greater than or equal to this number the analog output will be set to its maximum value.

Default settings:

1: **Assigned signal:** none (output is disabled)

2: **Minimum Value:** depends upon assigned measurement as follows:

Resistivity	:0 ohms-cm
Conductivity	:0 S/cm
TDS	:0 ppm
Degrees C	:-40
Degrees F	:-40
pH	:0 pH
Volts	:-1.5 volts
Flow Rate	:0 gallons/minute
Total Flow	:0 gallons
Pressure	:0 PSI
Tank full	:0%
Tank Level	:0 gallons
% Rejection	:0%

% Recovery :0%
% HCl :0%
% NaOH :0%
%H_2SO_4 :0%

Cubic Meters /Hr :0
Liters :0
Liter/min :0
Feet/Second :0

3: **Maximum Value**: depends upon assigned measurement as follows:

Resistivity :50 ohms-cm
Conductivity :100 S/cm
TDS :62,500 ppm
Degrees C :140 Deg C
Degrees F :284 Deg F
pH :14 pH
Volts :+1.5 volts
Flow Rate :1,000 gallons/minute
Total Flow :999 gallons
Pressure :max. PSI of sensor
Tank full :100%
Tank Level :999 M gallons
% Rejection :0100%
% Recovery :100%
% HCl :100%
% NaOH :100%
%H_2SO_4 :100%
Cubic Meters/Hour :45.42 m 3/hr
Liters :999 M Liters
Liter/min :1,000 Lit/min
Feet/Second :1,000 feet/second

Any default amount can be manually overridden.

To change the setting:

1: Press **menu,** then press **6** for the control menu

Main
Enter menu no.
Or NEXT for list

2: Press **3**.

1-Setpnt 2-Relay
3-Analog Output

3: Enter an analog output number

Analog Output?
Enter No. (1-2) ___

4: With this menu, selection number 4 can be used to set the analog output to the default setting

To assign a signal press **1** and go to step 5

To set the minimum value press **2** and go to step 6

To set the maximum value press **3** and go to step 6

Out#: 1-Sig 2-Min
3-Max *4-Default

5: Make a selection, then press <— to return to the previous menu.

Out#: 1-Sig 2-Min 3-Max *4-Default

6: This menu is used to select the units for the minimum or maximum value. This selection is actually a multiplying factor that will be applied to the number entered.

1-x1: (units) multiply value by 1.
2-u: (micro) multiply value by 0.000001
3-m: (milli) multiply value by 0.001
4-k: (kilo) multiply value by 1,000
5-M (mega) multiply value by 1,000,000

Min#Units: *1-x1 2-u 3-m 4-k 5-M

or for maximum selection:

Max#Units: *1-x1 2-u 3-m 4-k *5-M

7: Enter the minimum value, press **enter** and the number will appear on the middle line in the position XX.XX. The units selected from the previous menu will appear in position y. Press enter again to return to the previous menu.

Min# XX.XX y Enter No. _____

or for maximum selection, enter the desired value:

Max# XX.XX y Enter No. _____

4.3. INVERTING THE ANALOG OUTPUTS

The analog outputs can be inverted by setting the minimum value higher than the maximum value. For example, pH can be programmed to control an inverted output by setting the minimum = 14 and maximum = 0. Table 4.1 shows the output current for various pH values with this setup.

pH Reading	Output Current (mA)
0	20
7	12
14	4

Table 4.1

4.4. OUTPUT HOLD FEATURE

Under some circumstances, it may be desirable to hold the relay states and analog output values at their current levels. This is frequently used when installing a new sensor and during cleaning or calibration of pH and ORP sensors.

The display continues to give current measured values while the outputs are held.

The 770PC can be programmed to hold the outputs for a specified amount of time. The timer can be set from 1 minute up to 99 minutes. After the time has expired the outputs will return to normal operating conditions.

To enable the hold feature, set the timer as follows:

1: Press Menu.

```
MAIN
Enter menu no.
Or next for list
```

2: Press 6 for the Control Menu.

```
1-Setpnt  2-Relay
3-Analog  4-Hold
```

3: Press 4 to access Hold Timer Menu.

```
Hold Outputs? 00
Enter Min. >
```

Enter the desired number of minutes to hold the outputs. Press the ENTER key. The time will then appear on the top line. For example. setting the timer to 15 minutes will be shown as:

```
Hold Outputs? 15
Enter Min. >
```

Press Exit Menu when done.If the timer is set to a value greater than 0, then the top line of the display will flash the message : “Hold!” when displaying measurements. A typical display is:

```
Hold!
A   18.15 M0-cm  C
B   52.83 PSI
```

Also, while the hold feature is enabled, a time-remaining message will be displayed every minute. An example of this message is:

```
Outputs are held
for 13 more min.
```

The hold feature can be terminated by setting the time to zero.

CHAPTER 5. TRANSMITTER OPERATIONS

In the menu mode all parameters can be viewed and/or modified from the keypad. While the unit is displaying measurement data, enter the menu by pressing **menu.** The <— key is always used to return to the previous menu. The **exit menu** key may be pressed at any time to exit the menus. While the unit is in the menus, measurements continue to be performed and all control functions remain operational. The menus are equipped with an automatic time-out feature. If a key is not pressed within a 4 minute period, the menus will be terminated and the unit will return to the display of measurement data. The menu time-out feature is disabled when a 1-point or 2-point calibration is being performed.

All 770PC parameters are saved in a non-volatile memory integrated circuit and are restored upon power-up. A copy of the Block Diagram 770PC menu structure is located in the Appendix.

5.1. MEASUREMENT TYPE SELECTION

The 770PC measures four parameters in each cycle. These measurements are referred to as Channel A Primary (Ap), Channel A Secondary (As), Channel B Primary (Bp), and Channel B Secondary (Bs). Each can be assigned a specific measure type by entering the “Measurement Mode” menu.

Default Settings:

Conductivity:

Primary Signal - Resistivity
Secondary Signal - Degree C

pH:

Primary Signal- pH
Secondary Signal - Degree C

Flow

Primary Signal - GPM
Secondary Signal - Total Gallons

Pressure

Primary Signal - PSI
Secondary Signal - KPas

Tank Level

Primary Signal - % Full
Secondary Signal - Total Gallons

Temperature:

Primary Signal - Degrees C
Secondary Signal - Degrees F

Chemical cell:

Primary Signal- Resistivity
Secondary Signal **-** Degree C

Voltage:

Primary Signal - Voltage
Secondary Signal - Voltage

Flow:

Primary Signal: -GPM
Secondary Signal - Total Gallons

To change a measurement type:

1: Press **menu,** then press **0** for the measurement menu:

Main
Enter menu no.
Or NEXT for list

2: Select a channel.

Measurement Mode	
1-Ch A	2-Ch B

3. Select either Primary or Secondary,

Ch # Measurement	
1-Prime	2-Second

The menu will display a list of measurement types that are available (based upon the sensor type installed on the selected channel).

4: Select a measurement from the menu options below.

Conductivity:

*1-Res	2-Con
3-TDS	9-More

Press **9** for other measurement options:

4-DegC	5-DegF
6-%Rej	*9-Other

pH:

*1-pH	2-Volts
3-DegC	F-DegF

Temperature:

*1-Degrees C
2- Degrees F

Flow:

*1-GPM	2-Gals
3-m^3	9-More

Press **9** for other measurement options:

4-cu M/hr	5-Hz
6-%Rec	9-More

Press **9** for other measurement options:

7-Litr	8-L/min
0-Ft/s	9-More

Pressure:

*1-PSI	2-KPas
3-mmHg	9-More

Press **9** for other measurement options:

4-Volt	5-Diff
6-Bars	*9-More

Tank Level:

*1-%Full	3-PSI
2-Gals	4-m^3

5: Press <— to back up to the previous menu (or press **exit menu** to exit the menus). Repeat this process until all 4 measurements have been assigned.

5.2. DISPLAY SETUP

Each line of the display can display any one of the 4 measurements. For example, line 1 can be programmed to display Chan-

nel B primary, line 2 can display Channel A Primary, and line 3 can display Channel A secondary.

Default settings:

Line 1 - Channel A Primary
Line 2 - Channel A Primary
Line 3 - Channel B Primary

To change any of these settings:

1: Press **menu,** then press 1 for the display menu.

Main **Enter menu no.** **Or NEXT for list**

2: Press **1, 2**, or **3**.

Display Setup **Enter Line No. ____**

3: Press **1** to assign a measurement to a display line.

1-Select Measure **2-Format Display**

4: Select on of the 4 measurements to be displayed on the line number entered in step 2. It is important that you remember the measurement type assigned to these measurements from the previous section.

Dis Line 1 *1-Ap **2-As 3-Bp 4-Bs**

5: Press <— to back up to the previous menu (or Press **exit menu** to exit the menus). Repeat this process until all display lines have been assigned.

5.3. DISPLAY FORMAT

In the automatic mode the number being displayed can have from 0-4 digits after the decimal point. Each line of the display can be set to display a set number of digits to the right of the decimal point. This feature is useful if a reading fluctuates and the last digit(s) are difficult to read. Each line can be set to automatically adjust this number.

Default setting: Each line will automatically adjust the number of decimal digits.

To change settings:

1: Press **menu,** then press 1 for the display menu.

Main **Enter menu no.** **Or NEXT for list**

2: Enter **1, 2,** or **3**.

Display Setup **Enter Line No. ____**

3: Press **2** to format the display for the line selected.

1-Select Measure **2-Format Display**

4: Press **2** to select fixed digits.

Decimal Places ***1-Auto 2-Fixed**

5: The current setting will be displayed. The current setting is in position X, enter a number from 0 to 4.

L#= X Dec Places Enter D Places

6: Press <— to back up to the display setup menu to program another line or press **exit menu** to exit the menus. Repeat this process until all display lines have been set.

5.4. RANGE SELECTION

Only the resistivity, conductivity and TDS measurements have selectable ranges.

Default setting: auto-ranging enabled.

To set a specific range:

1: Press **menu,** then press **5** for the range menu.

Main Enter menu no. Or NEXT for list

2: Select a measurement to adjust a range on.

Set Range? 1-Ap 2-As 3-Bp 4-Bs

3: Select a range.

Resistivity:

*1: Auto 2: Mo-cm 3:Ko-cm 4: o-cm

Conductivity:

*1: Auto 2:mS/cm 3:uS/cm 3:nS/cm

TDS:

*1: Auto 2: K ppm 3: ppm 4: m ppm

Pressure:

*1: Auto 2: PSI 3:KPSI 4: MPSI

Other measurements:

No range for this mode, press NEXT

4: Press <— to back up to the previous menu (or press **exit menu** to exit the menus). Repeat this process until the range has been set for each of the 4 measurements.

5.5. COMPENSATING MEASUREMENTS

Resistivity, TDS and conductivity measurements can be compensated. With temperature compensation, the resistivity reading is referenced to 25°C. As an example, with standard compensation, the resistivity of ultrapure water will read 18.18 Mo-cm, regardless of the temperature reading.

A number of different compensation methods are available:

1. None.
2. Standard (NaCl).
3. Cation.
4. Ethylene-Glycol (100%).
5. Isopropyl Alcohol (75%).
6. Linear (% per Degree ˚C).
7. Light 84
8. Ethylene-Glycol (50% H_2O)

A measurement that is compensated will be indicated by the letter “C” after the reading. The letter “U” will be displayed if the measurement is not compensated, except on line 1.

For Pharmaceutical USP 23 conductivity measurements where uncompensated measurement is required, select none for compensation.

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/Ammonia/ETA Compensation

Power industry applications for specific conductivity using ammonia or ETA (ethanolamine) water treatment and cation conductivity measurements with acidic samples are appropriately compensated with this setting. It takes into account the effects of temperature on the dissociation of pure water with the presence of these bases and acids.

Glycol Compensation

This compensation matches the characteristics of cooling antifreeze solutions used in various processes. “Glycol” is 100% ethylene glycol. “Gly50” is 50% ethylene glycol in deionized water.

Alcohol Compensation (IPA)

This compensation provides for the temperature characteristic of a 75% solution of isopropyl alcohol in pure water used for some rinsing operations in semiconductor manufacture. Compensated measurements using this solution may go well above 18 Mohm-cm.

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 and Light) is recommended.

Default setting: standard compensation method.

To change the compensation:

1: Press menu, then press 4 for the compensation menu.

```
Main
Enter menu no.
Or NEXT for list
```

2: Press 2.

```
1-Temp Source
2-Compensation
```

3: Select a channel.

```
Set Compensation
1-Ch A   2-Ch B
```

4: Select a compensation method.

```
*1-None      2-Stand
3-Cation     9-More
```

Press key 9 for more selections

```
4-Glycol     5 IPA
6-Linear     9-More
```

Press key 9 for more selections

```
7-Light 84
8-Gly50      9-More
```

5: If “Linear” is selected then the next menu will allow the setting of the linear value as % per DegreeC.

```
A: %/DegC= 2.000
Enter No.
```

5.6. TEMPERATURE SOURCE

Measurements such as the various conductance types may require a temperature value if compensated readings are desired. The pH measurement always requires a temperature reading for proper measurement processing. Three options are available for specifying the source of temperature:

1: **From its own sensor** - a temperature sensor must be built into the sensor.

2. **From the other sensor** - a temperature sensor is not installed on this channel but

is available to the other channel.

3: **Manual source** - if the temperature of the solution is known then it can be entered manually in degrees Celsius.

Default setting: temperature reading from the same channel.

To change the source of temperature:

1: Press **menu,** then press **4** for the compensation menu.

```
Main
Enter menu no.
Or NEXT for list
```

2: Press **1**

```
1-Temp Source
2-Toggle Comp/Un
```

3: Select a channel.

```
Temp Source
1-Ch A  2-Ch B
```

4: Select a temperature compensation source. If manual is chosen go to Step 5. If Channel A or Channel B are chosen go to Step 6.

A: Source	**3-Man**
1-Ch A	**2-Ch B**

Note that both channels A and B can use this temperature source for compensation purposes. Select 1 if it is desired to use the temperature reading of channel A for compensation. Select 2 to allow channel B to be used as the temperature source. Select 3 to enter a temperature manually from the keypad, instead of measuring the temperature from either channel.

5: Press **3**, enter a number from the keypad and press **enter.**

#: Temp = XX.XX
Enter No. _____

The number entered is displayed on the bottom line. If a mistake is made while entering the number, press <— to clear the entry. Press **enter** and the value will be displayed in the XX.XX position. Compensated Temperature is complete. When finished entering the number press enter a second time to return to the previous menu.

6: Press <— to back up to the previous menu (or press **exit menu** to exit the menus). Repeat this process for both channels.

5.7. SETPOINTS

Four setpoint (limits or alarm conditions) can be assigned to any of the four measurements (Ap, As, Bp, Bs). More than one setpoint can be assigned to the same measurement. A setpoint can be defined as a high limit, a low limit or a USP 23 limit. See Section 5.7.1 for detail on the USP 23 setpoint. A setpoint alarm condition occurs when the measurement is greater than the high or USP 23 limit, or less than the low limit. This condition is indicated by a flashing measurement reading. Also the measurement being displayed will be preceded by the character

“>” for a high limit error or “<” for a low limit error.

Default setting: setpoints are disabled.

To enable or modify a setpoint:

1: Press **menu,** then press **6** for the control menu.

Main
Enter menu no.
Or NEXT for list

2: Press **1**

1-Setpnt	**2-Relay**
3-Analog Output	

3: Enter the setpoint number.

Which Setpoint
Enter No. (1-4) ___

4: Select a parameter.

SP# 1-Sig 2-Type
3-Value 4-Other

If “Sig” is selected:

Assign SP# 1 -Ap
2-As 3-Bp 4-Bs

If ‘Type” is selected:

SP# 1-off 2-Hi
3-Low 4-USP23

Press ← to return to the previous menu after making a selection.

If “Value” is selected:

Ap = 12.50 Mo-cm
Enter sp#: _____

Enter the value for the setpoint and then press ENTER and the new setpoint value will be displayed on the top line. Press ENTER again to return to the previous menu.

If “Other” is selected, an over-range condition will be considered to be the same as an active setpoint condition.

5.7.1. USP Setpoint

The USP type setpoint is a high alarm used for pharmaceutical water monitoring with non-temperature compensated measurements. USP 23 (United States Pharmacopoeia, 23rd edition) requires that non-temperature compensated conductivity of pharmaceutical waters must be below a limit from its table based on the temperature of the sample. The 770PC instrument has the USP 23 table in memory and automatically determines the conductivity limit based on the measured temperature.

The USP 23 setpoint value set in the 770PC is the percentage safety margin below the USP 23 limits to activate the setpoint. For example, the USP table conductivity limit at 15 C is 1.0 µS/cm. If the setpoint value is set at 40% then the setpoint will activate whenever the conductivity goes above 0.6 µS/cm at 15 C.

Stage 1 Conductivity Limits as a Function of Temperature

Temperature (C)	Conductivity Limit (µS/cm)
0	0.6
5	0.8
10	0.9
15	1.0
20	1.1
25	1.3
30	1.4
35	1.5
40	1.7
45	1.8
50	1.9
55	2.1
60	2.2
65	2.4
70	2.5
75	2.7
80	2.7
85	2.7
90	2.7
95	2.9
100	3.1

5.8. RELAYS

Two relays can be programmed to activate when a setpoint error occurs with any of the four setpoints. Each relay has the following programmable parameters:

1: **Assigned Setpoints** - each relay can be set to be activated from an error on any combination of setpoints. For example, relay #1 can be programmed to be activated when a limit is exceeded on setpoints #1, #2, #3, or #4.

The relay will not be deactivated until error conditions for all assigned setpoints are resolved.

2: **Relay State** - The relay is set to the "Normally "Open/Normally Closed" positions when programmed in the "normal" relay state (i.e. the relay functions as indicated by the label markings on the real panel). Selecting the inverted state will cause the relay to operate in the opposite condition as indicated by the rear panel label. In this mode the normally-open and normally-closed positions are swapped.

NOTE: NC=NC in "normal" state.
NC=NO in "inverted" state.

WARNING: THE "INVERTED" STATE WILL REVERT TO NORMAL STATE WHEN A POWER LOSS OCCURS.

3: **Delay Time** is the length of time that the setpoint error condition must exist before activating the relay. If the setpoint error condition disappears before the delay is over, the relay will not be activated.

4: **Hysteresis Value** is entered as a percentage of the setpoint value that must be exceeded before the relay is deactivated.

Default settings:

1. Relay is disabled.
2. No setpoints are assigned.
3. Delay is 0 seconds.

4. Hysteresis is 0%.
5: Relay state is normal.

To modify these settings:

1: Press **menu,** then press 6 for the control menu.

```
Main
Enter menu no.
Or NEXT for list
```

2. Press **2**.

```
1-Setpnt  2-Relay
3-Analog Output
```

3: Enter a relay number.

```
Which Relay?
Enter No (1-2) ____
```

4: From this menu you can enable the relay, disable the relay, or go to the relay setup menu. If “Setup” is selected, go to Step 5.

```
Relay #   1-Enable
*2-Disab  3-Setup
```

5: To program the operation of a relay, a relay must be “enabled” and set points must be assigned.

```
R#  1-Hys  2-State
3-Delay  4-Setpts
```

Hysteresis value press **1**, go to step 6.

Relay state press **2**, go to step 7,

Delay time, press **3**, go to step 8.

Assign setpoints to this relay press **4**, go to step 9.

6: “Hyster”: The hysteresis setting will be displayed in the position XX. Type in a new value from 0 to 99 and press **enter.** The new value will be displayed on the top line. Press **enter** again to return to the previous menu.

```
R# Hyster = XX%
Enter No. ____
```

7: “State”: Select “Normal” or “Inverted”, press <— to return to the menu in Step 5.

```
R# is   1-Normal
2-Inverted
```

8: “Delay”: The delay setting will be displayed in the position XX. Type in a value from 0 to 99 seconds and press enter. Press enter again to return to the menu in Step 5.

```
R#  1-Sp1    2-Sp2
    3-Sp3    4-Sp4
```

9: “Setpts”: Press keys “1” through “4” to toggle the “*” for that setpoint.
After programming relay, hysteresis or delay, press enter twice and <— to reach enable menu. After programming relay state or setpoints, press <— twice to return to enable menu.

```
Relay #    *1-Enable
2-Disab     3-Setup
```

NOTE: Relays must be enabled to activate relay programs.

Press **1** to enable relay programs after programming.

5.9. SYSTEM RESET

A system reset sets all parameters of the 770PC to the default condition. Various self tests and other initialization procedures will also be performed.

1: Press **menu,** then press 9 for the other menu.

Other Menus
1-Reset 2-Test

Press 1 to select next menu.

2: Press **2**.

1-Measure Reset
2-Reset System

3: Press **1** to reset the system or press **2** to quit without doing a reset.

1-System Reset
2-Return

5.9.1. Measurement Reset

A measurement reset will reset the total flow and tank level measurements to zero. This function has no effect on all other measurements.

1: Press **menu,** then press 9 for the reset menu.

Main
Enter menu no.
Or NEXT for list

2: Press **1**.

Other Menus
1-Reset 2-Test

3: Press1.

1-Measure Reset
2-System Reset

4: Press **1** to reset measurements or press **2** to quit without doing a reset.

1-Measure Reset
2-Return

5: Press **exit menu** to leave menus.

5.10. MEASUREMENT AVERAGING

Measurement Averaging is used to stabilize measurements in applications with rapidly changing parameters or noise. Different levels of averaging are available for various applications. In general, a higher level of averaging will lead to a longer response time to a change in the measurement.

Averaging can be set to None, medium, high, or Special. To change the level of averaging:

1: Press Menu.

Main
Enter menu no.
Or NEXT for list

2: Press 3 for the Time/Avg Menu.

1-Set Averaging
2-Set Meas Time

3: Press 1 to select the Set Averaging menu.

Set Average 1-Ap
2-As 3-Bp 4-Bs

4: Press 1, 2, 3, or 4 to select a measurement. For example, press 1 to set averaging for the measurement Ap:

Ap: *1-No 2-Med
3-Hi 4-Special

Press keys, 1, 2,3, or 4 to select the desired level of averaging. the Special Averaging is a unique method that provides a high level of averaging for measurement changes less than 1%. If the measurements are changing more than this amount then the averaging is automatically switched to a lower level to provide faster response to major changes.

Note: If measurement noise can exceed 1%, then the Special Averaging should not be used.

5.11. MEASUREMENT TIMING: 50/60 HZ OPERATION

The 770PC measurement program can reduce (filter) the effects of power line noise that is common in many environments. The input power to the 770PC is either 50Hz or 60Hz. By selecting the proper frequency from the menus, the effect of the power line noise will be reduced. To set the frequency of the power source (also referred to as the measurement time):

1: Press **menu,** then press **0** for the measurement menu.

Main
Enter menu no.
Or NEXT for list

2: Press **2** to select the Set Measurement Time menu.

1-Set Averaging
2-Set Meas Time

3: Press **3** for 60Hz operation, **4** for 50Hz operation.

Set Measure Time
3-60Hz 4-50Hz

5.12. PERCENT REJECTION - REVERSE OSMOSIS OR ULTRAFILTRATION

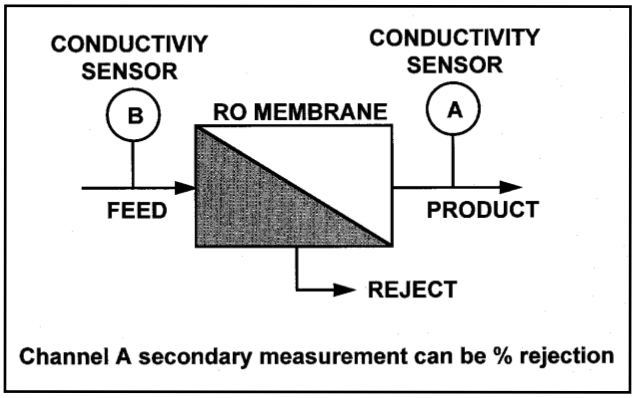
Percent rejection is measured in µS/cm (conductivity) to determine the ratio of

impurities removed from product water to the total impurities in the incoming feedwater. RO membranes typically remove (reject) 90% of the dissolved inorganic contaminants in water. One 770PC transmitter must be connected to two conductivity sensors to achieve a percent rejection measurement.

The formula for obtaining Percent Rejection is:

[1-(Product/Feed)] X 100 = %

See the schematic diagram below of an RO installation with sensors installed for Percent Rejection.



IMPORTANT: When preparing the system to perform a percent rejection measurement, the product monitoring sensor must be installed in the channel that will measure percent rejection. If the product conductivity sensor is installed in channel A, then percent rejection must be measured in channel A. Likewise, if the product sensor is installed in channel B then the percent rejection measurement must also be programmed in channel B.

The remaining channel may be programmed to display any of the display options available for a conductivity sensor, i.e.; conductivity, resistivity, temperature or TDS.

To program the transmitter for percent rejection:

1: Press **menu,** then press **0** for the measurement mode.

Main
Enter menu no.
Or NEXT for list

2: For the purpose of this example, channel A will be used for the percent rejection measurement. Press **1** for Channel A. This will select channel A as the channel to measure and display the percent rejection measurement.

Measurement Mode	
1-Ch A	**2-Ch B**

3: Again, for the purposes of this example press **1** for Primary.

Ch A Measurement	
1-Prime	**2-Second**

4: Press **9,** notice that the asterisk moves

to that selection.

1-Res	**2-Con**
3-TDS	***9-More**

The additional options will be displayed.

4-Deg C	**5-Deg F**
6-% Rej	***9-More**

5: Press **6**, notice the asterisk move to the "6 - % Rej".

4-Deg C	**5-Deg F**
***6-% Rej**	**9-More**

6: Press **exit menu** to exit the menus and the transmitter will begin to display the measurements in Percent Rejection.

	90.00	
A	**90.00**	**% Rej**
B	**1.54**	**mS/cm**

If Channel B is used as the % Rejection channel. Channel B may then be programmed as A was above. If the transmitter does not display the A Primary measurement in the large characters (line 1), as above, see the menu section on programming the display in section 5.02 Display Setup, if that is desired.

5.13. SECURITY PASSWORD / LOCKOUT MENUS

The Password/Lockout feature allows a "password owner" to select a password number to lock the menu software from unauthorized access. Password/Lockout is possible in a single point-of-use instrument or throughout a network of instruments.

1: Press **menu**

Main
Enter menu no.
Or NEXT for list

2: Press **8** for Password/Lockout access

Lockout:	**1-Enab**	
***2-Disab**	**3-Chang**	

This menu allows the user to "Enable", "Disable" or change the Password/Lockout access number. The asterisk "*****" at 2-Disab indicates that the Password/Lockout is disabled and the security lock is NOT activated. A user password "00000" is stored in the instrument software during the manufacturing process. For unique system security, a new 5-digit user specified password is recommended.

NOTE: A unique user password can be changed only when the "password owner" decides.

3: To program your personal password, Press **3**.

Change: Enter
Old Pass: >

4: Enter the factory installed password "00000".

Change: Enter Old Pass: XXXXX>

5: Press **enter** and enter the new password.

Enter New Password: XXXXX>

6: Press **enter**

Password=XXXXX Press 5 if OK

7: The new password is displayed on line 1. If the correct password is displayed, press **5**; or <— to enter a new password.

Lockout: 1-Enab *2-Disab 3-Chang

CAUTION: FOR SECURITY PURPOSES, KEEP THE UNIQUE USER PASSWORD CONFIDENTIAL! THE NEW USER INSTALLED PASSWORD MUST BE "ENABLED" TO ACTIVATE THE LOCKOUT.

Lockout: 1-Enab 2-Disab *3-Chang

5: To enable the Password/Lockout, Press **1**.

Enter Password to Lock: >

6: Enter the 5-digit password.

Enter Password to Lock: XXXXX>

The password will be displayed as "XXXXX" for security purposes. Press **enter** to lock the menus.

Menus are Locked Press EXIT Menu

NOTE: If the incorrect password has been entered, the menu will return to step #4 above.

7: Press **exit menu** to return to the measurement mode.

8: Check to insure that the Password/Lockout is activated, Press **4**.

Lockout Enabled Password?

9: Press **exit menu**, to return to the measurement mode.

5.13.1. Password/Lockout Access

1: Anyone pressing the menu key for access when the Password/Lockout is "Enabled", will see the following message:

Lockout Enabled Password? >

2: Access to the menus will not be allowed without a password. To access the menus, a password must be entered at this time.

Lockout Enabled
Password?XXXXX>

3: Enter the password and Press **enter.**

Main
Enter menu no.
Or NEXT for list

Access to the menus is now permitted.

5.14. SMART AUTOMATIC TRANSMITTER CALIBRATION

Smart Automatic Calibration provides a simple and automatic method of Voltage or Resistivity calibration for the 770PC instrument, with NIST traceability. Simply connect the Calibrator to channel “A” or “B” and follow these simple instructions for automatic calibration of each channel. Each channel must be calibrated separately for a complete calibration.

NOTE: The 770PC instrument must be operating for a minimum of one hour prior to calibration. This warm up period will insure the most accurate calibration.

The Smart Calibrators are labeled with calibration values listed for resistivity/temperature and voltage.

5.14.1. Resistance/Temperature Calibrator

If the instrument reading is within ± 0.3% in resistivity and ± 0.2° C in temperature of the value listed on the calibrator, instrument calibration is not required. However, a calibration may be performed to “fine tune” the instrument.

The 770PC uses four ranges resistors for measuring resistivity. For optimal performance over the entire instrument range, each range resistor should be calibrated. If only a small resistivity range is being measured then it is only necessary to calibrate the one or two range resistors that are used to measure that range. Table 5.1 shows the resistance ranges that are measured by each range resistor. Note that the ranges overlap and that they apply to a 1.0 cell constant cell. For cells with constants other than 1.0, multiply the measured resistivity by the cell constant to get a value for determining the range resistor being used. Example: If a cell with a constant of 0.1 cm-1 is measuring water at 1.0 Mohm-cm at 25°C, then the value for determining the range resistor used is 1.0 * 0.1 = 100 Kohms and the meter is measuring on range resistor 3.

Table 5.1

Range Resistor	Resistance Range (ohms)
1	0-3.3K
2	2.5K - 33K
3	25K - 330K
4	250K - 100M

5.14.2. Voltage Calibrator

If the instrument reads within ± 1mv of the label value, an instrument calibration is not required. However, a calibration may be performed to “fine tune” the instrument.

5.14.3. Calibration Procedure

1: Connect the Smart Resistivity or Voltage Calibrator to channel “A”. For the purpose of this manual, the Resistivity Calibrator will be used.

NOTE: Password/Lockout must be disabled or bypassed in order to access the menus and to perform this calibration.

```
* CAL *
A 18.18  Mo-cm U
a  25.14  Deg C
```

2: Press **menu.**

```
1:  Do Calibration
2:  Exit Menus
```

3: Press **1**, to do a calibration.

```
Please Wait
Calibrating Unit
```

This message will flash on the display for approximately three seconds while the instrument is being automatically calibrated by the Smart Automatic Calibrator.

```
1:  Do Calibration
2:  Exit Menus
```

4: Press **2** or **exit menu**, to leave menus. The displayed measurements will now show the calibrated Resistance and Temperature (or Voltage).

```
* CAL *
A 18.18  Mo-cm U
a  25.14  Deg C
```

The calibrated values should read within the specifications listed below and compared to the measurement values marked on each calibrator. This will insure that an accurate calibration has been completed.

5: Repeat this procedure for channel B.

Voltage calibration applies to the following sensors:

- pH
- Pressure
- Tank Level

Resistivity calibration applies to the following sensors:

- Resistivity
- Temperature
- Chemical

RESISTANCE/TEMPERATURE CALIBRATOR SPECIFICATIONS

Conditions: Ambient temperature range of 20-30 DegC

Resistivity Accuracy: +/- 0.0072 Mohms after factory calibration

Resistivity Drift During Calibration Peri-

od: +/- 0.00254 Mohms.

Temperature Accuracy: +/- 0.03 DegC after factory calibration.

VOLTAGE CALIBRATOR SPECIFICATIONS

Conditions: Ambient temperature range of 20-30 DegC.

Voltage Accuracy: +/- 0.17mV after factory calibration.

RESISTANCE SOURCES

Resistor Values Used: Four calibrators are available for calibrating the four range resistors in the 770PC. These calibrators are specified in table 5.2.

Calibrator	Resistor Value (ohms)	Temp. Resistor (ohms)	Temp. ˚C
1	1.816 M	1097.6	25.1
2	100K	1300.0	77.7
3	10K	1097.6	25.1
4	1K	1097.6	25.1

Table 5.2

Accuracy: +/- 0.25%

Temp Coefficient: +/-100ppm/DegC=+/-0.01%/DegC.

Long Term Stability: After 1000, +/-0.07%.

Other sources of error: Connectors and/or cable.

VOLTAGE SOURCE

Voltage Output: 0.4 volts (1.2 volt output goes through a resistor divider).

Temp Coefficient: +/-10ppm / DegC
=+/- 0.0001% / DegC
=0.012mV / DegC

Noise: 5 uV RMS

Long Term Stability: Not available.
Other sources of error: Resistors for voltage divider, connectors, cable.

5.15. USING THE FUNCTION KEY

While the transmitter is displaying measurement data, the Function key can be used to access some special information. The following functions are available.

Function Number **Result**

1 The current software revision levels are displayed: Programmed EPROM part number, measuring software revision level, and option board software revision level.

2 For Flow Sensors, the totalized flow is displayed with extended precision (7 digits) for a more accurate measurement (useful for billing purposes).

3 The Smart Sensor identification codes are displayed. These codes contain the sensor specification numbers and the serial number.

4 Output status of analog outputs, A1 and A2, in milliamps; and relay status, R1 and R2 on or off, are displayed.

To use the function feature the function key is pressed and a number from 1 to 4 is entered.

1: Press **function,** then enter the function number.

```
Function Menu
Enter No.:>
```

2: If function 1 is selected, then a typical display might appear as:

```
Revs     Meas=1.5
Opt=1.1  Dis 1.7
```

This display indicates that the transmitter is equipped with version 1.5 software, the optional board is equipped with version 1.1. software, and the display is equipped with version 1.7 software.

3: If function 2 is selected, then a typical display might appear as:

```
A = 7518.365 Gal
B = 12142.55 Gal
```

This display indicates that channel A has recorded 7,518,365 gallons.

4: If function 3 is selected, then a typical display might appear as:

```
A = 01031234
B = 03015678
```

This display shows the **Smart Sensor** identification codes. This feature and is used for troubleshooting purposes.

5: If function 4 is selected then a typical display may appear as:

```
A1 = 4.0000  R1 = Off
A2 = 4.0000  R2 = Off
```

This display indicates that both analog outputs are at the low end and both relays are deactivated (in their normal states).

CHAPTER 6. NETWORKING

The network requires a shielded two conductor cable, since all devices communicate over the same line. There are no two equivalent cables available.

The Thornton Network is a customized Local Area Network (LAN) for use with 770PC transmitters on a single 2 wire transmission line.

The LAN is used to:

- Inquire or set the parameters of any 770PC (remote control) or from a computer interface.
- Transmit measurement data to a PC or PLC for real time data acquisition or control. Capabilities exist for off-site monitoring.
- Update transmitter software with future releases.

6.1. LAN CAPABILITIES AND APPLICATIONS

Networking several 770PCs together, provides users with a variety of features and advantages.

- Personal computer, PLC, or modem interface.

The Thornton LAN operates on a baud rate of 691.2 kbits/sec. For a personal computer, PLC or modem to accept data, a Gateway device (Thornton part #774-xxx) is required which accepts the LAN data and retransmits it on a standard RS-232 port at 19.2kbaud.

NOTE: An interface communication program is required for reading the data from Gateway RS-232 port. Thornton Associates, Inc. has a communications program (Thornton part #7700) which interfaces an IBM compatible with the Gateway unit. The program enables the user to display measurements, change parameter configurations, save data on disk for historical recall, test the LAN and send data by modem to a remote location. Please contact Thornton Associates, Inc. for information and pricing.

A 770PC transmitter with a display (Thornton part #772-xxx) can assume the identity of any other transmitter on the LAN, whether the other unit is a blind transmitter (no display-Thornton part # 771-xxx) or another transmitter.

Once control over another transmitter has been established, the menu structure of the controlled unit can be scrolled through. This simulates physical presence at the controlled unit.

6.2. LAN FEATURES

Operating the LAN with a PC or a PLC offers the advantage of allowing a user to

monitor and control a system from a central computer terminal. Data can be received, stored and manipulated for historical graphs and trend analysis. A central operator can view the entire system from a single location. The interface with a PLC can be digital with the LAN or analog outputs can be obtained directly from the instruments. Operating the LAN with a modem offers the same advantage as using a PC and a PLC. Off site monitoring enables a service company to dial a customer's system through a modem and monitor the readings or change parameters. If off-site monitoring is desired, the modem interface offers a savings in service calls, provides a professional service image, and gives a service organization a convenience factor. Any current modem or modem card may be used to interface with the gateway device.

Future software upgrades may be downloaded either on site or through a modem. Without this feature, a user will have to replace the program chip.

6.3. LAN GUIDELINES

One spine network can handle multiple transmitters. Thornton advises a maximum of 40 transmitter per spine. For large systems, this may limit a system shut-down in the event of a power loss.

Note: The maximum distance for an individual spine is 1000 feet, end to end.

Note: One gateway device (Thornton part #774-xxx) is needed per spine if an RS-232 device is used to control the LAN. The gateway can be placed in any position along the spine but must be within 50 feet of the host computer unless data transmission repeaters are used. For optimum operation, the Gateway should be at the center of the spine.

Note: Each 770PC has a lAN communication interface built-in. therefore, the initial hookup, and any future expansion can be connected in the same manner. Please use the following steps.

1: See the installation instructions for the individual 770PC transmitters.

2: Take the "y" interconnect cable (Thornton part #1000-54) and connect the shielded tin lead wire to "LAN-" on the rear terminal block of the transmitter. Next, connect the blue tin lead wire to "LAN+" on the rear terminal block. A female and a male Amp connector are available for connecting the network cables.

3: Attach a 2-wire network cable (Thornton part #1xxx-78) to the appropriate

connection (female Amp to male Amp) of the 'y' interconnect cable. These LAN cables are available in 5, 10, 25, 50 and 100 foot lengths. Attach a second 2-wire network cable to the appropriate connector (male Amp to female Amp) of the 'y' cable.

4: When all the 770PC transmitters are connected, there will be (1) open female Amp connector and (1) open male Amp connector. on each end of the last remaining 'y' cables. Attach the LAN terminators (Thornton part #1000-55) to each remaining open connector. The terminators reduce interference on the LAN cable.

6.4. REMOTE CONTROL MODE

1: Press **menu**, then press **7** for the communication menu.

Main **Enter menu no.** **Or NEXT for list**

2: Press **1**.

1-Remote Control **2-LAN Setup Info**

3: Press **2**.

Remote Control **1-Disab *2-Enab**

4: The address of this unit is displayed on the middle line. Enter the address of the unit to be controlled.

Control Unit xxx **Enter No.>**

5: Press **enter**. At this point, if it is available, the unit will connect to the controlled unit.

Connect to unit **#xxx Established**

After 2 seconds, the unit will begin displaying the measurements of the connected unit. Now the menu structure can be entered and the parameters can be configured. As a reminder that another unit's menu and measurements are being displayed, the unit # will always be indicated in line 1 of the display.

Note: If connection is attempted to a unit which is not available on the LAN, the display will read:

Unit #xxx is not **Available**

Note: To find the assigned address # of a transmitter:

A) Press 7 after getting into the main menu (follow steps 1 & 2). Next, press 2 for "LAN setup info". The assigned address of the unit will be revealed.

Note: To End Session:

A) Enter the menu as described in steps 1 through 3 and select the "disable" function.
or
B) Press exit menu 3 times on either unit. The unit which is now being operated remotely has the following display:

This unit is in remote mode-xxx

When operation is disabled, the remotely operated unit returns to normal operation.

6.5. CHANGING A TRANSMITTERS ADDRESS FOR INSTRUMENTS WITH SOFTWARE EARLIER THAN VERSION 2.0

1: Shut off the power to the transmitter!

2: Remove the front snap-on bezel to expose the four screws retaining the lens plate. Remove the four retaining screws and carefully lift the lens plate away from the unit.

CAUTION: THE LENS PLATE IS CONNECTED TO THE DISPLAY PCB BY A RIBBON CABLE, WHICH MUST BE CAREFULLY DISCONNECTED.

3: Remove the four screws which retain the display PCB to the enclosure. Carefully remove the display PCB from the unit.

CAUTION: THE DISPLAY PCB IS CONNECTED TO THE MEASUREMENT PCB BY A WIRE ASSEMBLY AND A CONNECTOR, WHICH MUST BE CAREFULLY DISCONNECTED.

4: Pull out the measurement PCB from the right side of the enclosure. Locate the 8 position dip switch which is used to set the LAN address for this transmitter. When setting the address of the transmitter, make sure no other transmitter on the LAN has that same number. Refer to table 1 for the switch positions.

5: Slide the measurement PCB back into place ensuring that the board is firmly connected. Reconnect the wire assembly from the display PCB to the measurement PCB. This connector is keyed to fit in only the proper orientation. Be certain that this connector is installed covering all connector pins. replace the screws to fasten the display PCB in the enclosure.

6: Reconnect the ribbon connector from the lens plate to the display PCB. This connector is not keyed for proper orientation. Do not twist ribbon cable. Connect the ribbon cable so that it will lay flat when unit is reassembled. Check to insure that the lens plate is not upside down. Install screws to fasten the lens plate to the unit. Replace the snap-on bezel.

6.6. SETTING THE NETWORK ADDRESS FOR INSTRUMENTS WITH VERSION 2.0 SOFTWARE OR LATER

When using the Thornton Local Area Network, each unit is identified by a network address number from 1 to 127. In software versions prior to version 2.0, the address was set via a switch located inside the transmitter. Version 2.0 and later software allows the address to be set via the menus. The address is stored in non volatile memory and is retained in the event that the instrument is powered down.

To set or change the network address:

1: Press menu.

Main
Enter menu no.
Or NEXT for list

2: Press 7 for the communications menu.

1-Remote Control
2-Set LAN address

3: Press 2 to enter the Set LAN Address menu.

LAN address = XXX
Enter No.>

The current network address will be displayed in the position “XXX”. To change the address, enter a number (from 1-127)

The 770PC will display the following message while it checks the network for the availability of this address number:

Please wait...
Checking Network

If the address is used by another device then the following message will be displayed:

Address XXX is used. Press Next

If the address is used then press the Next key and enter a new address number.

If the address is accepted then the menu shown in step 3 will be displayed with the new address number. For example, if the address is set to 95 and is accepted then the menu will appear as:

LAN address = 95
Enter No.>

When done, press the Exit menu.

Table 6.1: Measurement Board Switch Settings
For Instruments With Software Earlier Than Version 2.0

The LAN address for the measurement board is set using switch #SW1. In the following table, “d” indicates that the switch is down (in the direction of the arrow or facing U10).

LAN Addr	Switches 12345678	LAN Addr	Switches 12345678	LAN Addr	Switches 12345678	LAN Addr	Switches 12345678
0	not used	32	ddudddddd	64	dudddddd	96	duuddddd
1	ddddddddu	33	ddudddddu	65	dudddddu	97	duuddddu
2	ddddddddud	34	ddudddddud	66	dudddddud	98	duuddddud
3	ddddddduu	35	ddudddduu	67	dudddduu	99	duuddduu
4	dddddddudd	36	dddudddudd	68	dudddudd	100	duuddudd
5	ddddddudu	37	ddudddudu	69	dudddudu	101	duuddudu
6	ddddddduud	38	ddudddduud	70	dudddduud	102	duuddduud
7	ddddddduuu	39	ddudddduuu	71	dudddduuu	103	duuddduuu
8	ddddddddd	40	ddudddddd	72	dudddddd	104	duuddddd
9	ddddddddu	41	ddudddddu	73	dudddddu	105	duuddddu
10	dddddddud	42	ddudddddud	74	dudddddud	106	duuddddud
11	dddddddduu	43	ddudddduu	75	dudddduu	107	duuddduu
12	ddddddddd	44	ddudddddd	76	dudddddd	108	duuddddd
13	ddddddddu	45	ddudddddu	77	dudddddu	109	duuddddu
14	ddddddddud	46	ddudddddud	78	dudddddud	110	duuddddud
15	ddddddduu	47	ddudddduu	79	dudddduu	111	duuddduu
16	ddddddddd	48	ddudddddd	80	dudddddd	112	duuddddd
17	ddddddddu	49	ddudddddu	81	dudddddu	113	duuddddu
18	ddddddddud	50	ddudddddud	82	dudddddud	114	duuddddud
19	ddddddduu	51	ddudddduu	83	dudddduu	115	duuddduu
20	ddddddddd	52	ddudddddd	84	dudddddd	116	duuddddd
21	ddddddddu	53	ddudddddu	85	dudddddu	117	duuddddu
22	ddddddddud	54	ddudddddud	86	dudddddud	118	duuddddud
23	ddddddduu	55	ddudddduu	87	dudddduu	119	duuddduu
24	ddddddddd	56	ddudddddd	88	dudddddd	120	duuddddd
25	ddddddddu	57	ddudddddu	89	dudddddu	121	duuddddu
26	ddddddddud	58	ddudddddud	90	dudddddud	122	duuddddud
27	ddddddduu	59	ddudddduu	91	dudddduu	123	duuddduu
28	ddddddddd	60	ddudddddd	92	dudddddd	124	duuddddd
29	ddddddddu	61	ddudddddu	93	dudddddu	125	duuddddu
30	ddddddddud	62	ddudddddud	94	dudddddud	126	duuddddud
31	ddddddduu	63	ddudddduu	95	dudddduu	127	duuddduu

Example: Setting the LAN address at 22.

CHAPTER 7. SERVICE

770 Transmitters do not require regular service or maintenance. However, to prevent voiding the warranty, all repairs must be returned to the factory or repaired by an authorized technical service person.

CAUTION: THIS UNIT AND ASSOCIATED ELECTRONIC PARTS ARE STATIC SENSITIVE. ALL WORK MUST BE DONE AT AN APPROVED STATIC FREE WORK STATION.

WARNING: DISCONNECT POWER BEFORE OPENING THE CASE.

7.1. FUSE REPLACEMENT

Each 770PC is protected from accidental voltage overloading, short circuits and related damage by a 1/4 amp fuse (3/4 amp fuse for the 24VDC unit) located on the backplane printed circuit board (PCB). If this fuse requires replacement, do the following:

1: Disconnect all power to the 770PC unit before proceeding.

2: Remove the front snap-on bezel to expose the four screws retaining the lens plate. Remove the four retaining screws and carefully lift the lens plate away from the unit.

CAUTION: THE LENS PLATE IS CONNECTED TO THE DISPLAY PCB BY A RIBBON CABLE, WHICH MUST BE CAREFULLY DISCONNECTED.

3: Remove the four screws which retain the display PCB to the enclosure. Carefully remove the display PCB from the unit. Caution: The display PCB is connected to the measurement PCB by a wire assembly and a connector, which must be carefully disconnected.

4: Carefully remove printed circuit boards and place in a static free location.

5: If a NEMA 4X Rear Cover is installed on the 770PC unit, this must be removed prior to removing the Backplane PCB.

6: **CAUTION:** Be certain all power to the 770PC unit is disconnected before proceeding.

7: Remove the six mounting screws retaining the Backplane PCB. Carefully remove the PCB from the enclosure and place on a static free surface. Carefully remove the fuse from the fuse holder and replace with a new fuse. Replace the Backplane PCB insuring that the PCB is right side up (the wiring label on the rear of the PCB should be right-side readable).

NOTE: Make certain that all six screws are replaced.

8: Slide the Measurement PCB back into place from the front of the unit, insuring that the board is firmly connected. Reconnect the wire assembly from the Display PCB to the Measurement PCB. This connector is keyed to fit in only the proper orientation. Be certain that this

connector installed covering all connector pins. Replace screws to fasten the Display PCB in the enclosure.

9: Reconnect the ribbon connector from the Lens Plate to the Display PCB. This connector is not keyed for proper orientation.

NOTE: DO NOT TWIST RIBBON CABLE.

Connect ribbon cable so it will lay flat when unit is reassembled. Check to insure that the Lens Plate is not upside down. Install screws to fasten the Lens Plate to the unit. Replace the snap-on bezel.

10: Reconnect power and replace the NEMA 4X Rear Cover if used.

7.2. 770PC SOFTWARE UPGRADE MICROPROCESSOR REPLACEMENT

CAUTION - THIS UNIT AND ASSOCIATED ELECTRONIC PARTS ARE STATIC SENSITIVE. ALL WORK MUST BE DONE AT AN APPROVED STATIC FREE WORKSTATION. PERSONNEL REPLACING STATIC SENSITIVE DEVICES SHOULD BE PROPERLY GROUNDED TO AVOID COMPONENT DAMAGE.

WARNING - DISCONNECT POWER BEFORE OPENING THE CASE.

1: Disconnect all power to the 770PC before processing.

2: Remove the snap-on Bezel from the front of the meter to expose the four screws retaining the Lens/Membrane Switch Panel. Remove the four retaining screws and carefully lift the Lens/Membrane Switch Panel away from the unit. Disconnect the Membrane Switch Cable from the Display Printed Circuit Board (PCB). (See Section 10, Figure 2)

3: Place the Lens/Membrane Switch Panel in a convenient area for retrieval. Be sure to keep the o-ring seal in position on the back side of the Lens/Membrane Switch Panel.

4: Remove the four screws retaining the Display PCB. The display PCB is connected to the Measurement/LAN PCB by the Display Cable and a single connector which must be carefully disconnected at the Measurement/LAN PCB. Note the orientation of the connector for return to its original position during reassembly. The connector is keyed for proper orientation and cannot be reversed.

5: Place the display PCB on a static-free surface until ready for installation.

6: The Measurement/LAN PCB is located in the right hand track when viewed from the front of the meter. Remove the Measurement/LAN PCB from the unit by pulling straight out from the front. Place the Measurement/LAN PCB on a static-free surface.

7: The 770PC Operating Software Integrated Circuit (IC) is located on the Measurement PCB in the location designated U19 in the lower left corner (See Section 10, Figure 10) of the PCB. The IC

is removable from the socket, which is soldered to the PCB.

8: Carefully insert a flat screwdriver between the IC and the socket at the edge of the Measurement PCB. Pry the iC away from the socket until the IC is removed completely. (See Section 10, Figure 10) DO NOT pry the socket from the PCB.

9: Align the pins of the new version IC software with the socket pins.

CAUTION: THE ORIENTATION OF THE IC IS CRITICAL. IF IMPROPERLY INSTALLED PERMANENT DAMAGE MAY OCCUR. INSTALL THE HALF-CIRCLE MARKER ON THE IC WITH THE HALF-CIRCLE MARKER ON THE SOCKET. PRESS THE IC FIRMLY INTO THE SOCKET TO ENSURE A QUALITY CONNECTION.

10: Replace the Measurement/LAN PCB in the 770PC with the component side facing inward. This PCB is keyed and will only fit in the right hand track connector.

11: Connect the four wire Display Cable connector from the Display PCB to the/Measurement LAN PCB.

CAUTION: THIS CONNECTOR MUST BE ORIENTED AS PREVIOUSLY INSTALLED AND IS KEYED TO GUARANTEE PROPER INSTALLATION. BE SURE THE CONNECTOR IS INSTALLED COVERING ALL THE CONNECTOR PINS.

12: Replace the four screws securing the Display PCB.

13: Reinstall the Membrane Switch Cable connector to the pins on the Display PCB. make certain that the Membrane Switch Cable lays flat and ensure that it does not become twisted during assembly. Be certain that this connector is installed covering all the connector pins. Install the Lens/Membrane Switch panel on the 770PC unit using the four existing screws. Be certain the o-ring is in position and seals the case when assembled.

14: Replace the snap-on Bezel. Assembly is now complete.

15: Return power to the 770PC meter.

16: A “system reset” is required prior to operation. Press menu, press 9 (other menus), press 2 (system reset), press 1 (system reset), press exit menu.

CHAPTER 7. SERVICE

7.3. RECOMMENDED SPARE PARTS LIST

Description	Qty	Part#
Fuse:115/230 unit	1	35082
(Type 2AG, 1/4 Amp, Littlefuse® #225.250)		
Fuse:24VDC unit	1	35084
(Type 2AG, 3/4 Amp, Littlefuse® #229.750)		
Display PCB	1	07284
Measurement/ LAN PCB	1	07287
Backplane PCB	1	07286
Front Lens Plate	1	27196
O-ring		
Membrane Switch	1	82720
Rear Label	1	82737
Screws;Lens Plate	4	21150

7.4. ACCESSORIES

Description	**Qty**	**Part#**
1’ Sensor Patch Cord	1	1000-53
Network “Y” Cable	1	1000-54
Network Termination Set (2)	1	1000-55
Simulator, Resistivity 18MΩ	1	1850
Pipe/Wall Bracket	1	15540

7.5. OPTIONAL OUTPUT PRINTED CIRCUIT BOARDS

Description	**Qty**	**Part#**
Analog Output 0-10V/4-20mA	1	07288

7.6. NEMA 4X REAR COVER

Description	**Qty**	**Part#**
Rear Cover, NEMA 4X ASSY	1	1000-71
Individual Components		
Nema 4X Rear Cover	1	12158
Rear Cover O-Ring	1	27194
Rear Entry Plate	1	15535
Rear Entry Plate Gasket	1	27193
Plug	1	23139
Lock Nut	1	21289
Washer	1	23054

CHAPTER 7. SERVICE

7.7. TROUBLESHOOTING

Problem	Possible Cause
1. Display is blank	• no power to unit • blown fuse • loose display cable • display cable improperly connected • circuit board failure
2. Unit cannot identify Smart Sensor	• sensor improperly wired • non-smart sensor installed • sensor patch cord is defective defective sensor (Non volatile RAM failed) • patch cord is too long • non Thornton patch cord
3. Wrong readings	• sensor improperly installed • temperature compensation is incorrectly set or disabled. • sensor patch cord is defective • defective sensor • measurement board failure
4. Keypad not functioning	• keypad cable connector loose or broken • defective keypad
5. Unit missing on network	• no power to unit • address switch incorrectly set • loose network cables • units with duplicate address • Measure/LAN circuit board failure
6. Network not operating properly	• network cable crossed at one or more units • missing terminator(s) at cable end • maximum cable length exceeded • units with duplicate address • defective Measure/LAN circuit board on a unit
7. Negative readings in % rejection	• the % rejection measurements is calculated on the opposite channel

CHAPTER 8. TECHNICAL SPECIFICATIONS 770PC

Power:

Line voltage 24VDC @ 5 AMPS
90-130 VAC (47-63 Hz)
200-260 VAC (47-63 Hz)
15 watts maximum

Physical:

Dimensions: 4.6” x 4.9” 6.6” (117mm x 124mm x 168mm)
Panel cutout size: 3.625” x 3.625” (92mm x 92mm) 1/4 DIN

Environmental:

Storage temperature: -40° F (-40° C) to 158° F (70° C)
Operating temperature: 32° F (0° C) to 122° F (50° C)
Humidity: 0 to 95% RH (non-condensating)

Ranges:

Resistivity: 10Ω -cm to 20MΩ -cm, temperature compensated, aqueous samples; to 90MΩ -cm uncompensated, higher with non-aqueous samples
Conductivity: 0.050 µS/cm to 0.2mS/cm (.1 Constant Cell)
10 µS/cm to 100mS/cm (10 Constant Cell)
50 µS/cm to 1000mS/cm (50 Constant Cell)
Conductance: down to 0.02µS
TDS: 0-62.5k ppm (as NaCl)
Temperature: -40° F (-40ΩC) to 284°F (140ΩC)
pH: 0-14
Flow: 1/2” - 6” PVC or PVDF pipe
Pressure: 0-1000 PSI
Vacuum: 0-15 PSIA
Tank Level: 0 to 30 feet of head

Performance:

For resistance: 4Kohm-cm to 40 Mohm-cm (uncompensated resistivity with a 0.1 cell constant).
Accuracy: ±0.3% of reading up to 10 Mohm-cm
±0.4% of reading above 10 Mohm-cm
Repeatability: ±0.2% of reading up to 10 Mohm-cm
±0.3% of reading above 10 Mohm-cm

Relays:

2 relays, each rated for maximum of 5 amp resistive load at 30 VDC or 250 VAC; 1/10 HP at 125/250 VAC. (For CE-rated models, 772-209 and 772219, see manual 84350)

CHAPTER 8. TECHNICAL SPECIFICATIONS

Display:

3 line, vacuum fluorescent, alpha-numeric
Line 1: 5 characters, 10 mm x 6.4 mm
Lines 2 and 3: 16 characters each, 5 mm x 3.2 mm

Enclosure:

Material: Noryl® 900 (thermoplastic)
Weight: 3.5 lbs (6.6kg)

Keypad:

15 tactile feedback keys

Setpoints:

Four individual software controlled setpoints which can be set as a high or low limit. Any setpoint can be programmed to operate one of two output relays

Measurement Update Rate:

Each measurement parameter is updated once per second. One meter measuring two parameters on each of two sensors, will update the four readings once per second.

Analog Output Signals:

Output value is proportional to selected measurement signal
0 - 10 volts: isolated, 0.025% resolution, 600 ohms minimum resistance
4-20 mA: isolated, 3.91 µA resolution, 600 ohms maximum resistance

RS-232-C Interface:

Isolated, full duplex interface
Selectable baud rate, up to 19,200 baud

Sensor Patch Cord Length:

Maximum length is 300 ft (91m)

Temperature Compensation:

Automatic reference to 25°C for Resistivity, Conductivity, pH, Percent Rejection and TDS. Uncompensated measurement are also available.

Communications:

Local Area Network (LAN) Length: 1000 feet (305 m) maximum.

CHAPTER 9. MODEL NUMBERS

9.1. TRANSMITTERS

9.1.1. Blind

Part Numb	Outputs	Voltage
771-201	NONE	90-130VAC
771-202	NONE	200-260VAC
771-204	NONE	24VDC
771-211	(2) 4-20 mA	90-130VAC
771-212	(2) 4-20 mA	200-260VAC
771-214	(2) 4-20 mA	24VDC

9.1..2. Three-line Alphanumeric Vacuum Fluorescent Display

Part Number	Outputs	Voltage
772-201	NONE	90-130VAC
772-202	NONE	200-260VAC
772-204	NONE	24VDC
772-209*	NONE	24VDC
772-211	(2) 4-20 mA	90-130VAC
772-212	(2) 4-20 mA	200-260VAC
772-214	(2) 4-20 mA	24VDC
772-219*	(2) 4-20 mA	24VDC

9.1.3. Gateway

Part Number	Output	Voltage
774-231	RS-232	90-130VAC
774-232	RS-232	200-260VAC

* See also manual supplement 84350.

CHAPTER 9. MODEL NUMBERS

9.2. PATCH CORDS

9.2.1. Sensor Patch Cords with 8 Pin Female AMP to Tinned Leads

Part Number	Cable Length
1000-53	6” (15.2cm)
1005-77	5’ (1.5m)
1010-77	10’ (3m)
1025-77	25’ (7.6m)
1050-77	50’ (15.2m)
1100-77	100’ (30.5m)
1115-77	150’ (45.6m)
1120-77	200’ (61m)
1130-77	300’ (91m)

9.2.2. T-NET Local Area Network (LAN) with 4 Pin Female AMP to Tinned Leads

Part Number	Cable Length
1005-78	5’ (1.5m)
1010-78	10’ (3m)
1025-78	25’ (7.6m)
1050-78	50’ (15.2m)
1100-78	100’ (30.4m)

9.2.3. T-NET Local Area Network (LAN) Accessories

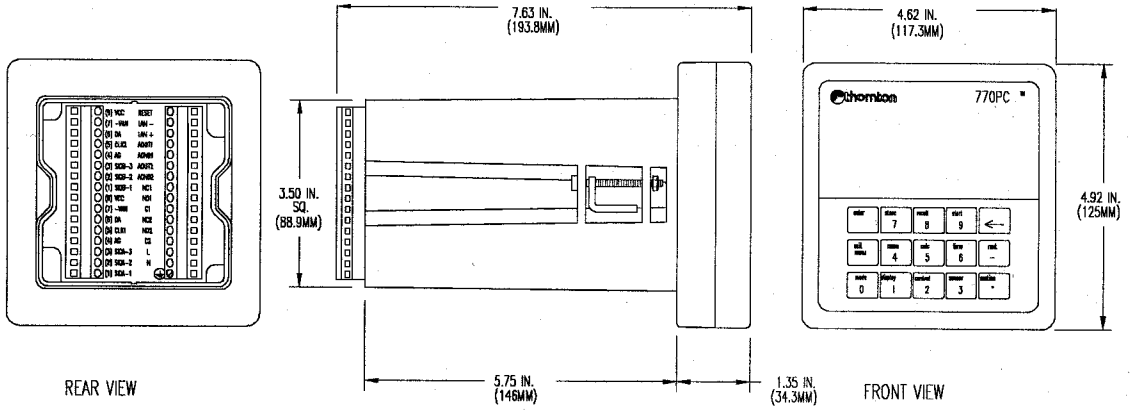
Part Number	Description	Additional Information
1000-55	Network Terminators	4Pin AMP (Set of Two)
1000-54	LAN “Y” Cables	4 Pin male AMP to 4 Pin female AMP to tinned leads

CHAPTER 10. TECHNICAL ILLUSTRATIONS

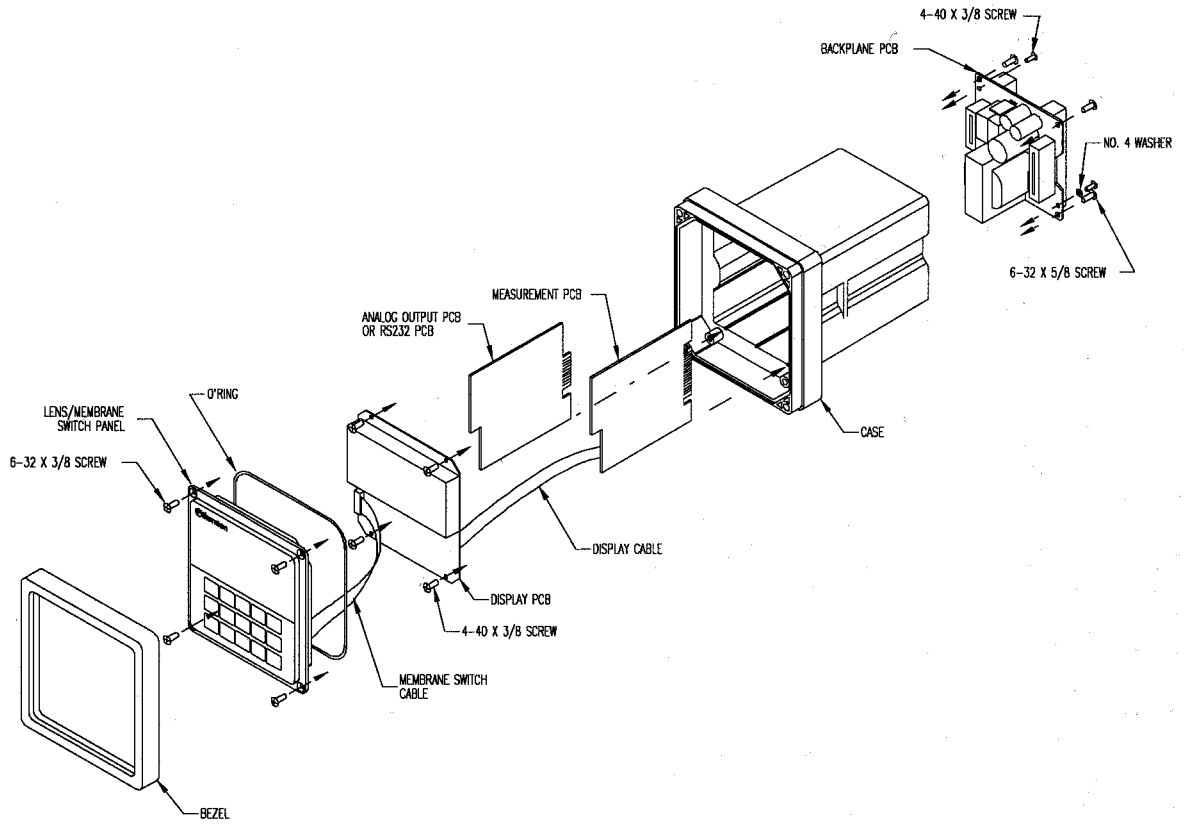
10.0. TECHNICAL ILLUSTRATIONS

The following illustrations are added to improve the user's understanding of this manual.

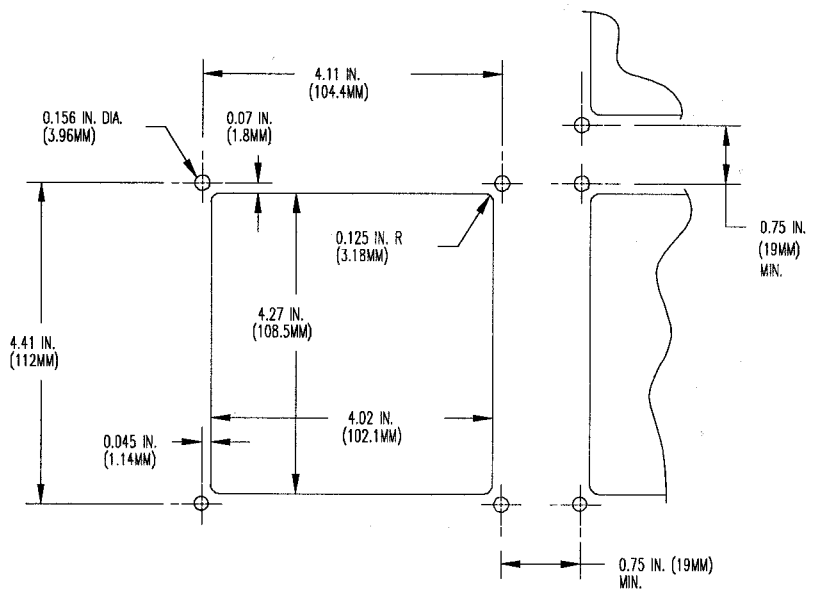
10.1. 770PC OVERALL DIMENSIONS



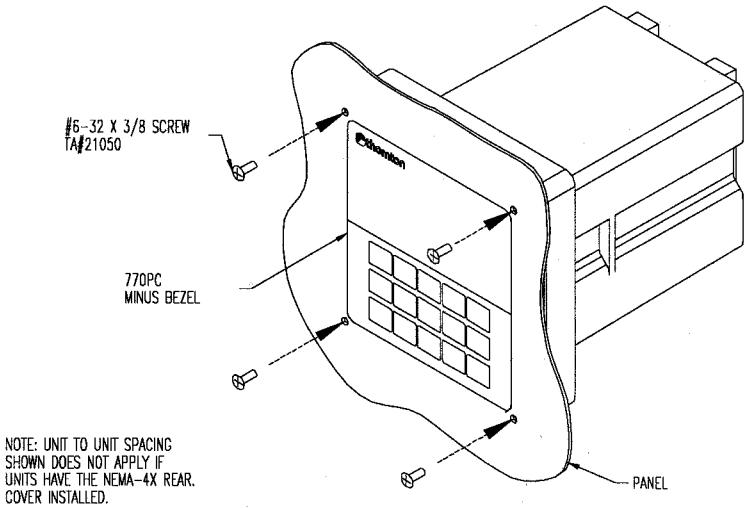
10.2. 770PC EXPLODED ASSEMBLY



10.3. REAR MOUNTING

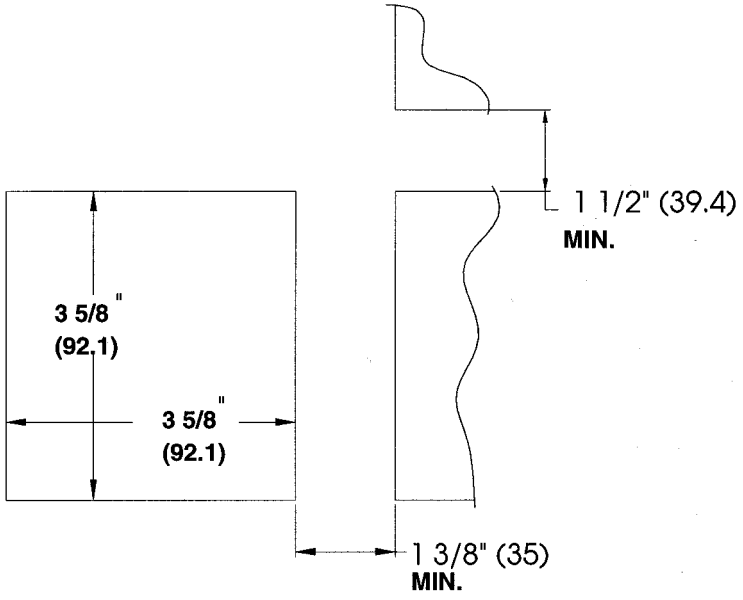


INSTALLATION

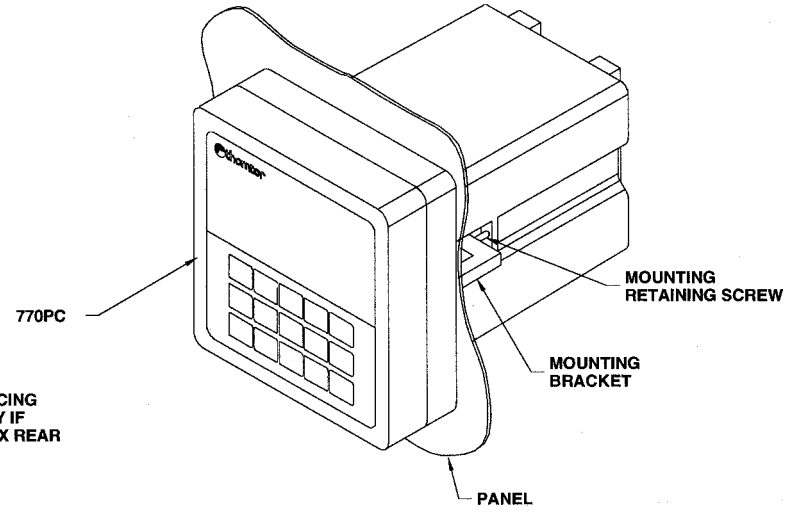


NOTE: UNIT TO UNIT SPACING SHOWN DOES NOT APPLY IF UNITS HAVE THE NEMA-4X REAR. COVER INSTALLED.

10.4. FRONT MOUNTING 1/4 DIN

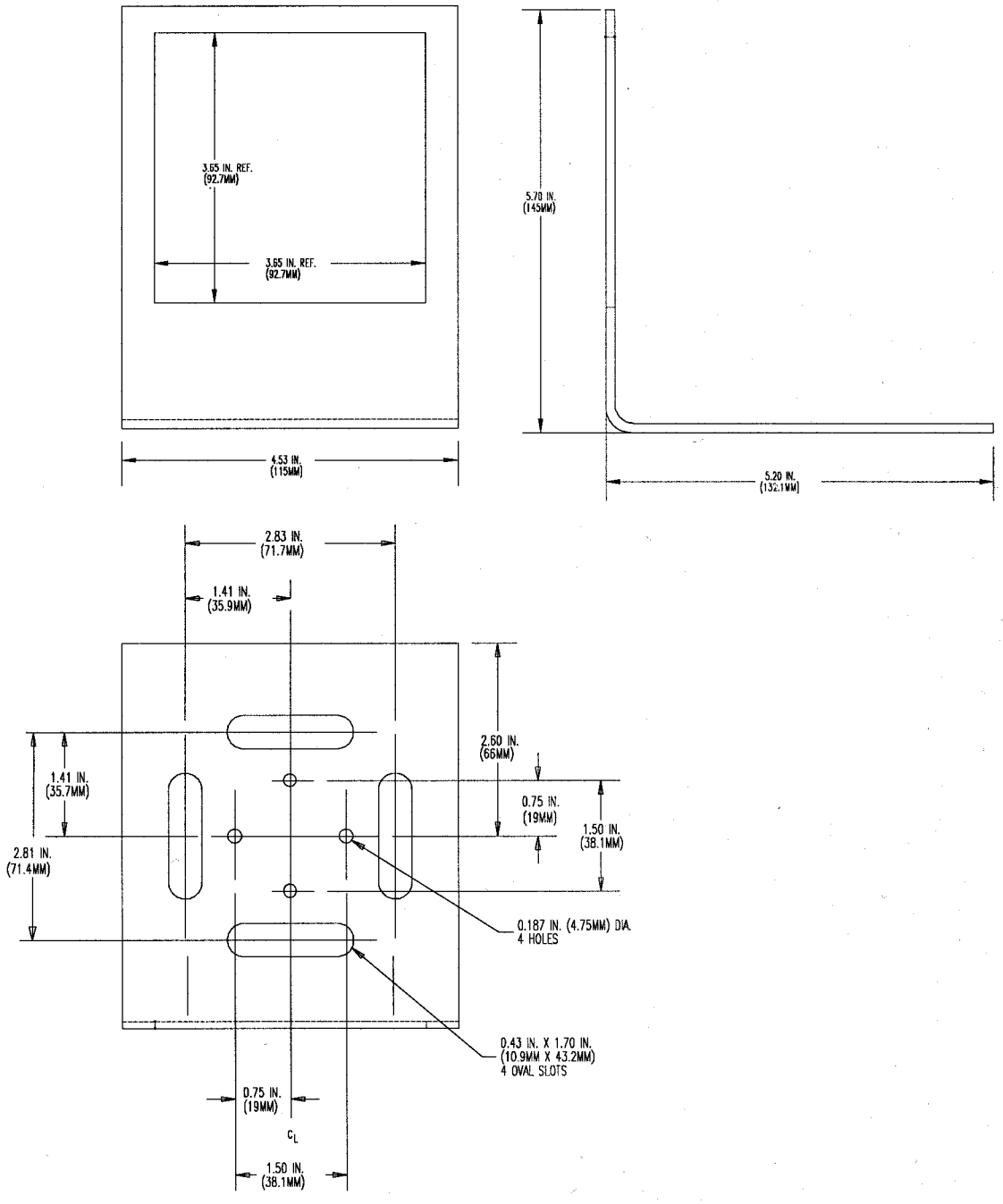


INSTALLATION

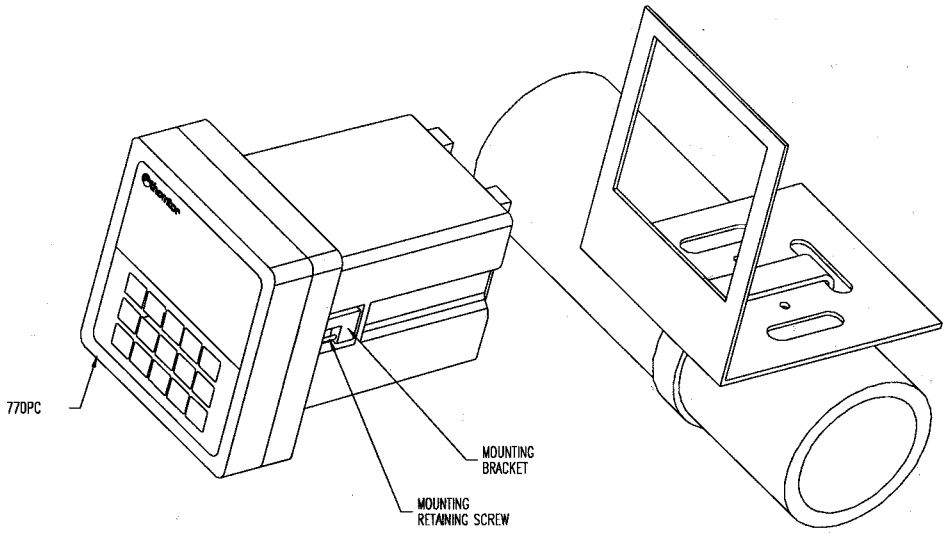


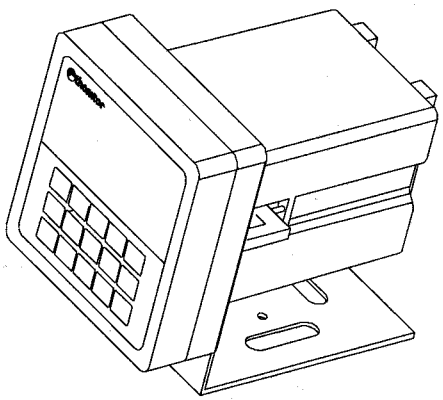
NOTE: UNIT TO UNIT SPACING SHOWN DOES NOT APPLY IF UNITS HAVE THE NEMA-4X REAR COVER INSTALLED.

10.5. PIPE/WALL MOUNTING BRACKET DIMENSIONS

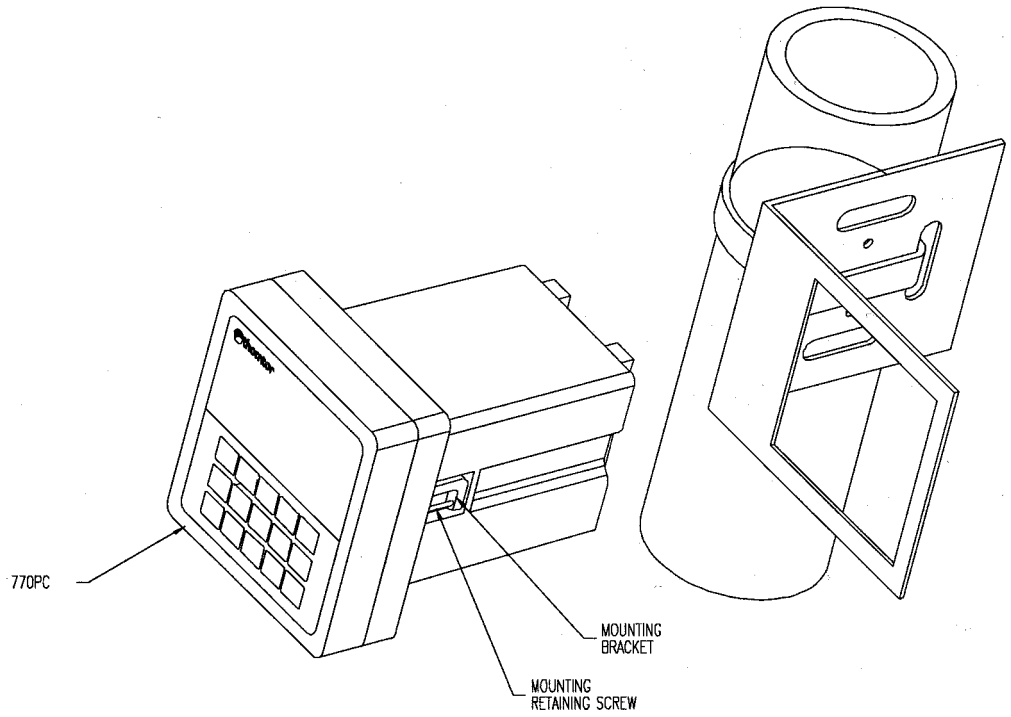


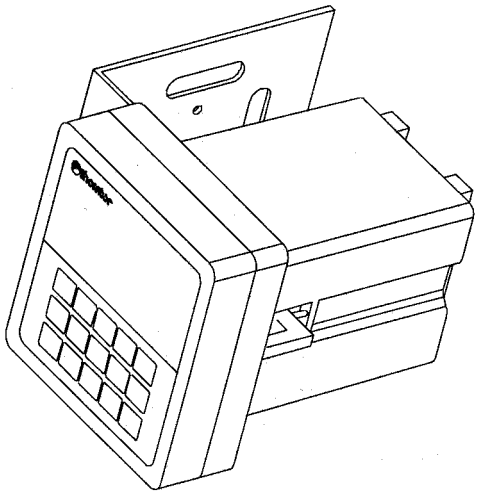
10.6. PIPE/WALL MOUNTING



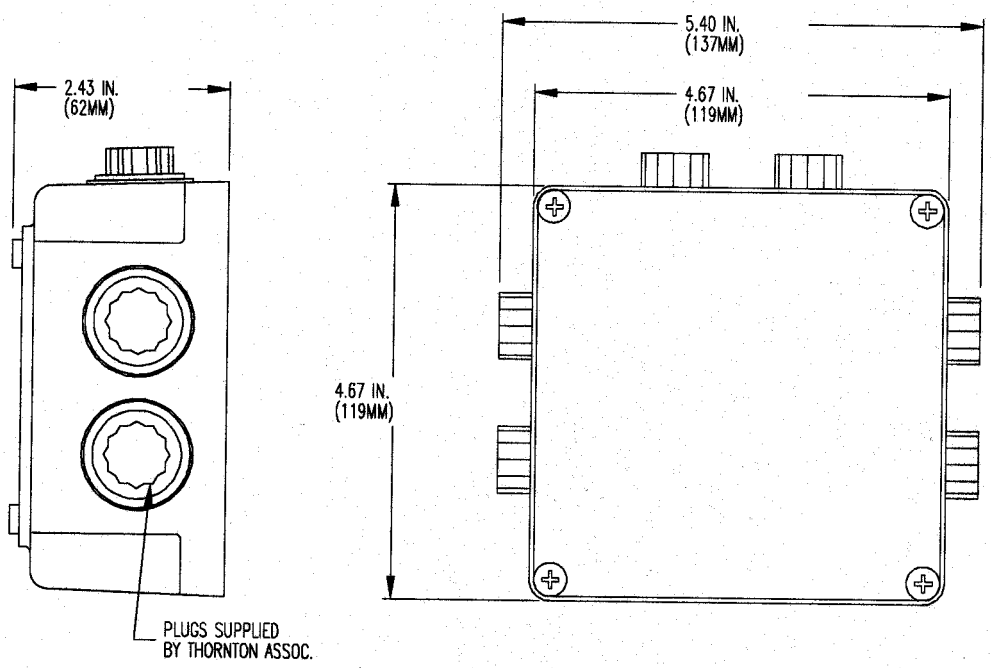


10.7. PIPE/WALL MOUNTING

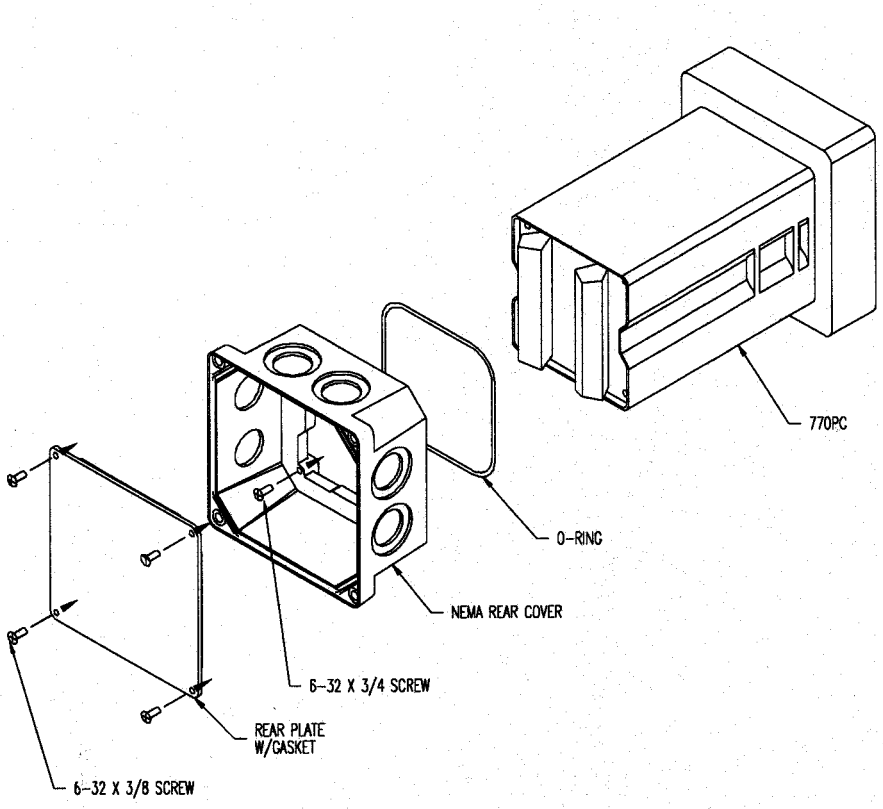




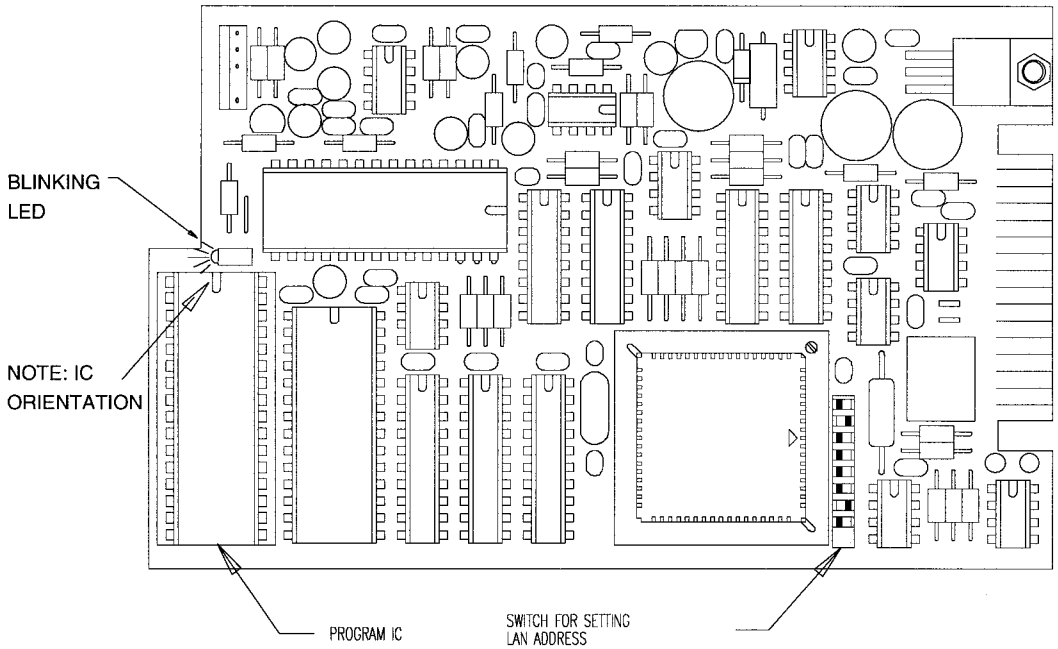
10.8. NEMA 4X REAR COVER DIMENSIONS



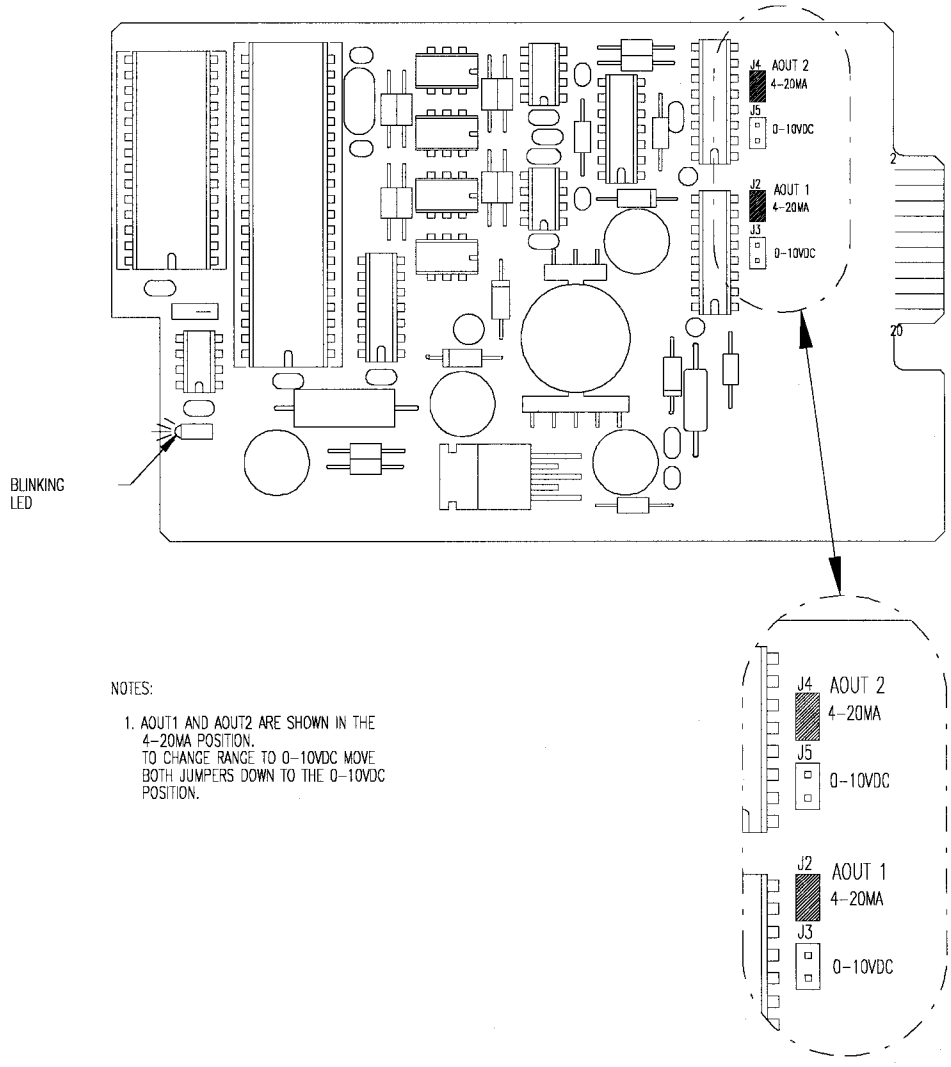
10.9. NEMA 4X REAR COVER EXPLODED ASSEMBLY



10.10. 770PC MEASUREMENT CIRCUIT BOARD



10.11. 770PC ANALOG OUTPUT CONVERSION

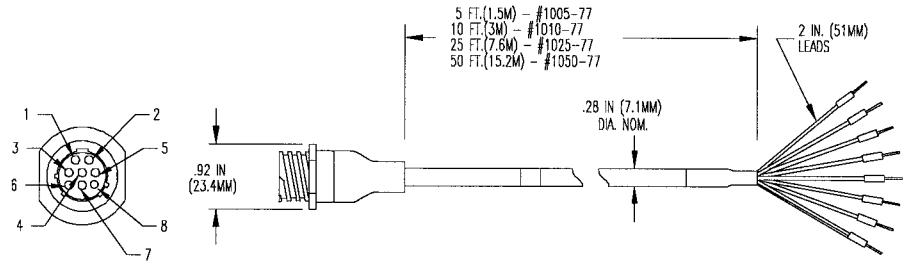


NOTES:

1. AOUT1 AND AOUT2 ARE SHOWN IN THE 4-20MA POSITION. TO CHANGE RANGE TO 0-10VDC MOVE BOTH JUMPERS DOWN TO THE 0-10VDC POSITION.

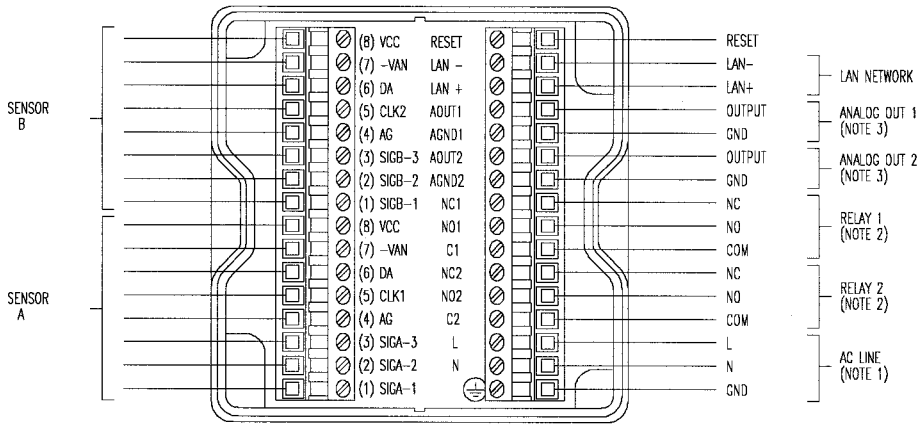
10.12. PATCH CORD WIRING

SENSOR PATCH CORD



(REF.) CONNECTOR PIN #	WIRE COLOR	WIRE NUMBER	SENSOR WIRING TO 770PC TERMINAL STRIP
1	BROWN	8	VCC
2	RED	7	-VAN
7	BLACK	6	DA
5	GREEN	5	CLK
3	ORANGE/DRAIN	4	AG
8	WHITE	3	SIG-3
4	YELLOW	2	SIG-2
6	BLUE	1	SIG-1

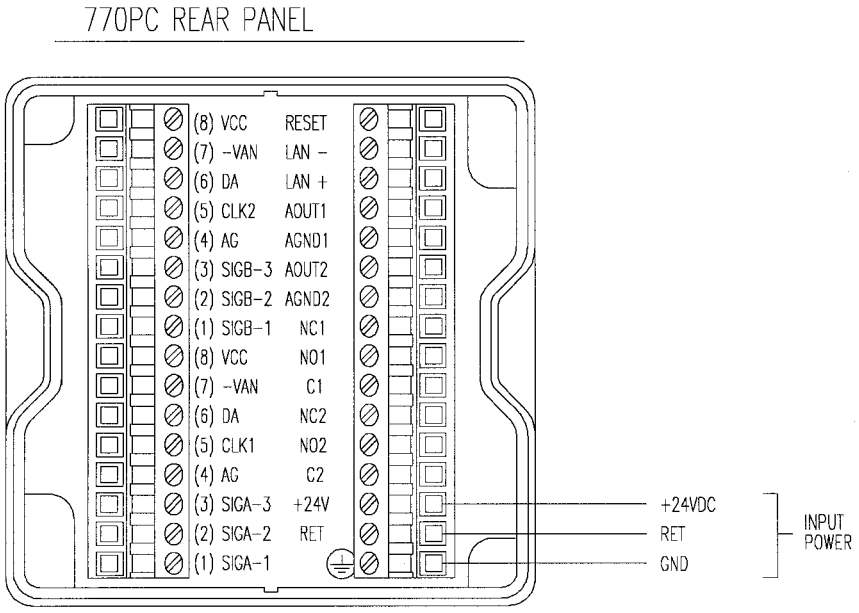
770PC REAR PANEL



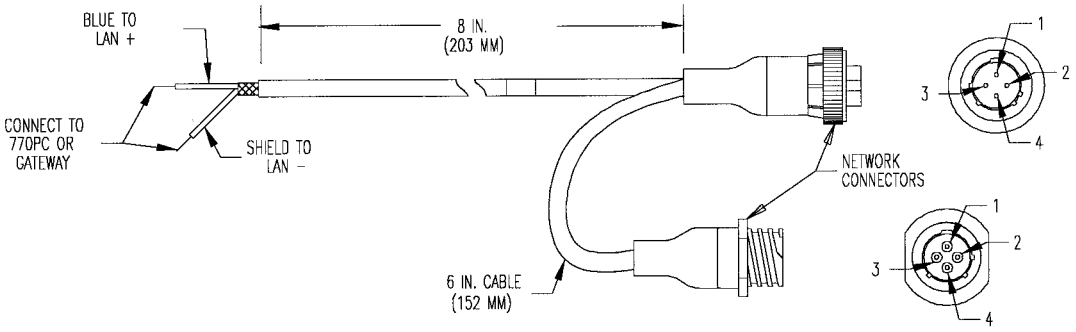
NOTES:

1. AC INPUT (FACTORY SET):
   120VAC, 50-60Hz OR 220VAC, 50-60Hz
2. RELAY CONTACTS MAX POWER:
   5A RESISTIVE LOAD AT 250VAC.
3. RECOMMENDED WIRE SIZE: 22-24AWG.

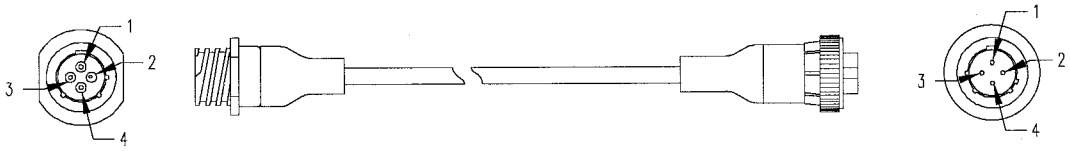
10.13. REAR PANEL: 24 VOLT UNITS



10.14. LAN CABLES AND TERMINATORS

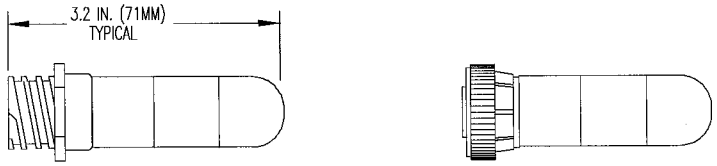


LAN NETWORK CABLE

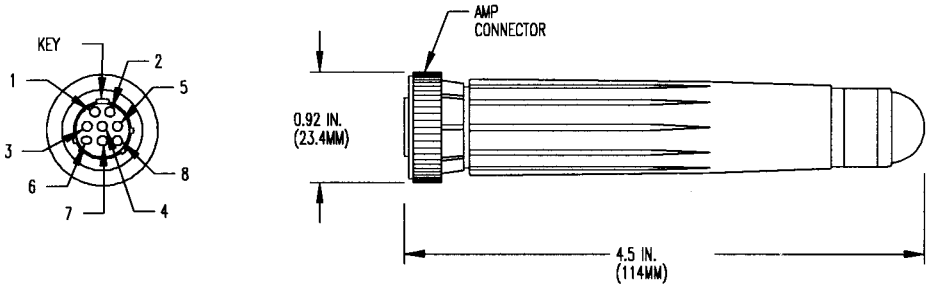


NETWORK TERMINATOR SET

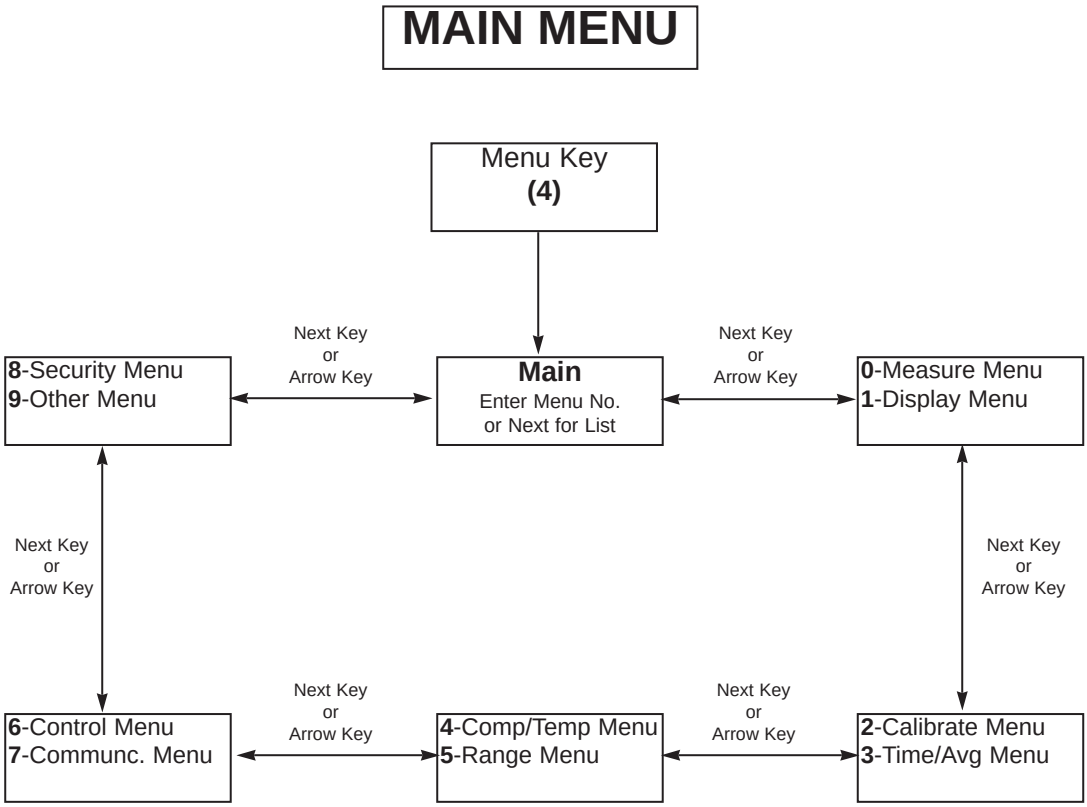
#1000-55



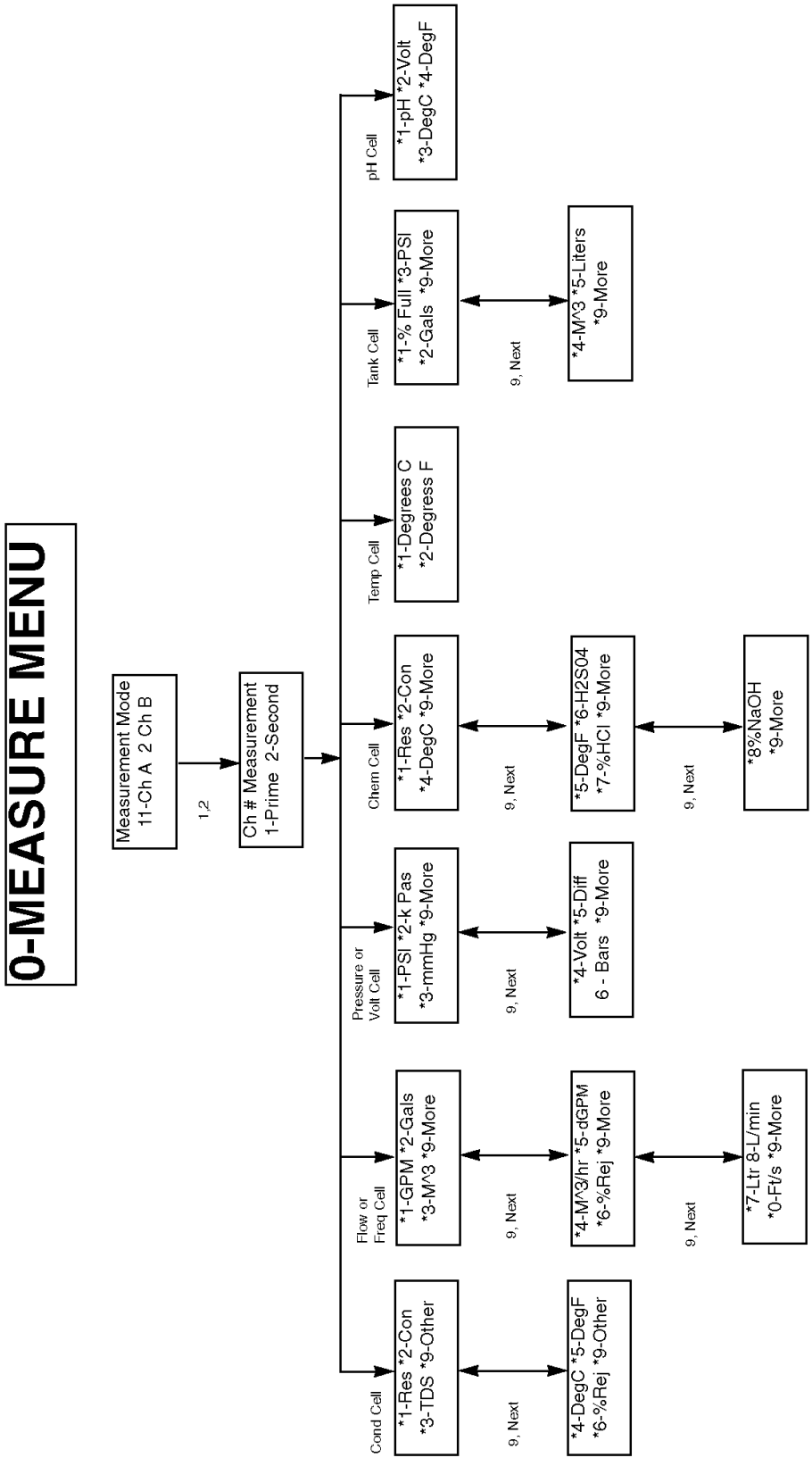
10.15. SMART SENSOR CABLIBRATORS



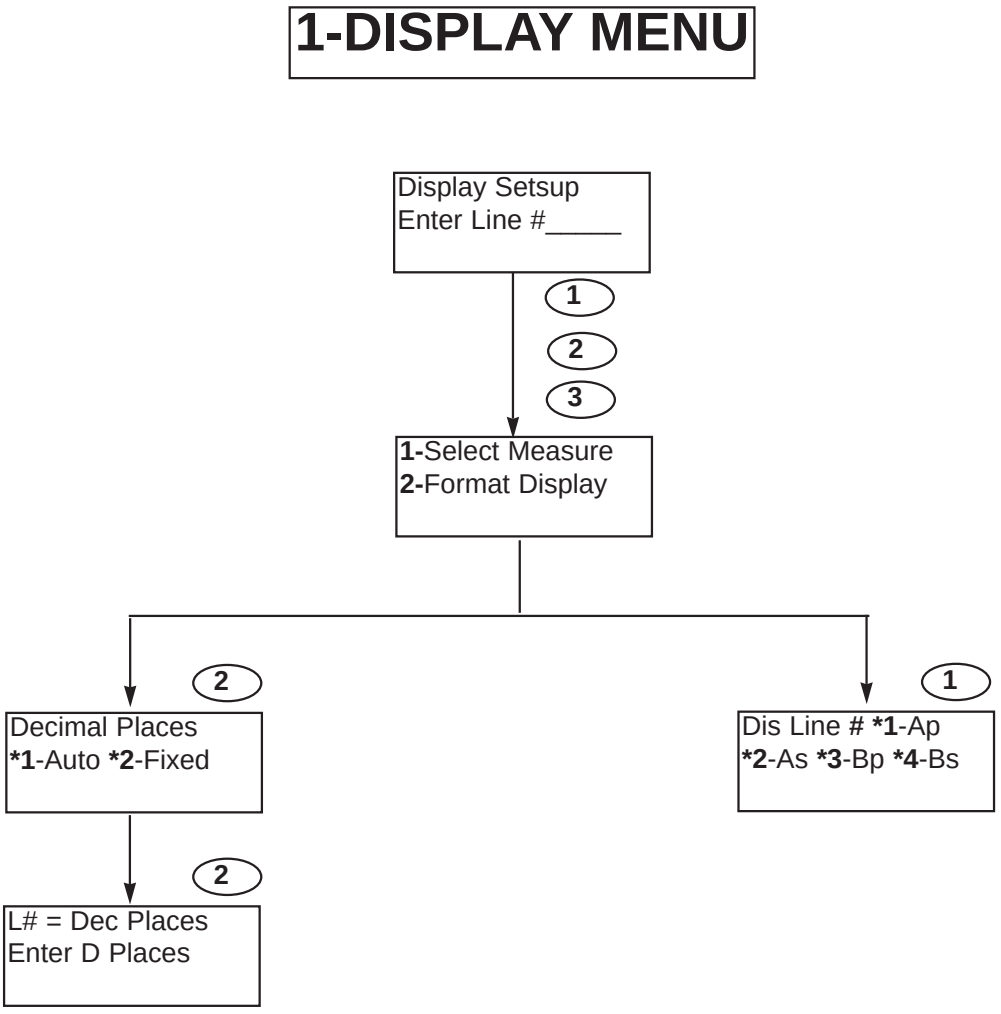
10.16. 770PC SOFTWARE MENU TREE - MAIN MENU



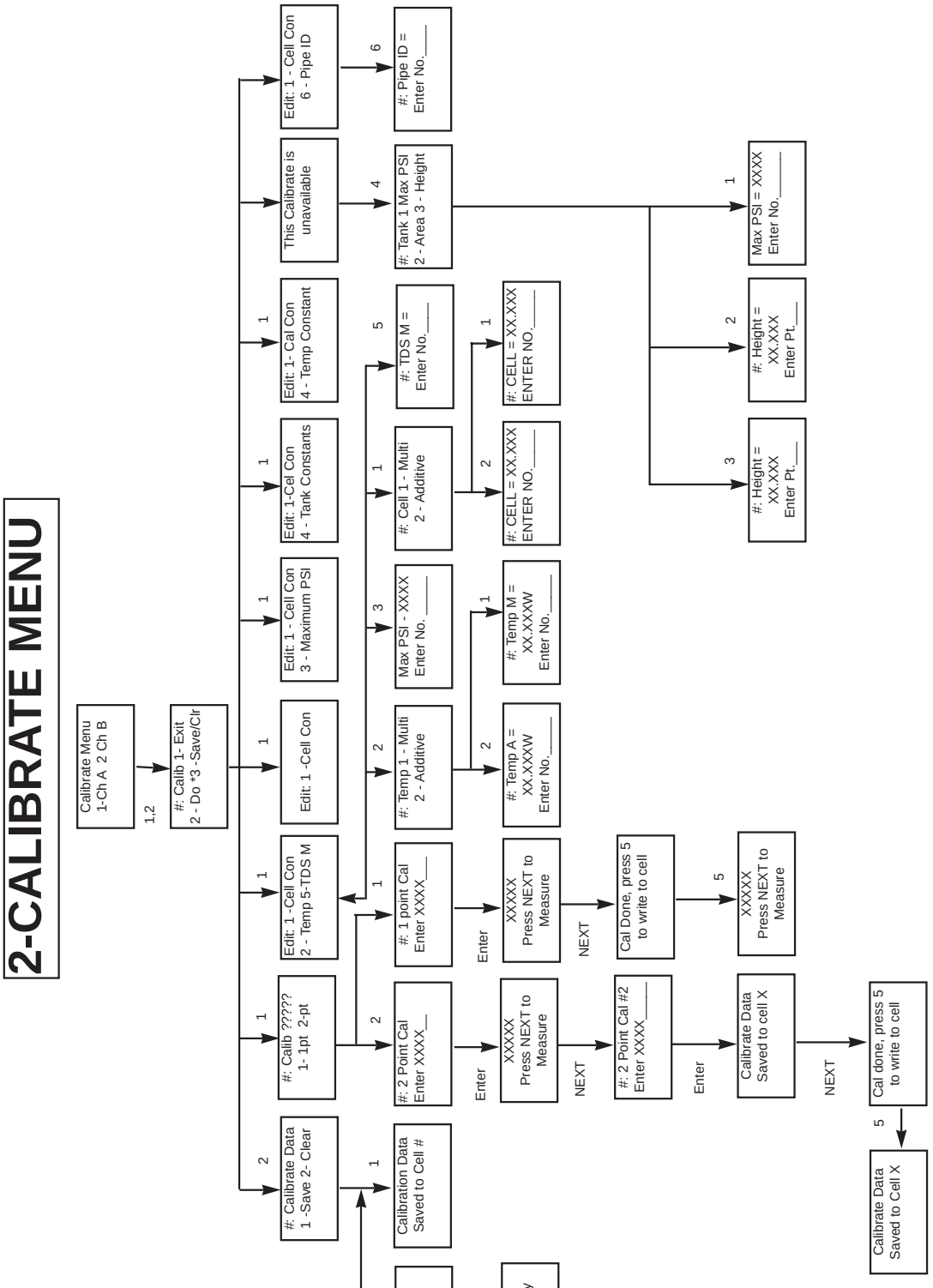
10.17. 770PC SOFTWARE MENU TREE: MEASURE MENU



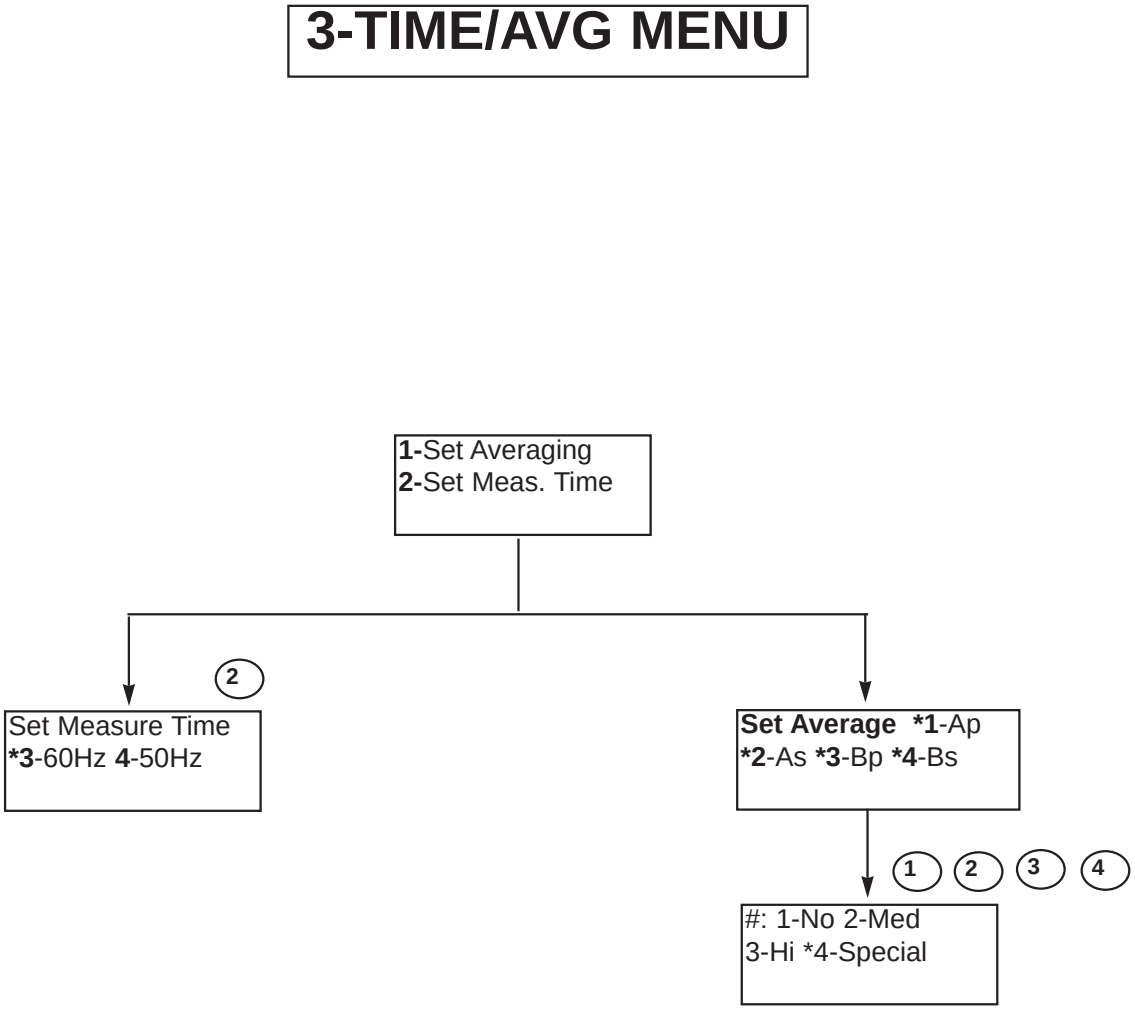
10.18. 770PC SOFTWARE MENU TREE - DISPLAY MENU



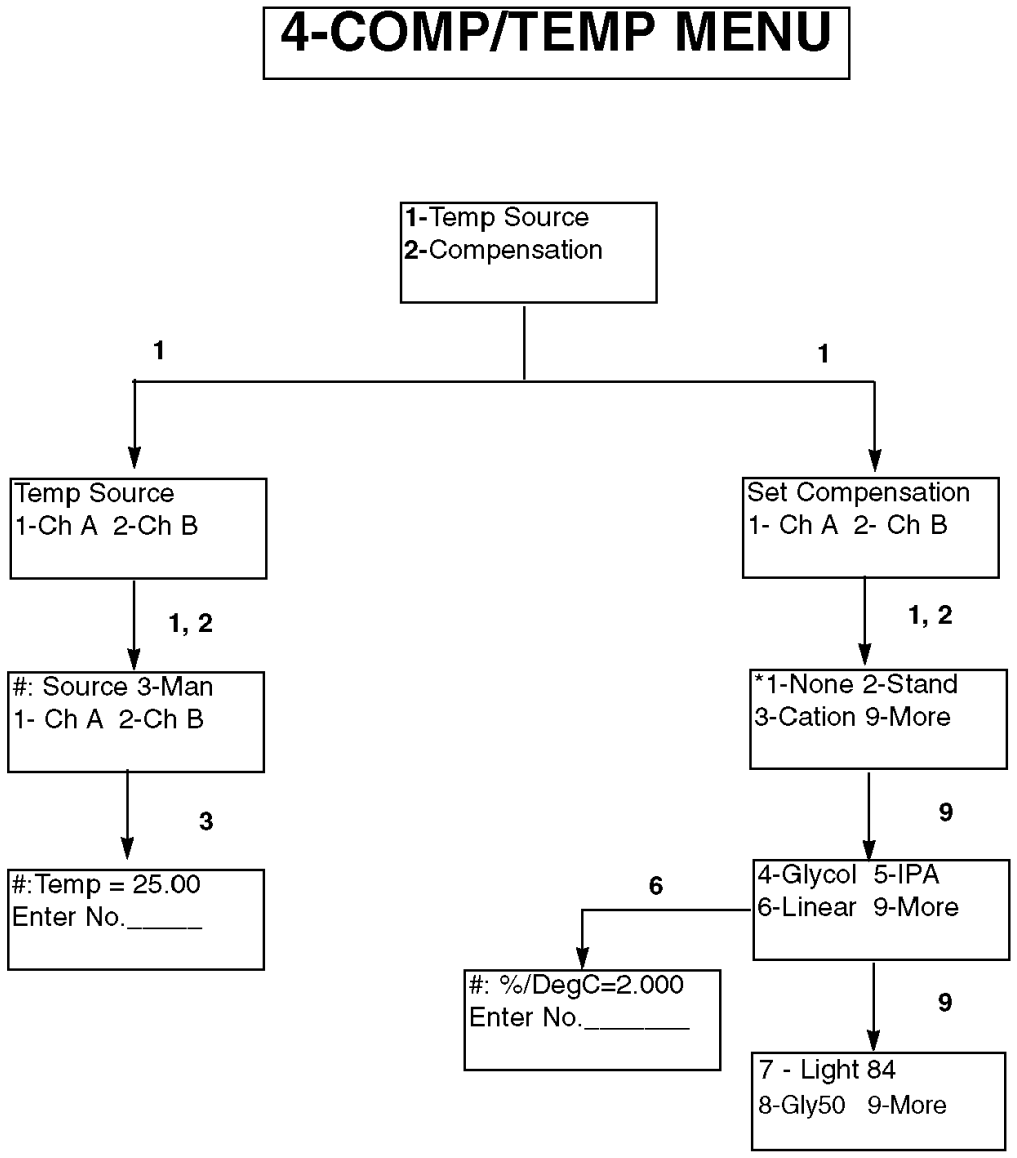
10.19. 770PC SOFTWARE MENU TREE: CALIBRATE MENU



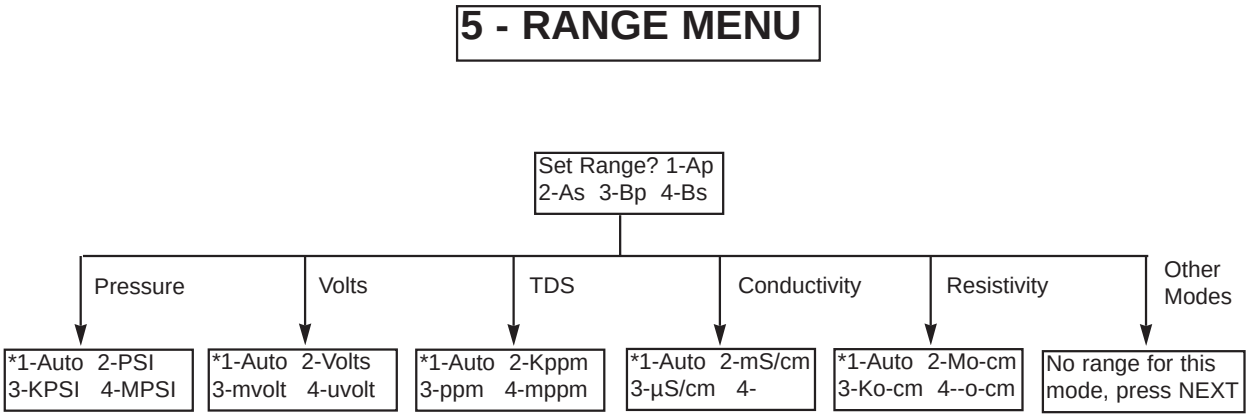
10.20. 770PC SOFTWARE MENU TREE - TIME/AVG MENU



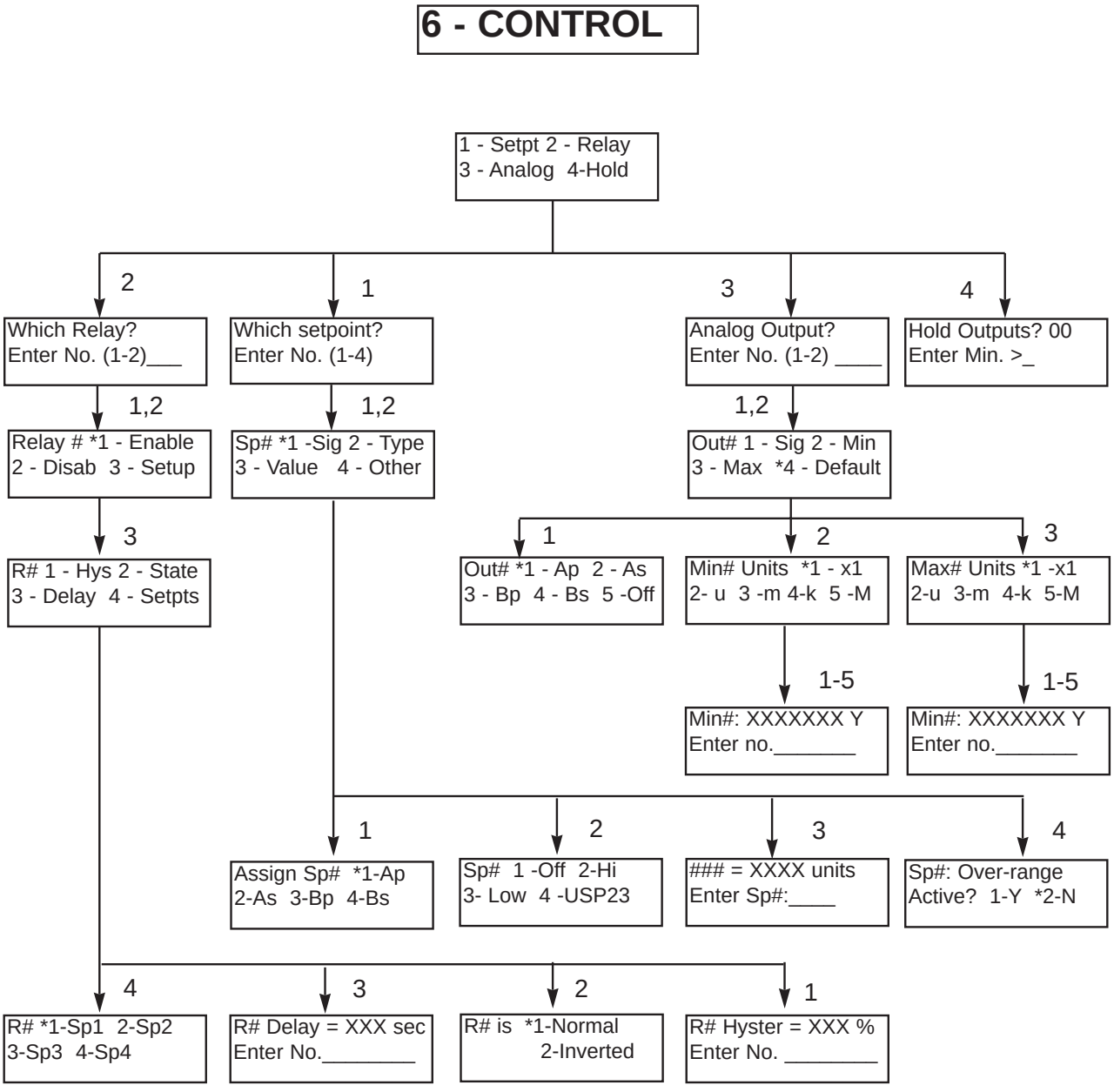
10.21. 770PC SOFTWARE MENU TREE - COMP/TEMP MENU



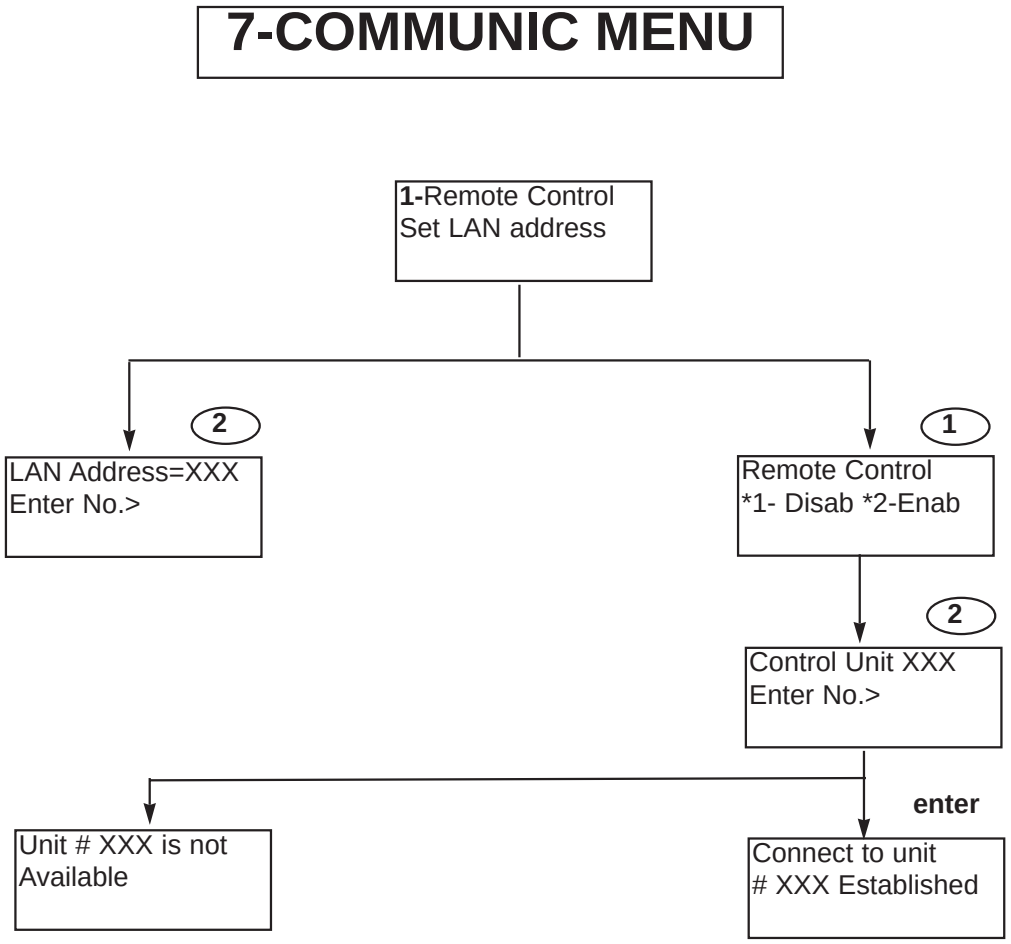
10.22. 770PC SOFTWARE MENU - RANGE MENU



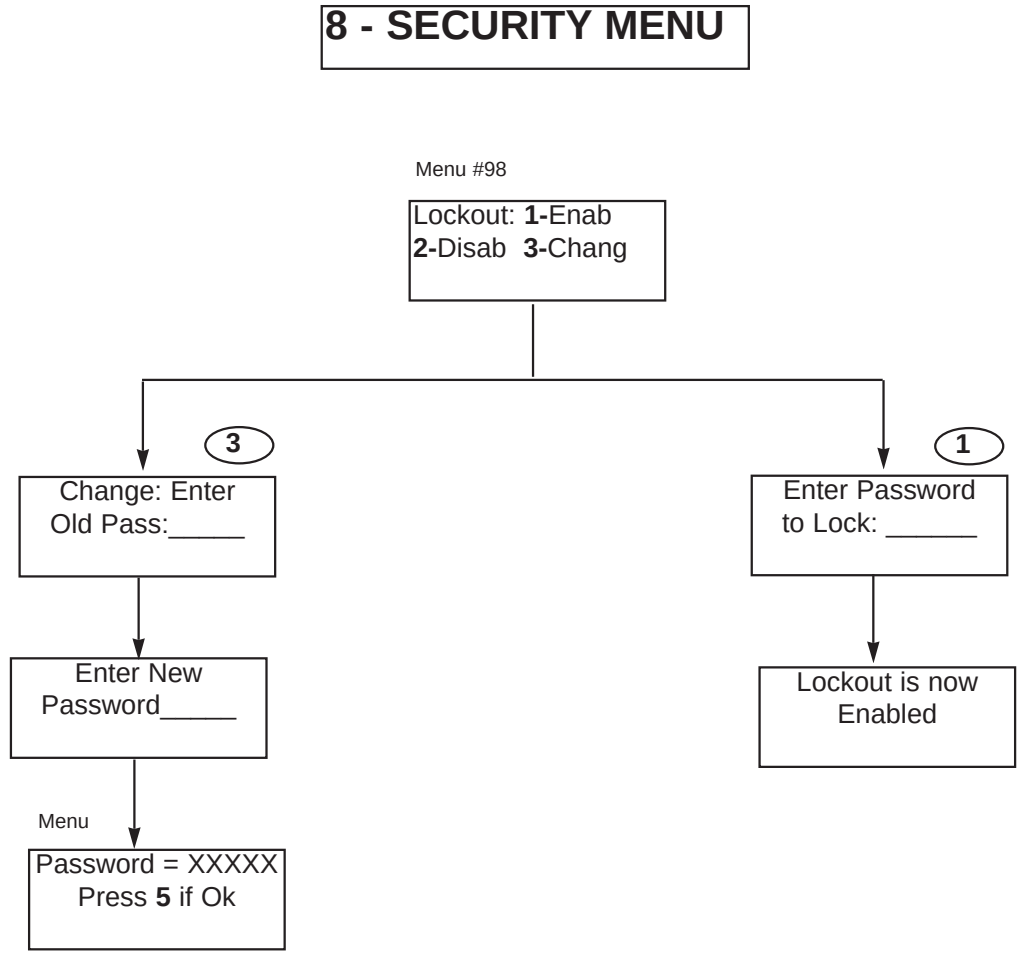
10.23. 770PC SOFTWARE MENU TREE - CONTROL MENU



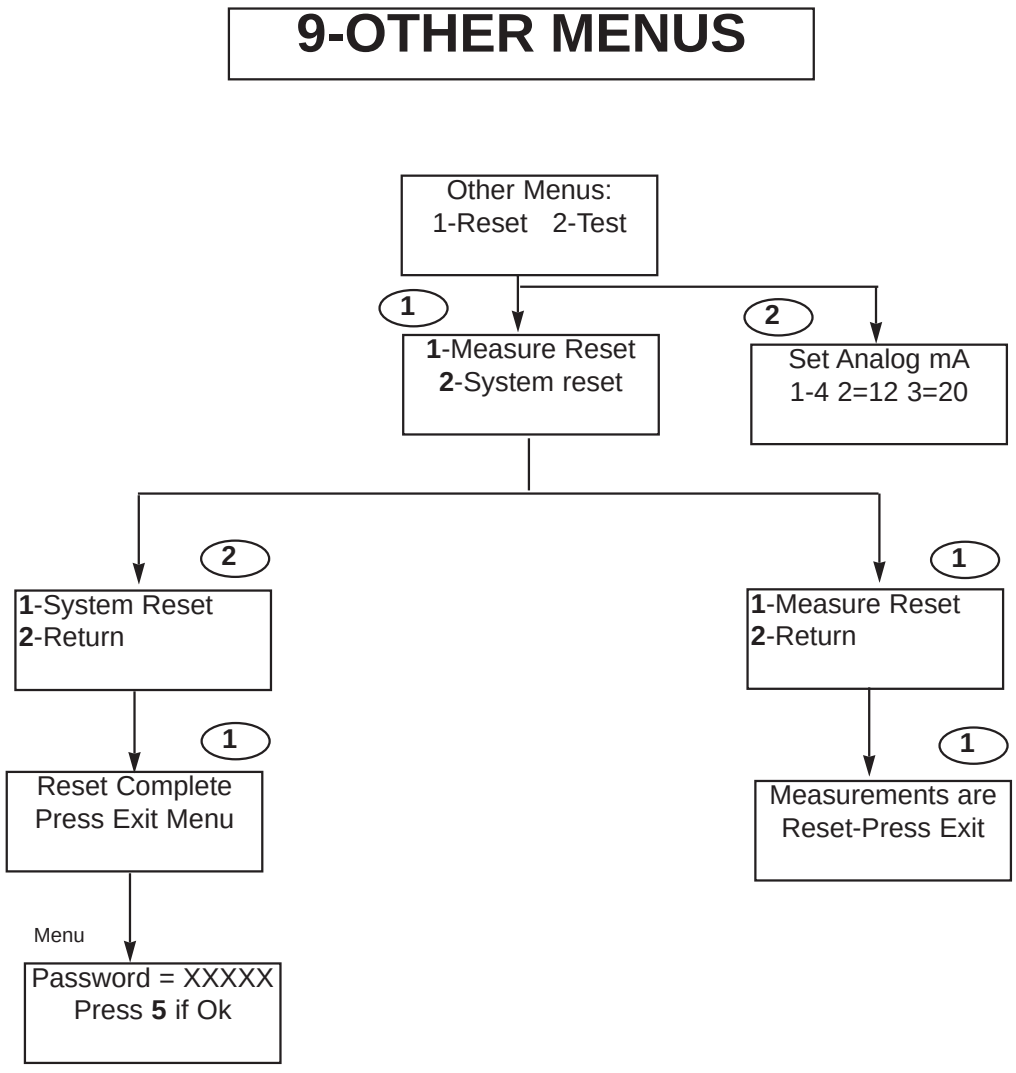
10.24. 770PC SOFTWARE MENU TREE - COMMUNIC MENU



10.25. 770PC SOFTWARE MENU TREE - SECURITY MENUS



10.26. 770PC SOFTWARE MENU TREE - OTHER MENUS



WARRANTY

Thornton Associates warrants products it manufactures against defects in materials or workmanship for one year from start-up or 18 months from the date of shipment from Thornton, whichever is sooner. Warranties do not apply to limited life components such as batteries. Some non-Thornton manufactured resale items may have shorter warranties than one year. Thornton honors only the warranty period of the original manufacturer. Catalog descriptions, although accurate, should not be taken as a guarantee or warranty. Thornton's obligation under the warranty shall be to repair at its facility or replace any products which Thornton finds to be defective. Items returned for warranty must be properly packaged, shipped prepaid and insured, and must be accompanied by the Return Authorization Number described below.

Returned Goods: Please contact us for a Return Authorization Number before any item is returned. Items returned for credit or exchange must be in salable condition. Items returned after 30 days from date of invoice, will be subject to a 10% rehandling charge.

Note: Substitution or modification of cables voids all warranties.

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