INSTRUCTION MANUAL

CHEMTROL® COMMERCIAL WATER CHEMISTRY CONTROLLERS

MODEL _____

S/N_____

WARRANTY

This CHEMTROL® Controller is warranted by SANTA BARBARA CONTROL SYSTEMS (SBCS) to be free from defects in manufacturing and workmanship for a period of FIVE (5) YEARS from the date of purchase for the printed circuit boards and ONE (1) YEAR for all other components. SBCS will repair or replace at its option any defective part during the warranty period. Labor, shipping or incidental expenses are specifically excluded from this warranty. For warranty coverage, defective parts should be returned immediately to your CHEMTROL® Dealer or to our factory postpaid with a copy of your purchase receipt and a description of the malfunction.

TECHNICAL SUPPORT	
US/CANADA	***800-621-2279***
OTHER COUNTRIES	***805-683-8833***
AUSTRALIA	***1-300-585-820***

Chemtrol®
Leader in Chemical Automation Since 1976

IMPORTANT SAFETY INSTRUCTIONS

Specified by ITS Testing Services for Swimming Pools and Spas

1. READ AND FOLLOW ALL INSTRUCTIONS

2. WARNING - To reduce the risk of injury, do not permit children to use this product unless they are closely supervised at all times.

3. A wire connector is provided on this unit to connect a minimum No. 8 AWG solid copper conductor between this unit and any metal equipment, metal enclosures or electrical equipment, metal water pipe or conduit within 5 feet of this unit.

4. DANGER - Risk of injury.
   a) Replace damaged cord immediately.
   b) Do not bury cord.
   c) Connect to a grounded, grounding type receptacle only.

5. WARNING - This product must be connected to a power source equipped with a ground-fault circuit interrupter (GFCI). The GFCI must be tested before each use. With the product operating, open the service door. If the product stops operating, this merely indicates that the door is equipped with an electrical interlock. Next, push the test button on the GFCI and close the service door. The product should not operate. Now open the service door, push the reset button on the GFCI and close the service door. The product should now operate normally. If the product fails to operate in this manner, there is a ground current flowing indicating the possibility of an electric shock. Disconnect the power until the fault has been identified and corrected.

6. DANGER - Risk of electric shock. Install at least 5 feet (1.5 m) from inside wall of any open body of water.

7. DANGER - Risk of electric shock. Do not permit any electric appliance, such as a light, telephone, radio, or television, within 5 feet (1.5 m) of an open body of water.

8. SAVE THESE INSTRUCTIONS

TABLE OF CONTENTS

CHAPTER I - INTRODUCTION

CHEMTROL® AUTOMATION

Congratulations on your selection of a CHEMTROL® **CT Controller** Programmable Controller for your water treatment facility.

CHEMTROL® Automation uses the most advanced electronic sensing technology to monitor and control the critical parameters for water treatment, i.e. conductivity, pH, Oxidation-Reduction Potential (ORP) and temperature. Also available is monitoring of flow rates for make-up and bleed water and influent/effluent filter pressures.

This Instruction Manual covers the following models:

- CHEMTROL® **CT110** with conductivity/**TDS** control, pH control option, ORP control option, Temperature monitoring, fill and bleed water flow programs, and three additives **programs**.

- CHEMTROL® **CT3000** with Conductivity/**TDS** control, pH control, optional ORP control, Temperature monitoring, fill and bleed water flow programs, and four additives programs.

- CHEMTROL® **CT6000** with Conductivity/**TDS** control, pH control, ORP control, Temperature monitoring, fill and bleed water flow programs, four additives programs, water level program, influent and effluent filter pressures, and automatic filter backwash.

Webserver remote operation is available on all models.

Use the appropriate sections in the manual for each model.

Water Maintenance

The primary purpose of water treatment is protection of the equipment from the aggressiveness of water and prevention of bacteriological growth.

The guidelines for **Commercial water chemistry controllers** include the following:

- Conductivity typically below 5,000 µS/cm - corresponding to Total Dissolved Solids (TDS) of less than 2,500 ppm (mg/l) - to prevent precipitation of dissolved salts and corrosion products,
- pH between 7.0 and 9.0, depending on chemical treatment, to prevent scaling or corrosion,
- Oxidation-Reduction Potential (ORP) above 650 mV to prevent algae growth and growth of bacteria, such as Pseudomonas, E. Coli, etc.,
- proper water balance with Langelier Saturation Index values between 0 and 0.3 for untreated waters, or up to 2.0 - for waters treated with phosphonates and/or polyacrylates,
- adequate filtration with a maximum turnover rate of six hours.

Reference Manuals

For more information on water treatment, see the Maintenance section in this Instruction Manual or refer to one of the following reference manuals:

- "***The NALCO Water Handbook***"
  Frank N. Kremmer, R.R. Donnelley & Sons Co.

- "***Water Treatment - Industrial, Commercial and Municipal***"
  D.C. Brandvold, DCB Enterprises, Inc.

- "***The Chemical Treatment of Commercial water chemistry controllers*** "
  James W. McCoy, Chemical Publishing.

- "**INDUSTRIAL W**ater Chemistry and Treatments, **CTI.**

Table I - TYPICAL TREATMENT VALUES

TYPICAL WATER TREATMENT FOR CHEMTROL water chemistry controllers			
TEST	**MIN**	**IDEAL**	**MAX**
CONDUCTIVITY, µS/cm			5,000
TDS, ppm			2,500
pH	7.0	8.5	9.0
ORP, mV	650	750	
LANGELIER SATURATION INDEX	0.0		2.0

CONTROLLER FEATURES

Integrated Water Treatment

Professional water treatment for **Commercial water chemistry controllers,** and other industrial applications requires the use of separate chemical and physical processes to remove undesirable and harmful components.

The CHEMTROL® **CT Controller** is an advanced controller that integrates all the different processes for complete water treatment. Designed around a sophisticated microprocessor with a large computer-like LCD (Liquid Crystal Display) screen, it displays full-size menus and submenus, making it easy to use and understand. All displays and adjustments are accessible from menu screens that are laid out in a logical and intuitive order. They can in fact be used without reference to the instruction manual.

All sensing devices are connected to the controller. This makes it possible to monitor the status of all operational parameters at a glance. Also, in case of malfunction or alarm, the operator is immediately alerted.

All control outputs are also connected to the single control panel which makes installation and maintenance much easier than with separate control units.

The central microprocessor manages all monitoring and control functions, including control of the recirculation pump, chemical additions, water balance and filter backwash.

Control Functions

The following display and control functions are available on the CHEMTROL® **CT Controller**:

- **Conductivity** in microsiemens/cm or as **Total Dissolved Solids** (TDS) in ppm or mg/l with programmable bleed,
- **Makeup Conductivity (CT112 only)** in microsiemens or as Total Dissolved Solids (MTDS) in ppm or mg/l, with programmable cycles of concentration
- **Temperature** display in degrees Fahrenheit or Celsius,
- **pH** from 0 to 14 with capability for programmable acid and base feed,
- **Oxidation-Reduction Potential (ORP or Redox)** in millivolts with programmable oxidizer feed, superoxidation and chemical savings program,
- **Sanitizer Concentration** in parts per million (PPM) or miligrams per liter (mg/l) with programmable sanitizer feed, superchlorination, and chemical savings program. This is available for Chlorine, Bromine, Chlorine Dioxide, and Peracetic Acid.
- **Water Flow** with display of the flowrates for make-up/fill and bleed water in gallons per minute (gpm) or liters per minute (l/m), cumulative flows in gallons (ga) or liters (l),
- **Filtration** with display of inlet and outlet pressures and programmable filter backwashing based on choice of time, inlet pressure, pressure differential or combinations of the above.
- **Additive Feed** for inhibitors, biocides, descalers, etc. - with choice of feed programs: manual, automatic (bleed & feed or bleed-then-feed), cycle timer, percent of flow, daily schedule or 2-week schedule controls with bleed and feed lockout, pre-bleed and pre-pH functions.
- **Water Balance** and **Saturation Condition** derived from the **Langelier Saturation Index** and showing water balance conditions as either OK, corrosive or scaling.

In addition, a 24-hour clock/calendar shows the date and time on the main screen. For other models that do not include all the functions listed above, only the applicable screens and menus are displayed.

Probe Failure Analysis

The CHEMTROL® **CT Controller** introduces a new proprietary technology (US Patent No. 6,657,546) called Probe Failure Analysis.

Conventional controllers detect probe failure by waiting for an alarm condition to develop. The CHEMTROL® **CT Controller** features dynamic testing of the response of the ORP and pH sensors.

This makes it possible for the controller to detect a probe failure immediately after the sensor fails to respond properly, therefore avoiding dangerous out-of-range conditions.

Remote Communications

The CHEMTROL® **CT Controller** features complete communication remote access by Ethernet connection using Webserver interface, which gives you access through any web-capable device; or PC-compatible software under Windows®. This type of communication provides the following capabilities:

- remote operation of controller with exact duplication of the LCD screen display and full access to all the menus and submenus,
- voice telephone report of test data,
- remote operational control,
- alarm callouts to a number of different pre-selected telephone numbers through text; or to a number of email addresses.
- automatic scanning of multiple facilities with programmable download and storage of test data on remote computer.

The Chemtrol® **CT Controller** units can also be made to communicate to Energy Management Systems (EMS) or Building Automation Systems (BMS) through different protocl sets. Currently, the Chemtrol® **CT Controllers** can communicate through Modbus, Lonworks, N2Bus, Bacnet MSTP and Bacnet TCP/IP systems.

Remote Operation

Unlike controllers that provide only a simulated representation of the display screen, the CHEMTROL® **CT Controller** features true remote duplication of the controller screen.

This means that any change on the CHEMTROL® **CT Controller** screen is immediately reproduced on the remote computer screen. And vice versa, any operation that is performed on the remote computer is reproduced immediately on the controller.

The same commands are available on both units. This allows instant verification and adjustment of all control parameters. Changes in parameter settings are subject to password verification to prevent unauthorized access.

Figure 1 - Control Panel of CT6000

CONTROL PANEL

LCD Display Screen

The operator operates the controller with the control panel, as shown in Figure 1 for the **CT6000**, CT3000 and CT1000. It features an LCD display screen with eight lines of text for menus and submenus and a 16-key data entry keyboard.

The LCD display shows "normal" characters (white on blue), reverse characters (blue on white) to highlight selected options, or flashing characters for alarm conditions.

The brightness of the LCD display screen can be adjusted with the potentiometer inside the cabinet on the Mother Board. It is located near the battery (R85 for all models). See the schematics in Chapter IV - Installation.

The LCD display screen features backlight illumination for better viewing at night and in dark areas. The backlight stays on as long as the unit is on.

Display Readings

The Display Screen for the **CT6000** (Figure 1) shows all the operating features at a glance.

Line 1 shows a **Conductivity** reading of 2000 µS/cm with the bleed valve in Automatic (A) mode and currently activated (>).
Line 2 shows a **pH** reading of 8.5 with the Acid feed mode in Automatic (A) and not running (no >).
Line 3 shows an **ORP** reading of 750 mV with the feed pump in the OFF mode (X).
Line 4 shows a **Temperature** reading of 72 F.
Line 5 shows the **Flow Rates** for make-up/fill and bleed waters at 15 and 10 gpm respectively, and the fill valve in Automatic mode (A) and not running (no >).
Line 6 shows the **Influent and Effluent Pressures** at 25 and 20 psi respectively and the backwash program in the Manual mode (M).
Line 7 shows control modes of the four **Additives**: Timer (T) for additive 1, Daily Schedule (S) for additives 2 and 3, Off (X) for additive 4.
Line 8 shows the **Date and Time** and an indication that the **Langelier Saturation Index (LSI)** as OK. The line is highlighted to give access to the Configuration Menu.

Data Entry Keyboard

The keyboard consists of a full 16-key numeric keypad. There are ten digits from “0" to “9" plus the decimal point “.” for data entry.

The operator navigates through all the menus and submenus with the four directional arrow keys: UP, DOWN, LEFT, and RIGHT.

The UP and DOWN ARROW keys move the cursor up and down each screen - with looping capability at both the top and the bottom of the screen. The RIGHT ARROW key is used to enter a submenu. The LEFT ARROW key is used to exit a submenu and return to the previous menu. The LEFT key can be pressed repeatedly from any submenu to return to the main display screen.

The “OK” key is used to save numerical data entry.

PROGRAM MENUS

Welcome Screen

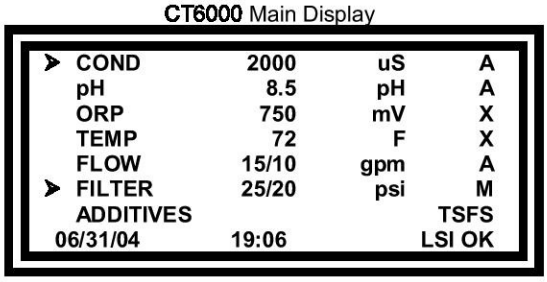
When power is applied to the controller, the CHEMTROL® **CT Controller** displays the Welcome Screen shown above. It shows the version of operating software installed on the controller and the numbers for Technical Support from the factory by phone 805-683-8833 or by fax 805-683-1893. In the USA and Canada, technical support is also available toll-free at 800-621-2279.

Welcome Screen

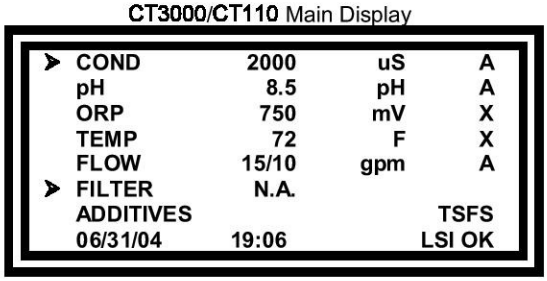
Display Screens

The Welcome Screen is followed by one of the display screens, as shown on the right. The **CT6000**, **CT3000** and **CT110** show 8 lines of display.

CT6000 Main Display



CT3000/CT110 Main Display



The Display Screen is the normal monitoring screen. It displays several lines of information, one for each operating function and one for system conditions.

Each line displays operational information on five columns, from left to right:

1. operational status (ON or OFF) with a small arrow indicating outlet activation,
2. function identification: CONDUCTIVITY, pH, ORP, TEMPERATURE, FLOWS, FILTER, and ADDITIVES,
3. Sensor readings,
4. units of measurement (US or metric),
5. operational mode, represented by a single letter:

A	for automatic control,
M	for manual operation,
T	for cycle timer,
F	for percent of flow,
S	for daily schedule
B	for 2-week schedule,
X	for OFF.

Main Menus and Submenus

As shown on the Menu Tree next page, there are several **Main Menus** that are accessed directly from the Display Screen, one for each operating function and one for system configuration. The **Submenus** are additional menus that are accessed from the main menus or other submenus.

The four arrow keys located on the front panel keypad are used to navigate through the menus. To access a submenu, use the UP and DOWN ARROW keys to highlight the desired line and press the RIGHT ARROW key. To exit from a submenu, press the LEFT ARROW key.

In this chapter, menus and submenus are identified by their line numbers that provide a road map for quick location.

Alarm Displays

Probe failure, out-of-range, overfeed and simulated low chemical level conditions are indicated on the Display Screen and on the Main Menus with flashing characters. For probe failure, the display flashes “Probe” on the corresponding line.

The display flashes for out-of-range, overfeed or simulated low chemical level alarm conditions. To determine the cause of alarm, move down with the DOWN ARROW key and enter the submenu with the RIGHT ARROW key.

Table II - Program Overview

- CONDUCTIVITY
- ACID / BASE
- ORP
- TEMPERATURE
- FLOW RATES
- FILTER
- ADDITIVES
- CONFIGURATION

MAIN MENUS

ORP
- Calibrate
- Setpoint
- Alarm Low
- Alarm High
- Time Limit
- Run Time
- Select Scale

Sanitizer
- Calibrate
- Setpoint
- Alarm Low
- Alarm High
- Time Limit
- Run Time
- Last Shock

pH
- Calibrate
- Setpoint
- Alarm Low
- Alarm High
- Time Limit
- Run Time
- Probe Clean

Conductivity/TDS
- Calibrate
- Setpoint
- Alarm Low
- Alarm High
- Time Limit
- Run Time
- Select Scale

TEMPERATURE
- Calibrate
- Alarm Low
- Alarm High

Flow
- Water Level
- Fill
- Total
- Bleed
- Total
- Tank Menu
- Cormon Menu

Tank
- Tank 1
- Tank 2
- Tank 3
- Tank 4

Corrosion Monitor (Cormon)
- Corrosion
- Imbalance
- Corrosion
- Imbalance

ADDITIVE CONTROLS

CONTROL TYPE
- OFF
- Manual
- Automatic
- Timer
- % of Flow
- Daily Schedule
- 2-Week Schedule

BLEED AND FEED
- Feed %
- Max Time
- Daily Schedule

BLEED LOCKOUT
- Lockout %
- Lock memory
- Pre-bleed
- Pre-bleed
- Pre-pH

DAILY SCHEDULE
- Next date
- Cycle (days)
- Start time
- Run time
- Bleed lockout
- Last date

CALIBRATION OPTIONS
- 1 Point (zero)
- 2 Point (slope)
- 3 Point (curve)

CONFIGURATION

- Initial Setup
- Operations
- Communications

INITIAL SETUP
- Language
- Units
- Code No.
- Clock
- Readings
- Data Logging
- Model Options

OPERATIONS
- Audio Alarms
- Bypass Line
- Saturation Index
- Print Reports
- Reset
- Battery
- Probe Monitor

COMMUNICATIONS
- Unit I.D.
- 4-20 mA Output
- Calibrate 4-20 mA
- Alarm Callout
- Network Setup
- Chemcom

CHAPTER II – INSTALLATION

See important safety information on the first page of the manual.

UNPACKING

Immediately upon receipt of your shipment, check the shipping carton carefully for damage and report any damage directly to the shipping company. Please report any shortage immediately to the factory.

Before opening the carton, check the outside label and verify the model number and options. Unpack the carton carefully, taking care not to lose any of the smaller parts, such as PVC fittings.

The controller carton should include the following:

- Controller Cabinet,
- Sensors as required for selected model,
- Instruction Manual and Warranty Card,
- Installation Report to be mailed back to the factory upon completion of installation,
- PVC fittings and Tees, or optional assemblies.

INSTALLATION REPORT

The Installation Report is a triplicate form designed to assure warranty coverage, technical updates and factory support.

1. White copy: to mail back to factory.
2. Pink copy: to Facilities Manager.
3. Yellow copy: to Qualified Dealer.

It must be filled out and signed by the Qualified Dealer and the facilities manager upon completion of installation.

TECHNICAL SUPPORT

Please take the time to read this detailed Instruction Manual to insure proper installation and operation. If you need further technical assistance, you can contact your Qualified CHEMTROL® Representative, call our Technical Department at **1300-585-820** or send us an e-mail at **support@chemtrol.com.au**

OVERVIEW

The CHEMTROL® **CT Controller** constitutes an integrated command center for complete monitoring and control of all water treatment operations, including chemistry and filtration.

All information provided by the sensors is processed by the microprocessor on the Mother Board and displayed on the Main Display screen. Command signals are then sent to the different control outputs on the Power Board (see ELECTRICAL below).

The schematic of installation in Figure 2 shows the principle of installation for the CHEMTROL® **CT6000** with all options installed.

CHEMTROL® **CT3000** and **CT110** controllers without all the above options are installed according to the same principles.

CONTROLLER CABINET

The CHEMTROL® **CT Controllers** are contained in rain proof and splash proof NEMA Type 4X cabinets. All electronic and electrical components are mounted inside the cabinet on two separate PC Boards. Outlets are provided on the bottom of the cabinet for ½" conduit connectors.

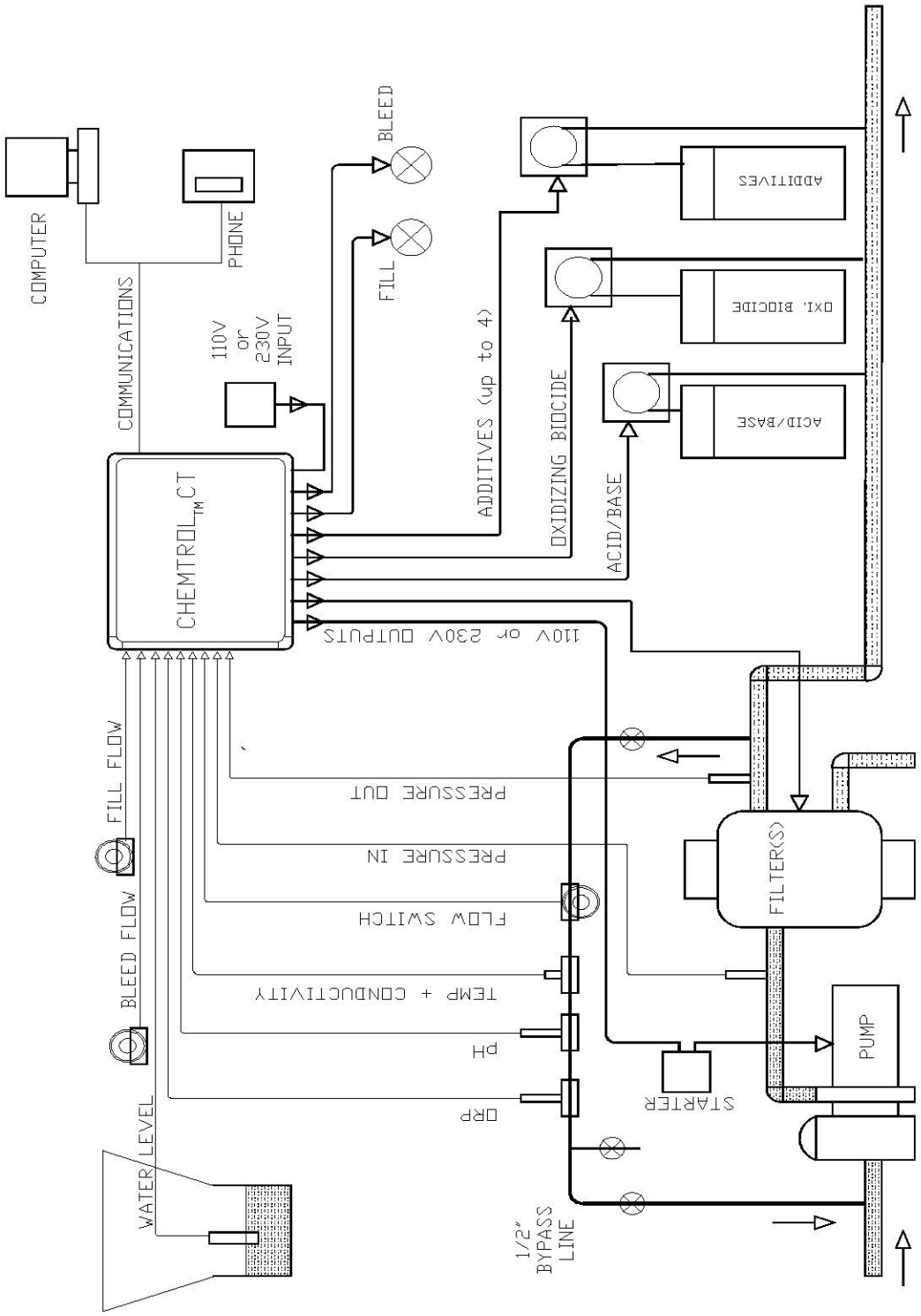
The external dimensions of the cabinets and the positioning of the mounting holes are shown in Figure 3 and Figure 4. To deter unauthorized removal, the mounting holes are accessible only from the inside of the cabinet. To facilitate installation however, external mounting ears are also included.

LOCATION

The cabinet should be mounted on a wall in a secure location:

- meeting electrical code requirements,
- within 10' (3 m) of the main recirculation line or of the bypass line - unless special extension cables are used for the sensors,
- not exposed to direct sunlight as the LCD display screen will darken at high temperature,
- easily accessible to maintenance personnel,
- if possible, in a separate room, or in a well- ventilated room as far away as possible from corrosive chemicals and storage tanks,
- away from power transformers, pump motors or high voltage power lines,
- safe from unauthorized access or vandalism.

Figure 2 - CT6000 Schematic of Installation



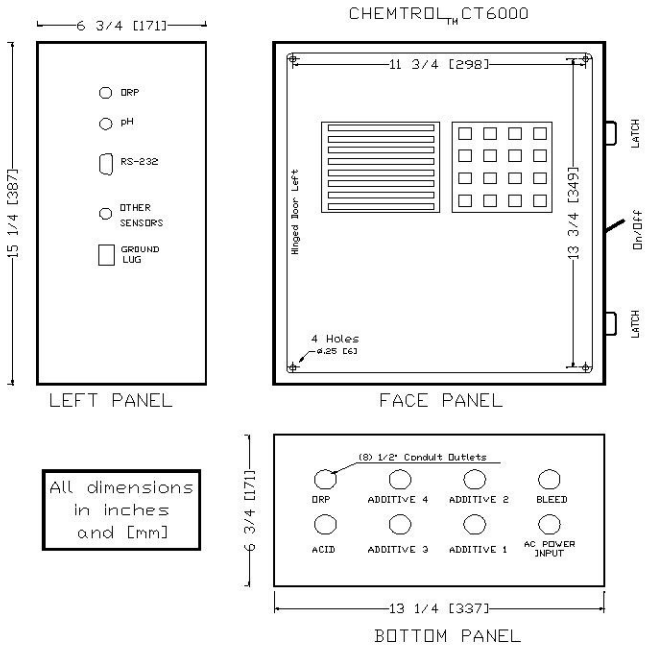


Figure 3 - CT6000 Controller Cabinet

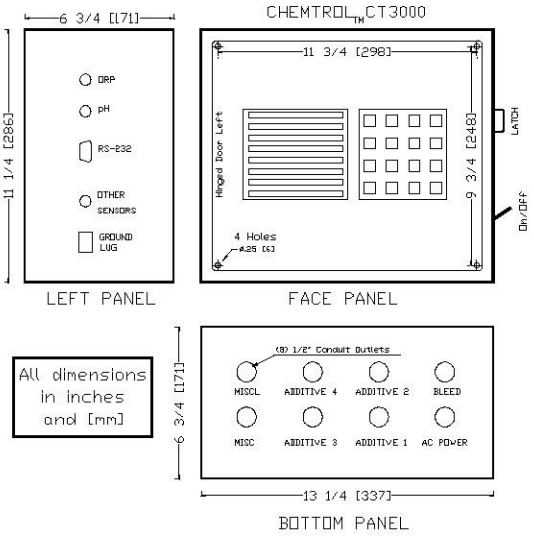


Figure 4 - CT3000 Controller Cabinet

INSTALLATION MUST FOLLOW ALL APPLICABLE ELECTRICAL CODES.

ELECTRICAL

Electrical Codes

The controller is available in either hard-wiring or plug-in configurations. Make sure to use the proper type of wiring according to the local electrical code, usually the same as for the chemical feeders.

The internal wiring of the controller is standard US, i.e.:

BLACK	HOT
WHITE	COMMON
GREEN	GROUND

Grounding (GFI)

A grounding lug is provided on the left side of the cabinet. It is important to connect it to a proper earth ground to prevent dangerous current leakage and electrical shock. Ground Fault Interruption (GFI) protection is also strongly recommended for all installations.

AC Power Input

The CHEMTROL® **CT Controller** is a dual-voltage controller with a voltage selector switch located inside the cabinet on the Power Board (see next page). Before connecting the unit to an external power supply, make sure that the voltage selector switch is set to the proper AC power input: 115 V or 230 V.

CAUTION: Damage resulting from improper voltage **selection is not covered by manufacturer warranty.**

Main Power Interlock

To prevent accidental chemical feeding, the controller and the chemical feeders should always be interlocked - i.e. wired in parallel - with the manual switch for the main pump so that there is no danger of feeding the chemicals if there is no water flow in the recirculation line.

Panel Interlock

For safety of operation, a panel interlock switch is mounted inside the cabinet to shut off all internal power when the control panel is open.

DO NOT ATTEMPT TO DEFEAT ITS PURPOSE !!!

PC Boards

There are two PC boards inside each controller cabinet: a Power Board (Figure 5, or Figure 10) and a Mother Board (Figure 11). They contain all the electrical and electronic components for the controller. The two boards are connected together with a flexible ribbon cable.

The schematics for the two boards show the location of the key components. In addition, all components are also labeled on the PC boards themselves.

The PC boards are protected with a 1 A fuse that is mounted on the upper right of the Power Board. If the fuse has to be replaced, make sure to use a one (1) Amp fuse only. The use of a larger fuse may cause irreparable damage to the electronic boards.

Power Board

The Power Board (Figure 5, or Figure 10) is mounted on the back panel of the controller cabinet. As shown on the schematic, it contains all the high voltage (115 or 230 V) circuits and components for inputs and outputs.

115V/230V Power Transformer

The CHEMTROL® **CT Controller** is equipped with a switchable, dual voltage power transformer that is mounted on the Power Board inside the cabinet.

The voltage selector switch is located near the upper right of the board. Always verify that the switch is set to the correct voltage, either 115 or 230V. Connecting the controller to higher voltage may cause damage to the electronics that is not covered by the manufacturer's warranty.

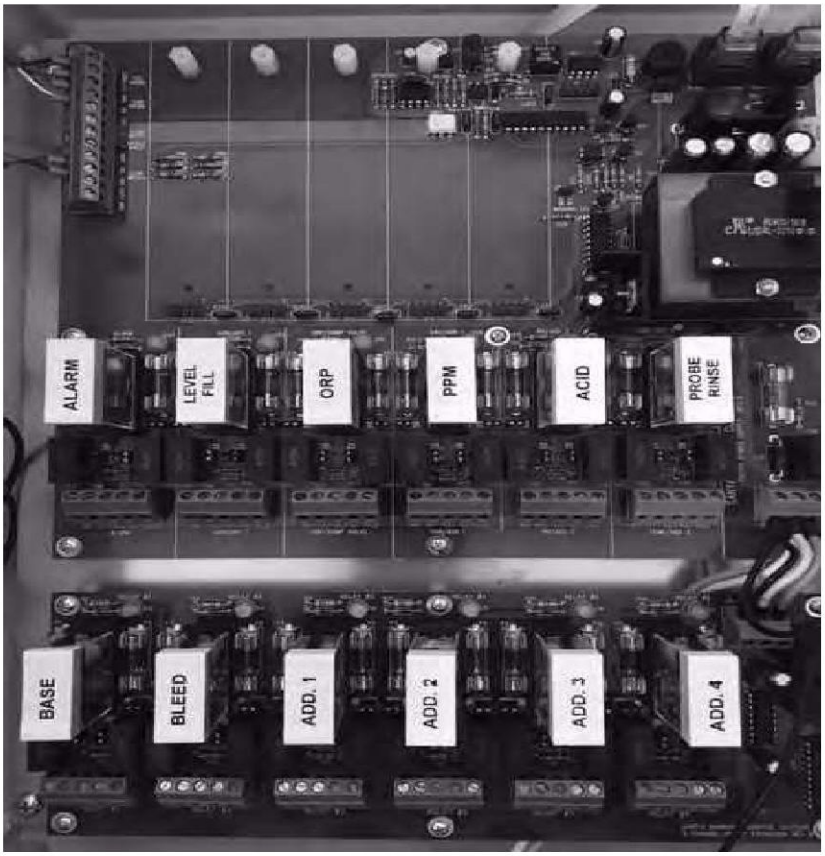


Figure 5. CT3000 Power Board

Notes:

1. Each relay is fused on both sides. The fuses that are immediately adjacent to that relay are for that relay.
2. Power selection is made using the three position jumper (JP7) which is just below the power transformer.

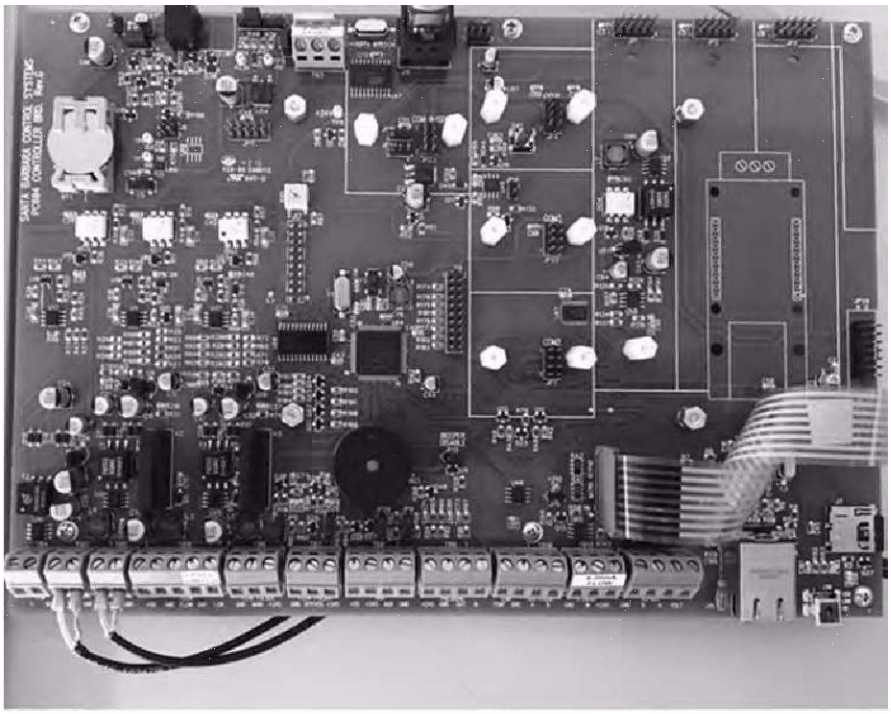


Figure 6. CT3000/6000 Motherboard

Notes:

1. Contrast Adjustment is made with the contrast potentiometer (R95).
2. The terminal strips along the bottom edge are for different sensor inputs. These connections will normally be brought to the outside of the enclosure, on the left side of the enclosure.
3. Ethernet connection is along the bottom edge of the board.
4. uSD Card socket is along the right edge of the board, near the bottom.

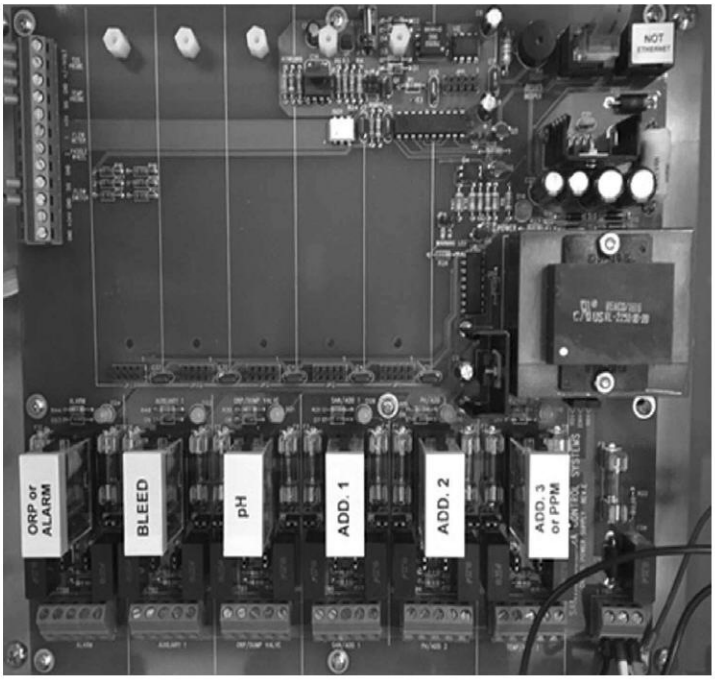


Figure 7. CT110 Power Board

Notes:

1. Each relay is fused on both sides. The fuses that are immediately adjacent to that relay are for that relay.
2. Power selection is made using the three position jumper (JP7) which is just below the power transformer

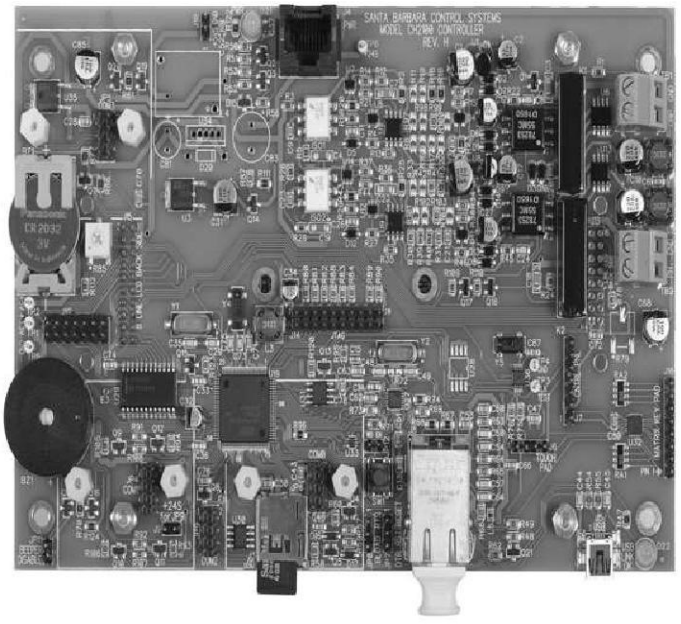


Figure 8. CT110 Motherboard

Notes:

1. Display contrast adjustment is made with contrast adjustment potentiometer (R85).
2. uSd Card Socket is found along the bottom edge, just left of center.
3. Ethernet connection is found along the bottom edge, just right of center.
4. ORP and pH internal connections are made along the right side at TB1 and TB2, respectively.

Figure 9. 4-20mA Expansion Card

Figure 10. Backwash Relay Expansion Card

Figure 11. PPM Expansion Card

Expansion Slots

In all of the Chemtrol® **CT Controllers**, there are five exp ansion slots available to add functional capabilities. The capabilities that can be added include (but are not limited to) PPM (Sanitizer) (See Figure 11.), Chemical Tank Level (See Figure 9.) , Fluorometer sensor, 4-20 mA Outputs (See Figure 10.); and additional relay outputs (See Figure 10.)

Relays and Fuses

The relays for the chemical feeders and other outputs are all rated and fused at 5 A Slow Blow. Other signal relays are 2 A at 30 V.

NOTE: *The fuses for the Power Supply to the PC boards are AGC-1 Fast fuses.*

Make sure not to overload these relays. Chemical feed pumps normally draw less than 5 A. However, if a pump draws more than 5 A, it will need a motor starter or a magnetic switch.

NOTE: Depending on options selected, not all relays may be included on the Power Board.

Fuses for **CT110** Power Board

F9	Power Supply	AGC 1 A Fast
F12 & 13	ORP/Alarm	5A Slow Blow
F10 & 11	Bleed	5A Slow Blow
F5 & 6	pH	5A Slow Blow
F3 & 4	Additive 1	5A Slow Blow
F1 & 2	Additive 2	5A Slow Blow
F7 & 8	Additive 3	5A Slow Blow

Fuses for **CT3000** Power Board

F9	Power Supply	AGC 1 A Fast
F12 & 13	Alarm	5A Slow Blow
F10 & 11	Level Fill	5A Slow Blow
F5 & 6	ORP	5A Slow Blow
F3 & 4	PPM	5A Slow Blow
F1 & 2	Acid	5A Slow Blow
F 7 & 8	Probe Rinse	5A Slow Blow

Fuses for **CT3000** Relay Expansion Board

F1 & F2	Base	5A Slow Blow
F3 & F4	Bleed	5A Slow Blow
F5 & F6	Additive 1	5A Slow Blow
F7 & F8	Additive 2	5A Slow Blow
F9 & 10	Additive 3	5A Slow Blow
F11 & 12	Additive 4	5A Slow Blow

Fuses for **CT6000** Backwash Expansion Board

F1 & 2	Filter 1	5A Slow Blow
F3 & 4	Filter 2	5A Slow Blow
F5 & 6	Filter 3	5A Slow Blow
F7 & 8	Filter 4 or Rinse 1	5A Slow Blow
F9 & 10	Filter 5 or Rinse 2	5A Slow Blow
F11 & 12	Filter 6 or Rinse 3	5A Slow Blow

Remote Alarm

On the **CT6000**, **CT3000** and **CT110**, the remote alarm is a 5A DPDT relay located on the upper right corner of the Power Board. The remote alarm relay can be set for dry or hot contacts, or for any external signal.

To avoid damaging the Power Board, make sure to use the right type of contacts. Call your dealer or the factory if you are not sure.

With hot contacts, the controller powers the alarm with 110 or 230V, depending on the setting of the input voltage selector switch (see preceding page). Connect the leads to the alarm to the Normally Open contacts (NO1 and NO2) on the terminal strip located next to the alarm relay.

With dry contacts, remove the shunts from J4 and J5 located below fuses marked F7 and F6. Wire the remote alarm to NO1 and C1.

For an external power source, wire the input power to the terminals marked NC1 and NC2. Wire the remote alarm to the normally open contact (NO1 and NO2). The alarm voltage will be the same as the external power source

Mother Board

The Mother Board (Figure 6 and Figure 8) is mounted directly behind the face panel of the controller and contains all the low voltage circuitry including the microprocessor and program chips, the LCD display and the keyboard pad.

The key features of the motherboard are the microprocessor, the uSD Card Socket for program updates and data downloads; the Ethernet communication connection; and the pH and ORP sensor connections. These senosr connections are brought to the outside of the enclosure; and can be seen on the left side of the enclosure.

Sensor Connections

When included in the original controller order, all ot the sensor connections are available on the outside of the cabinet via bulkhead connectors. The conductivity sensor is included in all controllers; and is marked on the outside of the cabinet as TDS/Temp.

For the sake of field upgrades, the sensor connections for each of the following functions are connected to Terminal Barrier Strips in these locations:

CT110 Power Board

TB1

5= +5V	
6=Flow Meter 1	Fill Water Meter Signal
7= Paddlewheel 2	Bleed Water Meter Signal
8= GND	Ground
9=SIG	Flow Switch Signal
10=GND	Flow switch Ground
11= +24V	Available for Powered Water Meter
12=GND	

In the **CT110**, the pH and ORP sensors will be connected internally on the Motherboard (see Figure 8). The Conductivity/Temperature connections are made on the Power Board, at TB!, positions 1-4. Any other sensor inputs will be made on expansion cards. (See Figure 9 and Figure 10).

Backup Battery

The 3V Backup Battery is located on the upper left of the Mother Board. It is used to maintain the memory settings in case of loss of AC power. This battery is designed to last for several years in normal operation and for up to six months if the AC power is shut off.

Under normal conditions, the controller will operate without battery power. However the clock and other memory settings will have to be restored in case of complete power shutdown. The battery should be replaced if the voltage falls below 2.6 V. This can be verified at any time in the Configuration Menu using the Battery Submenu.

Remote Communications

There are several remote communications options for the Chemtrol® **CT Controllers**. I will briefly cover each option here.

Webserver Communications

Each of the Chemtrol® **CT Controllers** can be equipped with an interface that will allow the user to access the controller through any web-capable device.

The Webserver Option can be configured to work in either of two ways: through the facility's local area network (LAN); or through a cellular modem to the internet.

Each Chemtrol® **CT Controller** is configured with a unique MAC address, which is used for these type of communications.

In order to work through the facility's LAN, the facility will need to allow access through their firewall. In many cases, the Information Technolgy (IT) Department of the facility can provide secure access through their firewall. In this type of case, Chemtrol would provide a form to be filled out with the access information from the facility. The Chemtrol IT Department will configure the MAC address and access information into the Chemtrol® Webserver. At that point, the facility would only need to bring a standard Ethernet cable to the controller; and the communication would be initiated.

Some facilites disourage this type of access into their network. In these cases, Chemtrol® can provide the Webserver access through a Cellular Modem. This solution requires that the facility (or service provider) obtain and maintain a service contract for the use of the cellular modem. This would not involve any access to the facility LAN.

4-20 mA Output Boards

There are several 4-20 mA Converter Boards available for the Chemtrol® **CT Controllers**. They all work essentially the same way. They provide two connection terminals for the output current. There purpose is to convert the digital outputs of the controller into analog signals that can be used by analog monitoring and control equipment.

If the boards are installed properly, the controller software automatically shows the 4-20 mA menu line in the Submenu 8.3 - Communications.

Field Installation

For field installation, turn off all power to the controller. Position the converter board over one of the expansion slots on the controller's power supply board. Press the female electrical connector of the output board onto the male header of any of the power board expansion slots. Use the instrument screw provided to secure the other end of the output board into the expansion slot.

The signal assignment of each pair of terminals will be clearly marked on the output card.

Building Management System (BMS) Communications

All of the Chemtrol® **CT Controllers** can be equipped to communicate to the facility Building Management System using a number of open protocol languages. The most common of these languages being used today are: Modbus, Bacnet IP, Bacnet MSTP and Lonworks. The controllers can be configured with any of these languages.

To enable this type of communication, there will be a module installed inside the controller which will convert the language of the controller to the open protocol language. (See Figure 12.)

Figure 12. BMS System Interface Module

PLUMBING

Plumbing includes installation of the sensors and connection of the chemical feeders or control valves.

Installation of Sensors

The CHEMTROL® **CT Controller** can use many sensors for measurement of water chemistry. For this discussion, we will restrict that list to: conductivity, temperature, pH, ORP, flow rate, pressure and water level:

- conductivity sensor for Total Dissolved Solids,
- potentiometric sensors for pH and ORP,
- thermistor for temperature,
- Hall effect pulse generator for flow rate,
- piezoelectric sensors for influent and effluent pressures,
- electro-optical water level sensor.

On small recirculation lines (2-inch pipe), the water chemistry sensors (conductivity, pH, ORP and temperature) can be installed directly on the main line using PVC reducing tees (Figure 16).

On larger lines, the sensors should be mounted on a bypass line, using either a Sample Line Assembly (Figure 17) or a Sensor Cell Cabinet (Figure 8).

In-line Installation (2" Pipe)

Use only 2x2x3/4 in. SST reducing tees without reducers. Do not install the sensors near an elbow or a constriction where there might be excessive turbulence.

Install the tees on the suction side of the pump and make sure that the tip of the sensor is oriented downward - as shown in Figure - to avoid formation of air pockets near the tip. The sensors should be readily accessible for servicing but not exposed to physical damage.

After inserting the sensor, be careful not to overtighten the compression fitting as it can crush the small glass tube inside the sensor. Make it finger tight (no wrench).

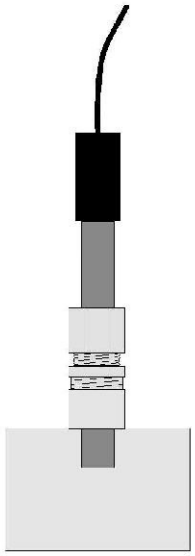


Figure 16 - Sensor Tee

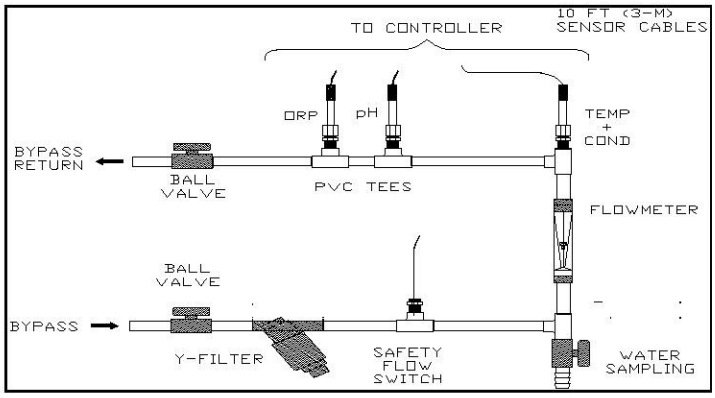
Sample Line Installation

The CHEMTROL® **Bypass Line Assembly** (P/N FSLYCT2) shown in Figure is recommended for installation of the sensors. It is designed to assure a smooth and reliable flow of water. It includes:

- PVC tees (3/4" SST),
- Fast & Tite fittings (3/4" MPT),
- In-line Y-filter (3/4" MPT),
- On/off flow switch (3/4" FPT),
- Two Union Connections
- Ball valve for water sampling and testing.

The Bypass Line Assembly should be installed exactly as shown on Figure . In particular, make sure to install the flowmeter in a vertical position and to install the flow switch downstream of (after) the sensors to assure a smooth flow of water near the sensors.

Figure 17 – CT Controller Sample Line Assembly



Sensor Cell Cabinet

For ease of installation and maintenance, the components of the bypass line assembly can also be supplied in a pre-plumbed Sensor Cell Assembly, also named Wet Box. As shown in Figure 18, the Wet Box is mounted in a separate fiberglass cabinet containing the sensor cell. It should be mounted on a ½" bypass line with Y-filter, flowmeter and paddlewheel safety flow switch.

Make sure that the Sensor Cell Assembly is located within 10' (3 m) of the controller cabinet or order sensor extension cables (see Sensor Cables).

See the wiring instructions in the ELECTRICAL section and the operational instructions under WATER FLOW below.

Water Flow

Proper flow of water past the sensors is essential to obtaining good readings. To check the water flow in the bypass line, start the main recirculation pump. Open any isolation valves on the bypass line and see the flow past the flow switch. If there is no water flow, replumb the bypass line as shown on the schematic.

NOTE: The most common installation problems with bypass line or wet box installations are caused by faulty hydraulics.

To ensure proper water flow, make sure that the intake side of the bypass line is connected to the pressure side of the recirculation system and that the return side is connected to a low pressure area - such as the vacuum side before the recirculation pump, or low pressure downstream

On/Off Flow Switch

An on/off-type flow switch is recommended with the CHEMTROL® **CT Controller** to prevent accidental feeding when there is no water flow.

If you purchase the flow switch with the controller, the flow switch connection will be available on the left side of the cabinet, marked Flow Switch. If you have a preference for another type of flow switch, you can make the flow switch connections on TB1 of the Power Supply Board (See Figures 5 and 7) at the Terminals 9 and 10.

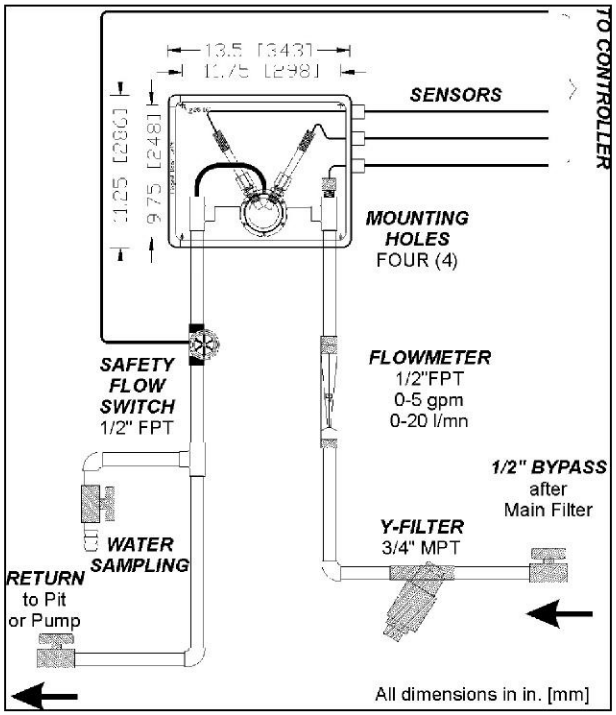


Figure 18 - Sensor Cell Assembly

CHEMISTRY SENSORS

Sensor Design

The pH and ORP sensors are non-corroding sealed combination electrodes (Figure 9). They do not require refilling. Each sensor has an external plastic body and an inner glass tube which can be broken if stressed too severely.

The potentiometric sensors produce small voltages - in the millivolts range. Since they have a high impedance (20 to 50 megohms), the electrical current produced by the sensors is extremely small - in the picoamp (10^{-9} A) range. The output is so small that it cannot be measured with ordinary voltmeters and must be internally amplified by the controller.

There is no electrical current flowing from the controller to the sensors and the sensors are optically isolated from the high voltage circuit inside the electronic module. Therefore they create no electrical danger.

pH Sensor

The pH Sensor senses the acidity of the water and works with any acid or base. It is recognized by its blue color and the glass bulb at the tip.

ORP Sensor

The ORP (Oxidation-Reduction Potential or Redox) Sensor monitors the activity of the sanitizer (Fast Acting Free Chlorine, Bromine or Ozone) through its oxidizing power. It is recognized by its red color, the wide platinum band at the tip of the electrode and the white plastic tag on the cable.

Sensor Installation

The pH and ORP sensors are shipped in individual cartons for extra protection. When ready for installation, remove the plastic cap on the tip of the sensor. If it is difficult to remove, dip it in water for a few seconds. It should then slide off easily.

There may be a white crystalline deposit around the cap. This is produced by the salt solution used for shipping and does not affect the performance of the sensor.

For installation of a sensor, the 3/4" bottom part of the Fast & Tite fitting should first be screwed in the PVC Tee (Figure 6). Teflon tape can be used but it should not be overtightened. The sensor with the upper part of the fitting should then be carefully inserted, as shown on the schematic above, being careful not to bend or overtighten it, to avoid breaking the small glass tube inside. The sensor tip should be about ½" (1 cm) inside the PVC tee. It does not matter which sensor, ORP or pH, is upstream or downstream.

Sensor Cables

Each potentiometric sensor is supplied with a standard 10' (3 m)-long cable made of coaxial wire designed to minimize electrical interference. For ease of identification, all ORP cables have a white marker.

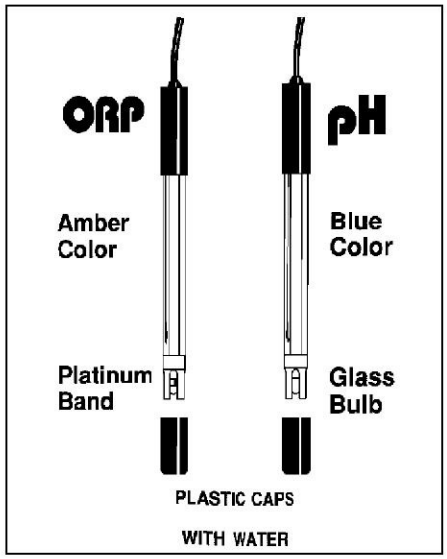


Figure 19 - ORP and pH Sensors

The cables are terminated with bayonet-type, spring-loaded, push-and-twist male BNC connectors. These are connected to the proper female BNC connectors located on the left side of the controller cabinet.

If the cable is longer than needed, it should be coiled neatly and attached under the cabinet. DO NOT CUT THE SENSOR CABLE under any circumstance.

If a longer cable is needed, custom-made extension cables with BNC connectors can be ordered from the factory in lengths of up to 100 feet. For longer distances, a pre-amplifier may be required. Consult your dealer or the factory for details.

Electrical Interference

Electrical interference from high voltage equipment, such as power transformers, pumps or high voltage lines, may sometimes produce erratic readings from the sensors. It may then be necessary to insulate the sensor cables by mounting them inside a metallic conduit line that is properly grounded.

Small signals may also be picked up from current leakage through the water line, due to faulty wiring or improper grounding of equipment, such as a pump or heater. Electrolytic chlorine generators are also a frequent source of current leakage.

To check for current leakage, compare the readings of the sensors when they are in line and when they are dipped in a plastic bucket containing the same water from the tower basin. If you get different readings, there is current leakage. Its source must be identified and eliminated with proper grounding by a qualified electrician.

Storage and Winterizing

CAUTION: STORING OR SHIPPING A SENSOR WITHOUT CAP OR WATER WILL VOID ITS WARRANTY.

All sensors are shipped with a plastic cap on the tip to protect the tip from physical damage. This cap also contains water to prevent the sensor from drying out.

Remember to store the protective caps inside the sensor box or inside controller cabinet so that they are available for storage, winterizing or shipping. When storing or returning any sensor for warranty consideration, always add water inside the cap to prevent the sensor from drying out.

The sensors can be damaged by freezing. They should be removed from the line and stored at room temperature whenever freezing is expected.

Sensor Warranty

The sensors are covered by a standard one-year manufacturer warranty. This does not include damage caused by physical abuse such as breakage of the inner glass tubing or by drying out of the tip. BE CAREFUL IN HANDLING THE SENSORS and ALWAYS REPLACE THE CAP WITH WATER INSIDE when not in use.

In case of sensor failure, return it as soon as possible with its cap on and with water inside the cap for warranty consideration or replacement.

CONDUCTIVITY/TEMPERATURE SENSOR

The Conductivity Sensor is mounted on a 3/4" MPT fitting that also contains the temperature sensor. It can be installed next to the ORP and pH sensor, either on-line or on the bypass line, using a 3/4" FPT PVC tee. Make sure that the head of the sensor is properly oriented with the flow of water to give a good solution sample (See Figure).

The two leads from the sensors should be connected as indicated on the Mother Board. If the temperature sensor is incorporated inside the conductivity sensor, there are two extra leads that should also be connected as indicated on the Mother Board (See Sensor connection page IV-7)

ELECTRONIC FLOW SENSOR

Either Hall effect type sensors or Reed switch (Contacting Head) type sensors can be used.

WARNING: Follow all manufacturer's instructions carefully and do not install in line under pressure.

Hall effect sensor

For fill water, connect the three leads from the sensor to the Terminal Barrier strip TB 4 as indicated on the Mother Board Schematic and the sensor connection paragraph page IV-7.

For bleed water, connect two leads from the sensor to the Terminal Barrier strip TB3 and the Red lead to the +24vdc Terminal Barrier strip TB4 as indicated on the Mother Board Schematic and the sensor connection paragraph page IV-7.

Reed switch sensor

For fill water, connect the two leads from the sensor to the Terminal Barrier strip TB 4 as indicated on the Mother Board Schematic and the sensor connection paragraph page IV-7.

For bleed water, connect the two leads from the sensor to the Terminal Barrier strip TB3 and the sensor connection paragraph page IV-7.

CAUTION: A 24VDC signal is used for signal generation with Hall effect sensors. Connecting the wrong wires may cause damage to the sensor and to the microprocessor.

Enter the calibration K-factor in pulses per unit of volume flow (gpm or l/m) for the specific pipe diameter and thickness, as listed in Chapter II, Submenu 5.2.

PRESSURE TRANSDUCERS

The pressure sensors are Series 2000 transducers with a 1/4-18 NPT thread connection rated at 60 psi (4 bar). They should be installed on the intake (influent) and return (effluent) sides of the filter or bank of filters.

Connect the leads from the sensors to the Terminal Barrier strip TB2 as indicated on the Mother Board Schematic (Chapter IV, Page 7). For calibration, enter a factor of 4.3 through the PUMP Submenu 6.2.1.

WATER LEVEL SENSOR

The water level sensor is an FLOAT-STYLE sensor with a 1/4" NPT thread. Locate it in a convenient location to open a fill valve as required to maintain constant water level.

Connect the leads from the sensor to the Terminal Barrier strip TB1 as indicated on the Mother Board Schematic (Chapter IV, Page 7).

CHEMICAL FEEDERS

Operation

Locate the 5-amp power outlets (110 or 230 V) on the Power Board (Figure 5, or Figure 10). They are marked ACID FEED, BASE FEED, OXIDIZER FEED, DE-OXIDIZER FEED. Connect as required to the chemical feeders for control of pH and ORP. Connect the power outlets marked ADDITIVE1, 2, 3 and 4 to a chemical feeder for each additive, as required. For best results, use the following guidelines:

1. Always inject the chemicals downstream of the sensors.

2. Proper operation of the overall "water / feeders / controller" system requires that the chemical feeders be properly sized and in good operating condition. Each feeder must be adjusted so that the chemicals are not fed excessively fast or slow. For best control, the feed control mode should be on Proportional control or the feed rate should be as low possible, just high enough to meet the expected chemical demand.

3. If the controller shows an out-of-range condition, this is usually caused by a malfunction of the chemical feed system. Make sure to investigate the cause and correct the malfunction before returning to automatic control.

4. An OZONATOR can be used together with chlorine or bromine feed but the presence of ozone in the water may affect the calibration of the sensor.

Chemical Feed Pumps

Chemical feed pumps are used to feed liquid oxidizer, such as sodium hypochlorite OClNa, also known as liquid chlorine, or solutions of calcium hypochlorite or dichlor powder. Liquid chemicals for pH control include muriatic acid, caustic soda or solutions of soda ash.

Any standard chemical feed pumps (diaphragm, piston or peristaltic) approved by NSF (National Sanitation Foundation), UL (Underwriters' Laboratories), ETL (Electrical Test Laboratories), CSA (Canadian Standards Association) or similar national and international organizations, can be used, as long as they are properly sized for the installation.

Install the pumps as shown in the main installation schematic, following the electrical code and the pump manufacturer's instructions.

Carbonic Acid Valve

A special solenoid valve for carbonic acid can be used to control the addition of CO2, an acid used to lower pH. It also increases Total Alkalinity making pH control difficult. Add muriatic acid, HCl, to reduce high alkalinity.

Erosion Feeder

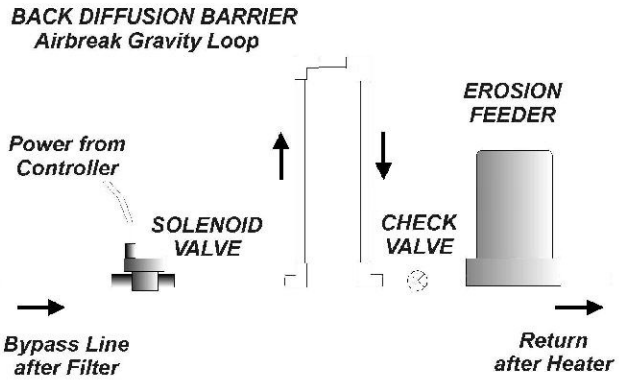


Figure 20 - Erosion Feeder Installation

Figure 20 shows the installation of an erosion feeder for bromine or chlorine tablets with a bypass line. The differential pressure must be at least 15 psi (1 kPa).

For automatic control, a solenoid valve is installed on the **intake side** of the bypass line, as shown on the schematic, to turn the flow of water through the feeder on and off as needed.

With bromine dihalo tablets, the solenoid valve can be mounted just before the brominator.

Because trichlor tablets are very corrosive, it is recommended to protect the solenoid valve with both a check valve and an air break to reduce back-diffusion of the chemicals. It is also recommended to switch to a less aggressive sanitizer.

Gas Chlorinator

Chlorine gas is very dangerous to use.

Gas chlorinators should be installed and maintained only by factory-trained technicians following the instructions of the manufacturer.

If required, the chlorine gas injection line can be controlled with a specially-designed, corrosion-proof solenoid valve installed between the gas chlorinator and a Venturi injector. Alternatively, a magnetic starter can be used to control a booster pump for the chlorinator bypass line.

BACKWASH

The Power Board (Figure 5) of the CHEMTROL® **CT6000** includes three (3) double-pole, double-throw (DPDT) 5A relays for automated filter backwash. They can be used to control solenoid valves, motorized valves, hydraulic valves or pneumatic valves.

Main Pump Shutoff

To relieve pressure on the backwash valves, it may be desirable to shut off the main recirculation pump during opening and closing of the valves.

Use Filter Submenu 6.8.1 in the CHEMTROL® **CT6000** to specify if the main recirculation pump is to be shut off during cycling of the valves. The standard shutoff value is 5 seconds but it can be changed through Submenu 6.8.1.1.

Single Filter Backwash

As shown in Figure 21, single filter backwash is controlled with four valves that are connected to the Normally Open (NO) and Normally Closed (NC) poles of Filter Relay 1.

Valves # 1 and #4 are connected to the Normally Open connectors on Relay #1 (marked NO1 and NO2). These valves are open for filtration and closed for backwash.

Valves # 2 and #3 are connected to the Normally Closed connectors on Relay #1 (marked NC1 and NC2). These valves are closed for filtration and open for backwash.

Multiple Filter Backwash

Figure 22 shows the connections for sequential backwashing of up to three filters with three-way valves connected to the Filter Relays. If more than three filters are used, several filters can be banked together.

For filtration, the valves are in the normally open position and connect the influent and effluent lines through each filter. In backwash operation (normally closed), the valve is connected to the waste discharge line.

A partial closure valve (priority valve or flow control valve) can be connected to the relay marked De-oxidizer. Specify in Submenu 6.6.1 if it is to be activated during backwash.

Backwash Stager

Multiple filter backwash can also be done with a backwash stager, a mechanical port selector for multiple filters that can be used in place of solenoid valves.

The stager is operated through a dry contact relay connected to Filter Relay #1 on the Power Board.

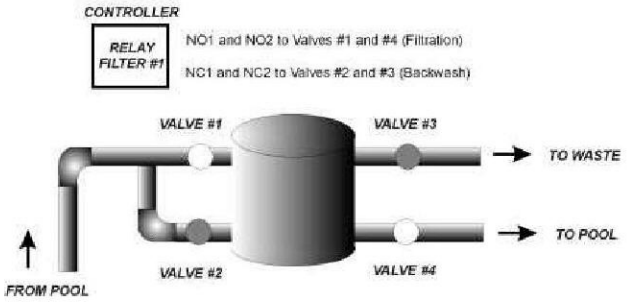


Figure 21 - Single Filter Backwash

Electrical Valves

Solenoid or motorized valves can be connected directly to the NO and NC sides of the filter relays if they draw less than 5 A. If more than 5 A, an intermediate relay of sufficient amperage should be installed.

Hydraulic Valves

Water pressure for a hydraulic valve can be controlled with a three-way piston valve, one port being used to apply water pressure for backwash and one port open to the atmosphere to relieve the pressure on termination.

For EPD or STARK filters, use an ASCO 3-way Solenoid Valve P/N 8221G2, Normally Closed - or equivalent.

Pneumatic Valves

Air pressure to pneumatic valves can be controlled with a standard two-way solenoid valve installed on the air line.

For MIAMI TANK filters, use an ASCO Solenoid Valve P/N 8210G94, Normally Closed - or equivalent.

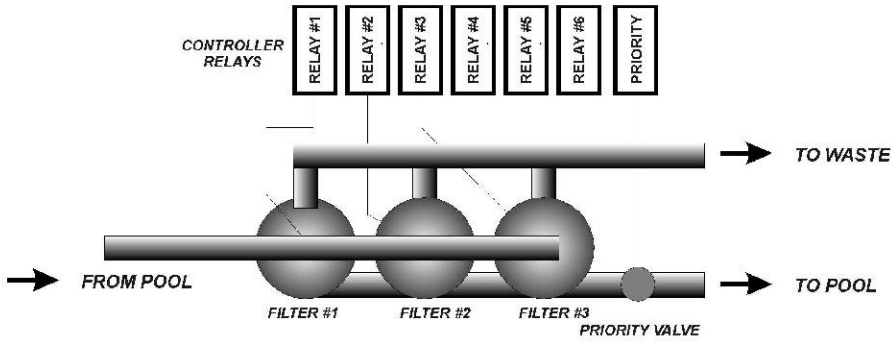


Figure 22 - Multiple Filters backwash

CHAPTER III - CONTROLLER OPERATION

This Chapter describes the operation of the CHEMTROL® **CT Controller**. For reference, the menus and submenus are shown in Chapter I - INTRODUCTION / Menu Tree.

Access

Each menu is accessed by highlighting a line on the Main Display screen with the UP and DOWN arrow keys and then entering the submenu with the RIGHT arrow key. To return to any previous menu, press the LEFT arrow key.

Each menu is identified by a combination of numbers, from 1 to 8, corresponding to the lines that are used to access it. For instance, Submenu 8.1.4 for Clock Setup is accessed through line 8 on the Main Display Screen (Configuration Menu), then line 1 (Initial Setup) and line 4 (Clock).

To facilitate startup of the controller, Menu 8 for Configuration and Setup is discussed first in this manual. All the other menus from 1 to 7 are discussed afterwards in numerical order.

Default Setup

The CHEMTROL® **CT Controller** is pre-loaded with standard defaults values for normal operating conditions. On startup, it uses the default values, i.e. English language, U.S. units, no password, standard setpoints and alarms, etc.

The operator can change the settings at any time. He can revert to the original default values (partial or complete) through the Reset Submenu 8.2.5.

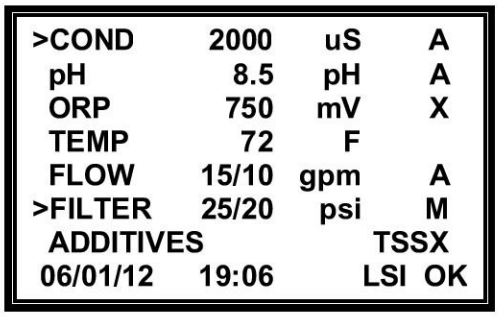
All settings are maintained in case of a power shutdown as long as the battery maintains a charge above 2.5 V. The original default values are automatically reloaded in case of complete loss of power (both line and battery power).

8 - CONFIGURATION MAIN MENU

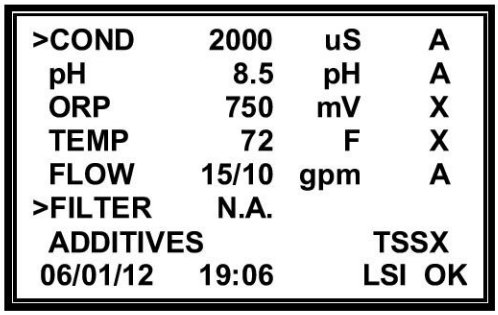
Access

To access the Configuration Menu, use the DOWN arrow key on the Main Display screen to highlight the last line and then press the RIGHT ARROW key to show the next menu. It includes the three submenus shown on the right (Menu 8).

CT6000 Main Display



CT3000/CT110 Main Display



Menu 8 - Configuration

8.1 - INITIAL SETUP SUBMENU

The Initial Setup Submenu is used to specify the basic operating conditions of the CHEMTROL® CT Controller. It is accessed through the Configuration Menu on the last line of the Display Screen.

8.1.1 - Language

The Language Submenu allows the user to select either one of three languages: English, French or Spanish for all displays screens. The standard (default) language is English. Language changes take effect immediately.

8.1.2 - Units

The Units Submenu allows the choice system of U.S. or Metric units to be used throughout the program. The standard (default) value is the U.S. system. The change of units takes place immediately.

The unit equivalencies are as follows:

U.S. METRIC

Conductivity	uS	uS
TDS	ppm	mg/l
pH	pH	pH
ORP	mV	mV
Temperature	F	C
Water Flow Rates	gpm	l/m
Water Flow	ga	l
Pressure	psi	kPa

8.1.3 - Code Number

The Code Number Submenu is used to define different operator access levels. Code numbers may be required for access at key points in the program and for remote communications.

Up to ten five-digit Code Numbers (no letters) may be entered, along with an associated access level from one to three. To make it easier to remember a code number, the operator may select a combination of numbers corresponding to a familiar name on a standard telephone keypad.

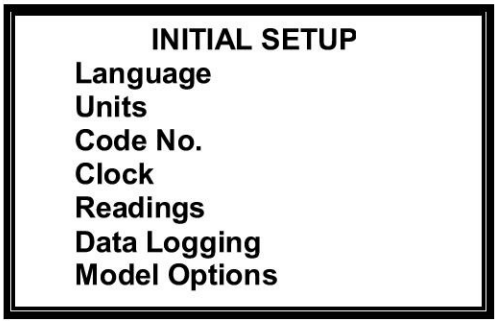
The following access levels are available:

Level 1: View only,
Level 2: Calibration,
Level 3: All functions.

To clear an existing code number, its access level is set to zero.

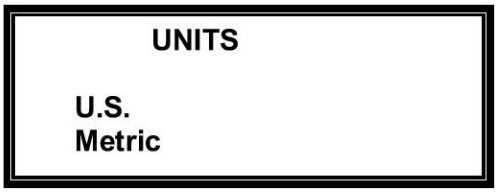
Once a code number has been acknowledged, it remains valid for an hour of continuous operation so that the operator does not have to re-enter it constantly. If necessary, it can be changed by returning to the Welcome screen.

Submenu 8.1

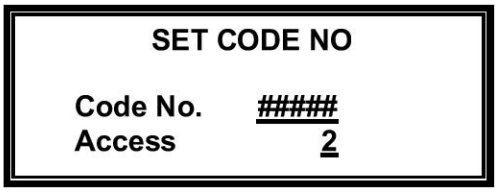


Submenu 8.1.1

Submenu 8.1.2



Submenu 8.1.3



8.1.4 - Clock

In case of a power shutdown, the clock is maintained by the backup battery. It needs to be reset only in case of complete power shutoff with loss of battery power or whenever the program chips are replaced or upgraded.

NOTE: The date uses a **MONTH/DAY/YEAR** calendar.
NOTE: The time display uses a **24:00 hour** clock.

8.1.5 - Readings

The DISPLAY HOLD parameter is used to stabilize sensor readings and minimize fluctuations. It specifies the time interval for data averaging and updating. The standard (default) value is 10 seconds. It can be changed to any value between one and sixty seconds.

8.1.6 - Data Logging

The DATA LOGGING screen shows the interval for storing the test data in the controller memory. Interval values range from one to 999 minutes, with a default of 60 minutes.

The memory chip can store up to 999 test results. When it is full, it writes over the oldest entries. Therefore the greater the interval is, the longer it takes to fill up the memory.

For instance, an interval of 60 minutes (one hour) fills the memory in 41 days. Data logging every four hours fills the memory in about 5 ½ months.

To avoid losing test data, remember to print it or download it to a computer before the memory is full (see Submenu 8.2.4 - Print Reports).

8.1.7 - Model Options

The Model Options Submenu is used to specify the functions that are actually installed on the controller. Non-installed functions should be set to “NO”. This way, the Display Screen shows N.A. instead of erroneous readings. For demonstration purposes, it is possible to access any function and review its features - even if it is not actually installed on the controller - by selecting “YES” for that option.

On the **CT6000** and **CT3000**, the ADDITIVE option submenu allows the selection of additive names from a pre-defined list. The RIGHT arrow key allows to browse through the list. The LEFT arrow key returns to the previous submenu.

Submenu 8.1.4

DATE/TIME	
Date	08/10/96
Time	17:00
Day of week	Mo

Submenu 8.1.5

DISPLAY HOLD
Time base for
Averaging display values
10 seconds

Submenu 8.1.6

DATA LOGGING
Time Base:
60 minutes
Reset

Submenu 8.1.7

MODEL OPTIONS	
CONDUCTIVITY	
pH	Yes
ORP	No
TEMPERATURE	Yes
FLOW	Yes
FILTER	No
ADDITIVES	Yes

8.2 - OPERATIONS SUBMENU

The Operations Submenu gives access to the operator to change the operating conditions during normal operation.

8.2.1 - Audio Alarms

This option is used to disconnect the audio alarm (buzzer) in case of out-of-range or other alarm conditions. All visual alarms, such as flashing on the screen, still remain operative.

8.2.2 – Sample Line Assembly

The Sample Line Assembly is a recommended feature for sensor installation on large recirculation lines, i.e. over 2 inches in diameter. It is included with **CT6000** controllers and optional for the **CT110** and **CT3000**.

A Safety Flow Switch is used to prevent operation when there is insufficient water flow in the bypass line. This may happen particularly when the bypass line is shut down for maintenance.

The standard flow switch provided with the CHEMTROL$_{(R)}$ **CT Controller** is an on/off-type flow switch with a shutoff set at about 1.0 gpm (3.8 l/m).

The Bypass Line Protection option should always be set to YES, indicating that the alarm is active and will cause the interruption of all feed and bleed events.

If the flow switch is defective or temporarily disabled, the bypass alarm can be overridden by setting the Bypass option to NO. This override should be used with extreme caution:

> ***Feeding chemicals when water is not running in the bypass line may cause dangerous water conditions and hazardous chemical reactions.***

8.2.3 - Langelier Saturation Index

The Langelier Saturation Index is used for monitoring the development of corrosive or scaling tendencies in water. It is calculated from the formula:

$$SI = pH + TF + AF + CF - 12.1$$

where:

- pH = pH sensor reading or keyboard input,
- TF = Temperature factor calculated from sensor input or keyboard input,
- AF = Alkalinity factor from data table,
- CF = Calcium Hardness factor from data table.

The CHEMTROL$_{(R)}$ **CT Controller** calculates the Saturation Index automatically using sensor input for pH and Temperature and operator data input for Alkalinity and Calcium Hardness. This eliminates the need for complex conversion tables.

Submenu 8.2

OPERATIONS	
Audio Alarms	YES
Bypass Line	YES
Saturation Index	OK
Print Reports	
Reset	
Battery	
Probe Monitor	YES

Submenu 8.2.3

SATURATION	
Alkalinity (ppm)	150
pH	7.5
Temperature	80
Limits	
Langelier Index	0.23
Condition	OK

Submenu 8.2.3.5

LANGELIER LIMITS	
Scaling above	+ 0.3
Corrosive below	- 0.0

8.2.3.1 - Langelier Limits

The standard Langelier limits show "OK" if the index is between 0 and 0.3, "CORR" if below 0, and "SCALE" if above 0.3. If an alarm condition develops, the Display Screen alerts it with flashing characters.

Because other values may be more applicable to the installation, the Langelier limits can be changed by entering preferred values in Submenu 8.2.3. 5. Use the RIGHT arrow key to change the + or - sign and press OK. Then, enter the desired value and press OK.

8.2.4 - Print Reports

The Print Reports Submenu is used to download the test data from the internal memory chip of the CHEMTROL® **CT Controller** (see Submenu 8.1.6 - Data Logging). The data is saved in memory in standard ASCII text format as shown on the right.

The data can be printed or downloaded using two different methods:

- on-site downloading to the uSD card in the controller.
- remotely by utilizing one of our Remote Operation options.

After downloading into a computer, the data file can be processed with a standard text editor or word processor. The CHEMCOM$_{TM}$ program can also be used to display the data graphically (see Chapter III - TELECOMMUNICATIONS).

For the **CT6000**, **CT3000**, a maximum number of 999 sets of test data can be stored in the controller memory chip. The **CT110** controller has a maximum number of 900 sets of test data. It is therefore recommended to download the data at periodic intervals to save it.

Downloading the data does not erase it from the memory chip. To erase all data in memory, use Submenu 8.1.6 - Data Logging and select Reset.

For printing, use the desired setup below, then enter Submenu 8.2.4 - Print Reports, select the proper dates, move to Print Data Log and press the RIGHT ARROW. A counter shows the number of tests being printed.

Data Backup to uSD Card

Each **CT Controller** is equipped with a Micro SD (uSD) card socket, and one USD card. This card can be used to download the datalog, and then transfer the data into a computer.

From the Print Reports Menu, this is accomplished through the Backup Datalog command. By pushing the Backup Datalog command, you are transfering the data from the controller to the uSD card. Once the backup is completed, you simply remove the uSD card from the controller, and install it into your computer's uSD socket, and transfer the data to the computer. Remember to return the uSD card to the controller, so you have access to it when you require the next data download.

Remote Download

Logged data can be more easily downloaded using the CHEMCOM$_{TM}$ software or the Webserver interface. This is explained in Chapter III - TELECOMMUNICATIONS.

If you are using Chemcom®, click on the CHEMCOM® icon in Windows® and use Menu 6 - REMOTE CONTROL to establish communication. When the image of the controller screen appears on the remote computer, go to Submenu 8.2.4 and select Print Data Log with the RIGHT ARROW key.

The computer screen displays: "Please wait ..." and a numerical counter showing the tests being downloaded. If a printer is connected to the computer, the data is printed at the same time.

The downloaded data is normally saved in a default text file named LOG.TXT in the Facilities Setup menu in the CHEMCOM$_{TM}$ program. Another name can be specified through the Edit Facility submenu. If the file already exists, the new data is added to the old data.

In the Webserver option, when you sign into your account on your web-capable device, you will see the list of controllers. Beside each selection, there is a drop-down box. One of the selections in the Drop-down box is to Download Data. By selecting that, the data from the server will download to your computer.

Data Display

To view the data in text form, as shown on the previous page, use Menu 8 - DISPLAY DATA/VIEW in the CHEMCOM$_{TM}$ program or use any standard text or word processor.

Graphic Display

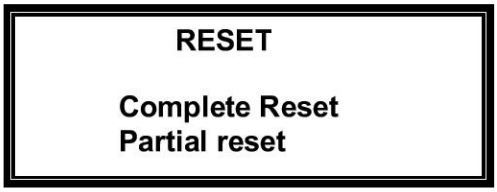
To display the data in graphic form, use Menu 8 - DISPLAY DATA/GRAPH in the CHEMCOM$_{TM}$ program (see Chapter III - TELECOMMUNICATIONS for details).

8.2.5 - Reset

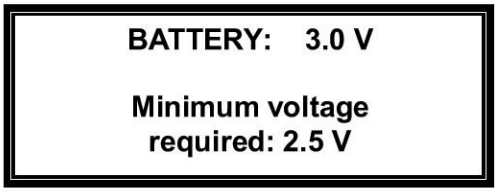
The Reset Submenu is used to take the calibration parameters back to the initial factory settings. This may be done on initial installation or whenever the operating parameters have been misadjusted by the operator.

Complete Reset resets all system parameters to their initial "default" settings. **Partial Reset** allows partial resetting of individual functions, such as Conductivity, pH, ORP, etc.

Submenu 8.2.5



Submenu 8.2.6



8.2.6 - Backup Battery

The CHEMTROL$_{(R)}$ **CT Controller** uses a 3V lithium battery to maintain calibration, setup and test data in memory storage in case of power shutdown. The battery is designed to last for more than 200 days without any power being supplied to the unit. The minimum voltage required is about 2.5 V. The Battery Submenu displays the voltage of the battery for information. A flashing display on the Main Display screen indicates a low battery voltage.

To prevent loss of memory data, the battery should be replaced when the voltage gets below 2.5 V. If power to the memory is completely discontinued, all settings revert automatically to the initial default values. They have to be individually reset to their proper values by the operator.

When changing the battery, it is important to keep power supplied to the unit to keep the proper settings in memory.

8.2.7 - Probe Monitor

Probe Monitor is a unique CHEMTROL$_{(R)}$ **CT Controller** feature (Patent Pending) that allows dynamic monitoring of the pH and ORP sensors to alert a probe failure as soon as it happens. Other controllers have to enter an alarm condition in order to alert the operator. This could result in potential damage and liability.

To activate or disactivate the Probe Monitor function, use the Right Arrow to select YES or NO in Submenu 8.2, line 7.
To activate or disactivate the Probe Monitor function, use the Right Arrow to select YES or NO in Submenu 8.2, line 7.

8.3 - COMMUNICATIONS SUBMENU

The details of the communications features are discussed in Chapter III - TELECOMMUNICATIONS.

The Communications Submenu is used to select the phone numbers to report alarm conditions and to enter the identification number for voice telephone reporting.

8.3.1 - Phone Numbers

Up to six (6) different phone numbers can be entered for automatic calling in case of an alarm condition. Each number is called sequentially until one of the numbers is answered and the proper password is entered.

To delete a phone number, replace it with 0 (zero).

8.3.2 - Unit Identification

The unit identification number is used to identify individual facilities for voice telephone reports, either a status report or an alarm report. The default value is 1.

8.3.3 - Alarm Calling

Specify YES if you want the controller to dial automatically the phone numbers listed above in 8.3.1.

8.3.4 - 4-20 mA

The 4-20 mA output is an option (OPTION 4-20) that includes one or two converter boards to convert sensor readings and/or control outputs into analog signals that can be fed into analog monitoring equipment (BMS) or control equipment (pumps or valves with analog control circuitry).

The converter boards plug into separate areas of the mother board of the controller (see Chapter II - INSTALLATION).

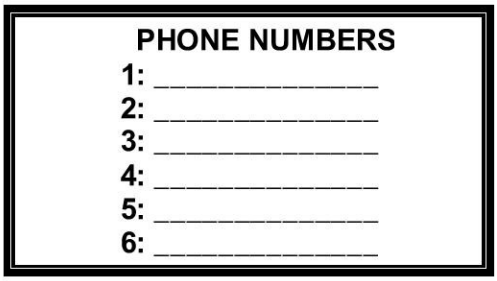
To convert sensor readings to BMS, the 4-20 mA SIGNAL Submenu is used to set the lower and upper limits for data conversion for each of the functions shown on the screen (Submenus 8.3.4 and 8.3.4.1). The standard (default) values for the 4-20 mA limits are the values that have been selected for the out-of-range limits. This means that the lower out-of-range limit corresponds to the minimum signal of 4 mA and the higher limit to 20 mA.

To change the limit values of one of the functions, highlight the desired function in Submenu 8.3.3 with the UP or DOWN ARROW key and press the RIGHT ARROW key to access the 4-20 mA LIMITS screen, as shown on the Submenu 8.3.4.1 for ORP.

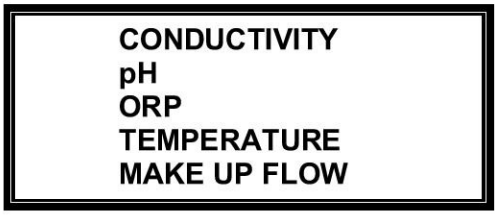
To convert control outputs to control equipment (valves, pumps), use the 4-20 mA CONTROL Submenu 8 (X.1.3.3) .

Submenu 8.3

Submenu 8.3.1



Submenu 8.3.4



Submenu 8.3.4.1

1 - CONDUCTIVITY MAIN MENU

Conductivity and TDS

The Conductivity sensor is used to monitor and control the concentration of **Total Dissolved Solids (TDS)** in the water. It reads the conductivity of the water in microsiemens per centimeter (µS/cm). The conductivity readings can be converted into ppm or mg/l of TDS by using a conversion factor that depends on the type of ionic species that are present in the water. Normally, a conversion factor of 0.5 is used for water solutions containing different species of carbonate and chloride ions (see 1.8 - Select Scale).

Control of Conductivity or TDS is obtained by replacing the water with fresh water when the concentration level gets too high. This is done by opening a valve to dump the water. Replacement with fresh water is done automatically by opening the valve through the water level control option.

Both flows of water - in and out - can be monitored with the flowmeter option.

Conductivity or TDS Display

Depending on the application, it may be customary to control either conductivity or TDS. The display is therefore available in the two systems, as shown on the sample screens.

Changing the displays from conductivity to TDS is done by changing the TDS factor from 1 to any other value different from 1. To do this, select the SELECT SCALE Submenu (see 1.8 and 1.8.2) and change the TDS factor value. If the TDS Factor is 1, the display shows Conductivity in µS/cm. If it is different from 1, it shows TDS in ppm or mg/l.

1.1- Control Mode

Line 1 shows the Control mode that is currently selected: OFF (X), Manual (M), AUTO (A), Cycle Timer (T), Percent of Flow (F), Daily Schedule (S) or 2-Week Schedule (B).

To change the Control Mode, select the first line with the UP or DOWN ARROW keys and press the RIGHT ARROW key. The Control Mode screen is then displayed.

The Control Mode screen and selection procedures are common to all control functions. See CONTROL Submenu in this Chapter.

1.2 - Display and Calibration

The second line displays the current reading of conductivity in µS/cm or TDS in ppm or mg/l.

The conductivity or TDS readings should be calibrated with standard test solutions and with temperature compensation activated on the controller.

As with all sensor calibrations, the conductivity sensor can be calibrated with 1, 2 or 3-Point calibration for origin, slope and curvature. This is done by pressing the RIGHT ARROW key to enter the CALIBRATION Submenu. The calibration procedure is common to all control functions. See CALIBRATION Submenu further down in Chapter II.

Menu 1

CONDUCTIVITY		AUTO
Calibrate	uS	1500
Setpoint	uS	2500
Alarm Low	uS	100
Alarm High	uS	5000
Time Limit	min	30
Run Time	15	60
Select Scale		

Menu 1 (Alternate)

TDS		AUTO
Calibrate	ppm	750
Setpoint	ppm	1250
Alarm Low	ppm	50
Alarm High	ppm	2500
Time Limit	min	30
Run Time	15	60
Select Scale		

Submenu 1.2.1

Use Automatic
Temperature Compensation
for Conductivity?
NO
YES

1.2.1 Temperature Compensation

After calibration, the Compensation Submenu 1.2.1 is displayed. This feature requires the use of the temperature sensor. The correction is expressed as a change of slope per degree Celsius at 25oC. The default is 2%, but it can be adjusted if necessary.

1.3 - Setpoint

The SETPOINT determines the conductivity or TDS level that will trigger the dumping (bleeding) of water when the controller when placed in the AUTO control mode.

To change the setpoint, press the RIGHT ARROW key and enter the numerical value with the digital keypad.

1.4 - Low Alarm

The ALARM LOW value is set to generate an alarm when the sensor reading falls below the set value. After the alarm value is set, the ALARM OPTIONS submenu 1.4.1 is shown, asking whether a low alarm condition should stop the dump valve and activate the alarm buzzer.

1.5 - High Alarm

The ALARM HIGH value is set to generate an alarm when the sensor reading rises above the set value. After the alarm value is set, the ALARM OPTIONS submenu 1.5.1 is shown, asking whether a high alarm condition should stop the bleed valve and activate the alarm buzzer.

1.6 - Time Limit

The TIME LIMIT sets the maximum amount of time in minutes that is allowed for continuous dumping of water to correct a high conductivity or TDS reading. This acts as a safety feature to prevent overdumping of water in case of a malfunction of the dump valve.

1.7 - Run Time

The RUN TIME displays the amount of running time in minutes for each current activation event and the cumulative run time since last reset to zero.

To reset the cumulative run time, enter zero in the last column. To reset only the current run time, turn the control mode off and back on.

After the cumulative run time is reset, the TOTAL TIME ALARM submenu (see submenu 1.7.1) is displayed to set the Total Time Alarm option. This alarm is activated when the cumulative run time reaches the alarm value. It does not lock the bleed control outlet.

1.8. - Select Scale

The Select Scale prompt takes the operator to the SELECT SCALE Submenu 1.8.

1.8.1 - Cell Constant

Conductivity is usually monitored with contacting-type sensors, which are made of two electrodes that are specifically sized and spaced to provide a known cell constant or factor.

The Cell Constant corresponds to the aspect ratio (in cm^{-1}) of the geometrical cell formed by the two electrodes (length divided by cross sectional area). It is set on the CHEMTROL® **CT Controller**, as specified by the probe manufacturer.

To check the cell constant, measure the conductivity of a water sample with a portable meter. Divide by the conductivity reading on the CHEMTROL® **CT Controller**. Make sure both instruments are consistent in using or not compensation.

Submenus 1.4.1 and 1.5.1

ALARM OPTIONS	
Bleed lockout	YES
Alarm Buzzer	YES

Submenu 1.7.1

TOTAL TIME ALARM
Alarm if total
Bleed time exceeds
110 min.
Enter 0 for no alarm

Submenu 1.8

SELECT SCALE	
Cell Constant	1.00
TDS Factor	0.50

1.8.2 - TDS Factor

The TDS Factor is the conversion factor used to convert from conductivity readings (in µS/cm) to Total Dissolved Solids concentrations (in ppm or mg/l). Entering a TDS Factor different from 1 automatically changes all readings and displays from conductivity to TDS.

Because the conductivity of ionic species varies with the type of electronic charges, the relationship with TDS is to a large extent empirical.

For most water treatment applications, the TDS factor is about 0.5. For instance, a Sodium Chloride solution with a conductivity of 2,764 µS/cm contains 1,410 ppm (mg/l) of NaCl. This indicates a TDS factor of 1,410 divided by 2,764, i.e. 0.51.

2 – Makeup Conductivity Menu (MCOND) (CT112 Only)

The **PX**112**x** controller is a modified **CT110**. The modification has been done to allow the control of cooling tower treatment based on Cycles of Concentration.

Cycles of Concentration

Cycles of concentration is a measure of the level of reuse of water in the tower basin. The higher the number of cycles, the more the water is being retained, rather than replaced with new makeup water.

The formula for Cycles of Concentration is as follows:

COC = Basin Water Conductivity/Makeup Water Conductivity

As an example, if you have makeup water with 500 uS of conductivity, and basin water of 1000 uS conductivity, you would be running your system at 2 cycles of concentration:

COC = 1000/500=2.0 Cycles

Controlling on Cycles of Concentration

Controlling on Cycles of Concentration is a useful option, if the makeup water that you are using fluctuates in quality. That is, if the makeup water in the morning has a conductivity of 500 uS, but changes to 1200 uS during mid-day high use periods, but you want to maintain the same level of water usage, controlling on cycles of concentration makes sense.

This is a typical scenario when a facilty supplements its city water supply with its own well water during the day.

MCOND Display

On the Main Screen of the **CT112**, the second line is the Makeup Conductivity line. It has four fields of information. The first is the number of Cycles of Concentration that the unit is programmed for. The second is the conductivity reading of the makeup water sensor. The third is the units of measure (either uS or TDS). The fourth is the current automation state.

CT112 Conductivity Menu 1

Menu 2.1 of the **CT112** looks identical to the Conductivity menu of the **CT110**/**CT3000**. However, there is one significant difference. The setpoint of the **CT112** is calculated by myltiplying the makeup water conductivity by the number of cycles, which is programmed in Menu 2.2.

If you try to program the conductivity setpoint for the **CT112** (Menu Item 1.3), the controller will not accept the value.

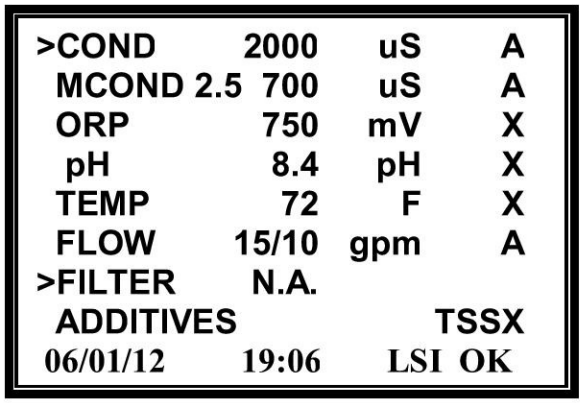
Menu 2 Cycles Menu

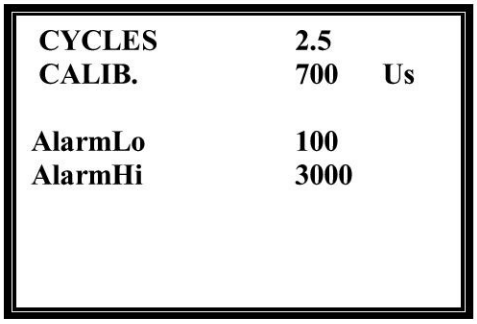
From this menu, you will program the number of cycles desired in your system.

2.1 Cycles

By entering this item, you will program the desired number of cycles in your system.

CT112 Main Menu





2.2 Calibration

This is where you will calibrate the makeup water conductivity sensor. For this sensor, ourstandard 1 or 2-point calibrations are available.

2.3 Alarm Low

This alarm triggers any time the makeup water conductivity falls below the programmed value. Low conductivity on the makeup water is generally not a problem, unless the sensor is sitting in air, in which case, it will move to zero.

2.4 Alarm High

This alarm is triggered when the makeup water conductivity rises above the programmed value.

2 - pH MAIN MENU

Operation

The pH function is used to monitor and control the concentration of acid or base in the water through the pH electrode.

The pH Menu screen is used to access all the pH submenus for Control Mode, sensor calibration, setpoint and alarm settings.

It also displays the actual run time for individual feed events and the cumulative run time since last reset to zero.

2.1- Control Mode

Line 1 shows the Control mode that is currently selected: OFF (X), Manual (M), AUTO (A), Cycle Timer (T), Percent of Flow (F), or Daily Schedule (S).

To change the Control Mode, select the first line with the UP or DOWN ARROW keys and press the RIGHT ARROW key. The Control Mode screen is then displayed.

The control mode screen and selection procedures are common to all control functions. See CONTROL Submenu in this Chapter II, page II-23.

2.2 - Display and Calibration

The second line displays the current reading of the pH sensor in pH units.

The pH sensor is best calibrated by testing the sample solution with a Phenol Red test kit. If needed, the CALIBRATION value may be adjusted to allow for differences or changes in pH sensor readings.

The pH sensor can be calibrated with 1, 2 or 3-Point calibration for origin, slope and curvature. This is done by pressing the RIGHT ARROW key to enter the CALIBRATION Submenu. The calibration procedure is common to all control functions. See CALIBRATION Submenu further down in Chapter II.

After calibration, the operator is shown the Submenu 2.2.1 asking whether automatic temperature compensation is to be used for pH readings. This option requires the use of the temperature sensor. The correction is normally small near neutral pH and is used only if large temperature fluctuations are expected.

2.3 - Setpoint

The pH SETPOINT determines the pH level that will be maintained automatically by the controller when placed in the AUTO control mode.

To change the setpoint, press the RIGHT ARROW key and enter the numerical value with the digital keypad. After pressing the OK key, the SETPOINT TYPE Submenu 2.3.1 is displayed asking whether the control is for Acid, Base or both.

Menu 2

pH		AUTO
Calibrate		7.4
Setpoint		7.5
Alarm Low		7.0
Alarm High		8.0
Time Limit	min	30
Run Time	15	60
Probe Rinse		OFF

Menu 2.2.1

Use Automatic
Temperature Compensation
for pH?
NO
YES

Menu 2.31

SETPOINT
Acid Feed
Base Feed
Both

The normal (default) setting is for Acid feed. This means that the feed outlet is automatically activated when the pH sensor reading rises above the setpoint. If it is set for base feed, the outlet is activated when the pH sensor reading is below the setpoint.

2.4 - Alarm Low

The ALARM LOW value is set to generate an alarm when the pH reading falls below the set value. After the alarm value is set, the ALARM OPTIONS Submenu 1.4.1 is displayed, to set the feed interlock and alarm buzzer options.

2.5 - Alarm High

The ALARM HIGH value is set to generate an alarm when the pH reading rises above the set value. After the alarm value is set, the ALARM OPTIONS screen is shown, asking whether a high alarm condition should stop the feeder and activate the alarm buzzer.

2.6 - Time Limit

The TIME LIMIT sets the maximum allowed time (in minutes) for continuous acid or base feed (see ORP submenus). This acts as a safety feature to prevent overfeeding in case of malfunction of the chemical feeder or as an alarm if the feed tank runs empty.

2.7 - Run Time

The RUN TIME line displays two separate values: the amount of running time in minutes for each current activation event and the cumulative run time since last reset to zero. To reset only the current run time, turn the control mode off and back on. To reset the cumulative runtime, enter zero in the last column.

After the cumulative run time is reset, the TOTAL TIME ALARM submenu 3.7.1 is displayed to set the Total Time Alarm option. It can be used to simulate a low chemical level alarm by entering the number of minutes needed to empty the chemical container: i.e. container volume divided by feeder rate (i.e.110 min = 55 ga / 0.5 gpm).

2.8 - Probe Clean

The Probe Clean Menu is used for automatic rinsing of the tips of the ORP and pH sensors by injection of a cleaning solution (usually a weak acid solution) through the recirculation line.

It has three modes of operation: Off, Manual and Automatic (see Submenu 2.8).

In both the Manual and Automatic modes, it allows a recovery time for the sensors to prevent chemical overfeeding while the signal is still affected by the cleaning solution (see Submenu 2.8.1). The recommended minimum is 1 minute.

In the Automatic mode, a 7-day weekly program is used to set up the ON and OFF times for probe cleaning any day or every day of the week (see Submenu 2.8.3).

Submenu 2.4.1 and 2.5.1

ALARM OPTIONS	
Feed lockout	YES
Alarm buzzer	YES

Submenu 2.7.1

TOTAL TIME ALARM
Alarm if total
Bleed time exceeds
110 min.
Enter 0 for no alarm

Submenu 2.8

PROBE RINSE
OFF
Manual
Auto

Submenu 2.8.3

PROBE RINSE	ON	OFF
MO	19:00	19:05
TU	00:00	00:00
WE	19:00	19:05
TH	00:00	00:00
FR	19:00	19:05
SA	00:00	00:00
SU	19:00	19:05

3 - ORP MAIN MENU

Operation

The ORP sensor is used to monitor and control a true oxidizer like ozone, or an oxidizing sanitizer, like chlorine or bromine. In the latter case, the controller monitors and controls the sanitizer through the oxidation-reduction potential it produces in the water.

The ORP Menu screen is used to access all the ORP submenus for Control Mode, sensor calibration, setpoint and alarm settings and shocking program (superchlorination if using chlorine).

It also displays the actual run time for individual feed events and the cumulative run time since last reset to zero.

3.1 - Control Mode

Line 1 shows the Control mode that is currently selected: OFF (X), Manual (M), AUTO (A), Cycle Timer (T), Percent of Flow (F), or Daily Schedule (S).

To change the Control Mode, select the first line with the UP or DOWN ARROW keys and press the RIGHT ARROW key. The Control Mode screen is then displayed.

The control mode screen and selection procedures are common to all sensor-based control functions. See CONTROL Submenu in this Chapter, page II-23.

3.2 - Display and Calibration

The second line displays the current reading of the ORP sensor in mV and is used to access the Calibration Submenu.

As with all sensor calibrations, the ORP sensor can be calibrated with 1, 2 or 3-Point calibration for origin, slope and curvature. This is done by pressing the RIGHT ARROW key to enter the CALIBRATION Submenu. The calibration procedure is common to all control functions. See CALIBRATION Submenu further down in this chapter.

Since the ORP sensor is direct reading and there are no readily available calibration solutions in the applicable range of operations for water treatment, it normally does not require calibration.

For other specialized applications, the calibration value may be adjusted to allow for differences or changes in ORP sensor readings.

3.3 - Setpoint

The ORP SETPOINT determines the ORP level that the CHEMTROL® PC maintains automatically when placed in the Automatic control mode.

Menu 3

ORP		AUTO
Calibrate	mV	750
Setpoint	mV	700
Alarm Low	mV	650
Alarm High	mV	850
Time Limit	min	30
Run Time	10	125
Last Shock		05/01/04

Menu 3.3

SETPOINT

Oxidizer
Reducer
Both

Submenus 3.4.1 and 3.5.1

ALARM OPTIONS

Feed lockout	YES
Alarm buzzer	YES

To change the setpoint, press the RIGHT ARROW key and enter the numerical value with the digital keypad. After pressing the OK key, the SETPOINT Submenu 3.3 is displayed asking whether the control is to be set for an Oxidizer, a Reducer or both.

The CHEMTROL® **CT Controller** includes one relay outlet for oxidizer and one for reducer (de-oxidizer) feed. The normal (default) setting is for an oxidizer. This means that the oxidizer feed outlet is automatically activated when the sensor reading falls below the setpoint.

3.4 - Low Alarm

The ALARM LOW value is set to generate an alarm when the pH reading falls below the set value. After the alarm value is set, the ALARM OPTIONS Submenu 3.4.1 is shown, asking whether a low alarm condition should stop the feeder and activate the alarm buzzer.

3.5 - High Alarm

The ALARM HIGH value is set to generate an alarm when the ORP reading rises above the set value. After the alarm value is set, the ALARM OPTIONS Submenu 3.5.1 is shown, asking whether a high alarm condition should stop the feeder and activate the alarm buzzer.

3.6 - Time Limit

The TIME LIMIT sets the maximum amount of time in minutes that is allowed for continuous feeding of the oxidizer to correct a high or low ORP reading. This acts as a safety feature to prevent overfeeding in case of a malfunction of the chemical feeder or as an alarm if the feed tank runs empty. The standard (default) value for ORP is 15 minutes but it can be changed at any time by the operator.

3.7 - Run Time

The RUN TIME line displays two separate values: the amount of running time in minutes for each current activation event and the cumulative run time since last reset to zero. To reset only the current run time, turn the control mode off and back on. To reset the cumulative runtime, enter zero in the last column.

After the cumulative run time is reset, the TOTAL TIME ALARM submenu 3.7.1 is displayed to set the Total Time Alarm option. It can be used to simulate a low chemical level alarm by entering the number of minutes needed to empty the chemical container: i.e. container volume divided by feeder rate (i.e.110 min = 55 ga / 0.5 gpm).

3.8 - Last Shock

The LAST SHOCK line shows the last date of Shock Treatment. It is shown for display only, no adjustment can be made to this date.

Press the RIGHT ARROW key to enter the Submenu 3.8 for Shock Treatment, De-shock and Chemical Saver.

For details on the following options, see the SHOCK and SAVER Submenu.

Submenu 3.7.1

TOTAL TIME ALARM
Alarm if total
Bleed time exceeds
110 min.
Enter 0 for no alarm

Submenu 3.8

ORP SHOCKS AND SHOTS

ORP Shock
ORP Deshock
ORP Booster

3.8.1 - Shock Treatment

Shock Treatment refers to treatment with an elevated level of oxidizer which should be performed from time to time to prevent the accumulation of noxious chemicals (chloramines) or biological forms (algae, etc.).

3.8.2 - Deshock

Deshock refers to the addition of a reducing agent (such as Sodium Thiosulfate) which is used to reduce excessive amounts of oxidizer introduced during Shock Treatment.

3.8.3 - Booster

The Booster/Single Shot function is used to schedule a delayed one-time feed event. See SHOCK AND SAVINGS in this Chapter.

4 - TEMPERATURE MAIN MENU

Operation

The Temperature Menu is used to monitor the water temperature with the temperature sensor.

The temperature values can be used for compensation of the conductivity and pH sensor signals. They are also used for calculation of the Langelier Saturation Index (LSI).

All displays are either in degrees Fahrenheit for the U.S. system of units or in degrees Celsius for the metric system.

The Temperature Menu screen is used to access sensor calibration and alarm settings.

4.1 - Display and Calibration

The second line displays the current reading of the Temperature sensor in either temperature units.

The Temperature sensor can be calibrated to adjust for changes in sensor readings.

The temperature sensor can be calibrated with 1, 2 or 3-Point calibration for origin, slope and curvature. This is done by pressing the RIGHT ARROW key to enter the CALIBRATION Submenu. The calibration procedure is common to all control functions. See CALIBRATION Submenu further down in Chapter II.

4.2 - Low Alarm

The ALARM LOW value is set to generate an alarm when the temperature reading falls below the set value. After the alarm value is set, the ALARM OPTIONS screen 4.2.1 is shown, asking whether a low alarm condition should activate the alarm buzzer.

4.3 - High Alarm

The ALARM HIGH value is set to generate an alarm when the temperature reading rises above the set value. After the alarm value is set, the ALARM OPTIONS screen 4.3.1 is shown, asking whether a high alarm condition should activate the alarm buzzer.

Menu 4

TEMPERATURE		
Calibrate	F	80
Alarm Low	F	70
Alarm High	F	85

Submenus 4.2.1 and 4.3.1

ALARM OPTIONS	
Alarm buzzer	YES

5 - FLOW MAIN MENU

The Flow Main Menu is used to monitor the flow of water in and out of the system (fill and bleed), the water level and the influent/effluent pressures at the filter, and operation of the recirculation pump.

Water Level

The water level in a water treatment system tends to decrease constantly due to evaporation, leaks and other losses. The water level control menu is used to add water automatically in order to make up for these losses.

Flow Rates

The flow rates for fill and bleed and cumulative volumes are monitored with flow meters and displayed on Menu 5.

Both can be used to determine the addition of chemicals (see Additives Menu 7).

Due to the high cost of industrial water treatment, it is also important to keep track of the amount of water going in and out of the system. The flow menu is used to monitor the fill and bleed flow rates as well as cumulative volume. The difference between the two cumulative values can be used to estimate the amount of water lost to evaporation and leaks.

Filter

Filters are used to remove solid particles from the water. As the filter becomes progressively saturated, the influent pressure increases. When the pressure gets too high, it is necessary to remove the accumulated solid particles by backwashing. With the CHEMTROL® CT6000, this can done automatically by monitoring the influent and effluent pressures at the filter.

5.1 - Water Level Control Mode

The water level can be maintained automatically with a fill valve controlled by an electro-optical sensor (P/N 138167).

As shown in Figure , the sensor uses the reflection of an LED beam inside a prism to determine the position of the water level. With no liquid present, the light beam from the LED is reflected within the prism to the receiver. When the liquid level reaches the prism, the index of refraction is changed and the beam does not reflect into the receiver. For best results, the surface of the prism must remain clean.

There is also an option to use a float level switch, instead of the optical sensor.

Submenu 5.1 is used to set the automatic fill valve to OFF, Manual or AUTO. The submenu allows the setting of a Time Limit for valve actuation to avoid overfilling.

It also displays actual and cumulative run times for water filling.

Menu 5

WATER LEVEL		**AUTO**
Fill	**gpm**	**15**
Total	**KGa**	**220**
Bleed	**gpm**	**10**
Total	**KGa**	**110**
P influent	**psi**	**25**
P effluent	**psi**	**20**
Main Pump		**AUTO**

Menu 5.1

WATER LEVEL		**AUTO**
Time Limit	**min**	**10**
Run Time	**5**	**15**

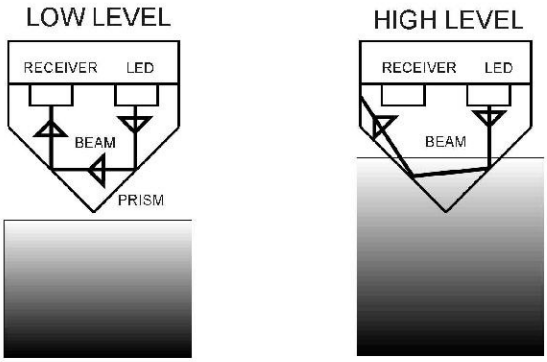


Figure 23 - Electro-optical Water Level Sensor

5.2 - Fill Flow Rate

Line 2 displays the make-up flow rate using either a Hall Effect or a Reed switch type flowmeter. To calibrate the meter, press the RIGHT ARROW key to enter the Fill Flowmeter Calibration Submenu 5.2.

For industry-standard pulsing watermeters, The flowmeter is calibrated by entering the number of gallons per pulse that the watermeter provides to the controller.

We can also setup to accumulate flow using sub-unit pulses by programming the controller with the manufacturer's K-Factor. If you have this sort of a flow sensor, please call the factory for direction.

5.3 - Cumulative Fill

Line 3 shows the fill water cumulative flow. By pressing the RIGHT ARROW key, the operator accesses the Fill Water History Submenu 5.3. Three counters are available for independent resets.

5.4 - Bleed Flow Rate

Line 4 shows the bleed water flow rate. Instructions for calibration are the same as for fill water in paragraph 5.2.

5.5 - Cumulative Bleed

Line 5 shows cumulative fill. By pressing the RIGHT ARROW key, the operator accesses the Fill Water History Submenu 5.5.

Submenu 5.2

```
FILL WATER
FLOWMETER CALIBRATION
Enter number of
Gallons per pulse:
____
```

Submenu 5.3

```
FILL WATER HISTORY

Total          Ga   220,000
Last Reset          06/01/04
Counter 1      Ga    90,000
Start Date          06/01/04
Counter 2      Ga    20,000
Start Date          06/07/04
```

Submenu 5.4

```
BLEED WATER
FLOWMETER CALIBRATION
Enter number of
Gallons per Pulse
____
```

Submenu 5.5

```
BLEED WATER HISTORY

Total          Ga   110,000
Last Reset          06/01/04
Counter 1      Ga    45,000
Start Date          06/01/04
Counter 2      Ga    10,000
Start Date          06/07/04
```

5.6 - Influent Pressure

Line 5 displays the Influent Pressure before the first filter.

This is one of the parameters that can be used to initiate the filter backwashing operation when it exceeds a specified value that is indicative of a dirty filter condition (see Filter Menu 7).

Pressure Alarms

Submenu 5.6 is used to specify the alarm limits for the influent pressure in case of malfunction of the pump, filter or valves. There is no equivalent submenu for the effluent pressure.

Submenu 5.6.1 sets the options for the alarms. If set on YES, the Feed Limit alarm shuts off the main pump and the buzzer alerts the operator.

Calibration

Upon exiting Submenu 5.6.1, the calibration submenu 5.6.1.1 is displayed. The pressure sensor is calibrated by entering a factor representing the output in volts per unit of pressure, as specified by the manufacturer of the sensor.

The factory set **default factors of 0.43 and 0.50** are valid for the transducer in the pressure range of 0 to 60 pi. It should normally not require any adjustment.

5.7 - Effluent Pressure

Line number 7 in the Pump Menu screen shows the value of the Effluent Pressure, i.e. after the filter(s).

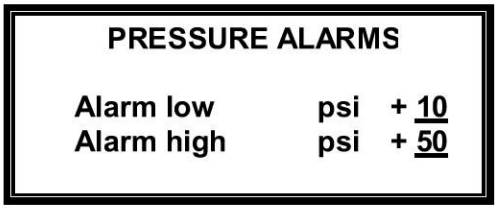
Submenu 5.7 is used for calibration of the effluent pressure sensor, if different from the influent sensor. It is calibrated in the same way as the Influent Pressure sensor.

Differential Pressure

The value of the Differential Pressure (Influent Pressure minus Effluent Pressure) is automatically calculated by the controller.

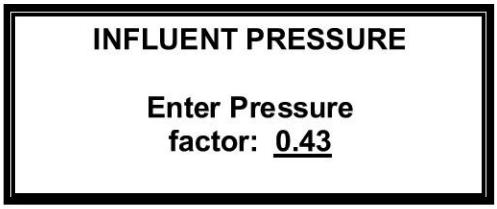
This is another parameter that can be used to initiate the filter backwashing operation when it exceeds a specified value that is indicative of a dirty filter condition (see Filter Menu 7).

Submenu 5.6



Submenu 5.6.1

Submenu 5.6.1.1



Submenu 5.7

5.8 - Main Pump Control

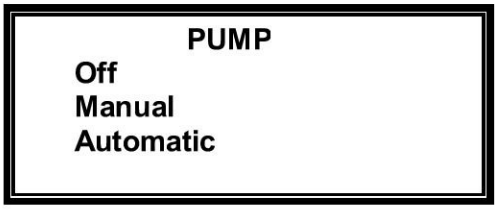
Line 8 shows the mode of operation of the recirculation pump: on, off, or on a weekly schedule. Press the RIGHT ARROW key to enter the Control Mode Submenu 5.8.

When AUTO is selected, the Pump 7-day Weekly Schedule Submenu 5.8.3 is displayed. Daily ON and OFF times can be selected by the operator. If nothing is selected, the pump stays on all the time.

All scheduled times should be entered in the 24:00 hour format. Different times can be entered for different days. This allows for reduced costs of operation on weekends.

Thirty seconds before the pump starts automatically, the alarm sounds a warning beep in case maintenance operations are being performed.

Submenu 5.8



Submenu 5.8.3

PUMP	ON	OFF
Mo	06:00	20:00
Tu	06:00	20:00
We	06:00	20:00
Th	06:00	20:00
Fr	06:00	20:00
Sa	06:00	18:00
Su	09:00	18:00

FILTER MAIN MENU Filter

Backwash

The Filter Menu for the CHEMTROL$_{TM}$ **CT6000** allows the operator to set the parameters for the filter backwash cycle. Automatic backwashing can be applied to one or more filters with programmable sequencing of multiple filters.
During backwash operation, the "BACKWASH CYCLE" message is displayed on the Main Screen.

Backwash operation is controlled with up to three (3) double-pole, double-throw (DPDT) relays to allow sequential closing and opening of backwash valves. See Filter Backwash in Chapter II - INSTALLATION for details.

Line 6.1 sets the BACKWASH mode to OFF, MANUAL or AUTO.

> OFF disables all backwash operations. If a backwash cycle is in progress, it is terminated immediately.
>
> MANUAL initiates an immediate backwash cycle.
>
> In the AUTO mode, the backwash cycle is initiated under programmable parameters, using a time schedule, influent pressure or differential pressure.

Line 6.2 sets the START DATE for the first timed cycle.

Line 6.3 sets the START TIME for time schedule cycles.

Line 6.4 sets the backwash duration per filter.

Line 6.5 sets the wait time between filters.

Line 6.6 sets the number of filters in the cycle (up to 3 filters or banks of filters). It then leads to Submenu 6.6 asking if a priority valve is used.

Line 6.7 calculates the total cycle time plus 3 minutes. If the flow rate at the end of the cycle is not restored to at least its initial value - indicating mechanical failure - the pump is shut off automatically.

Priority Valve

The Priority Valve submenu 6.6 allows the closing of a separate valve prior to individual backwashing of the filters. It is usually located on the return side of the recirculation line and is used to increase the water pressure and lift the sand beds inside the filters.

Pump Override

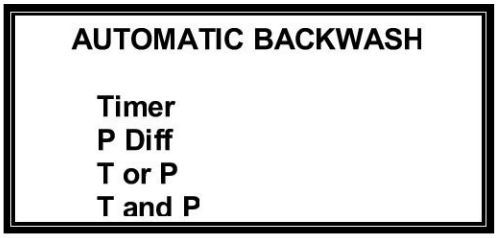
Submenu 6.8 sets the PUMP OVERRIDE option to shut off the pump during cycling of the backwash valves. This is sometimes recommended to reduce water pressure and facilitate operation of the valves.

The default value of 5 seconds can be changed by the operator through Submenu 6.8.

Menu 6

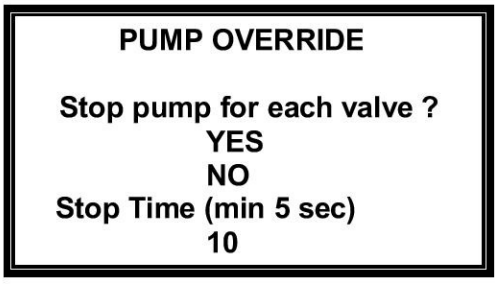
BACKWASH	AUTO
Start Date	08/10/96
Start Time	15:30
Filter Time (min)	10
Advance Time (min)	1
Number of Filters	6
Pump Shutdown	YES
Pump Override	YES

Submenu 6.1



Submenu 6.6

Submenu 6.8



6.1 - Automatic Backwash

Before accessing the setup screen, Submenu 6.1 shows a reminder indicating that the pump must be set to MANUAL or AUTO for the automatic backwash program.

Press the RIGHT ARROW key to enter the Automatic Backwash Program Submenu. This screen is used to select the type of automatic backwash.

6.1.1 - Timer Schedule

This option allows the operator to set a cycle schedule with a fixed interval of days between successive backwash operations. Pressure differential is not considered. If this option is selected, the program asks for the number of days between backwash cycles and then returns to the Backwash Submenu to specify the starting date and starting time of the day.

The standard (default) value for the backwash cycle is 14 days following the initial startup date set on the Backwash Submenu screen. It can be changed at any time by the operator.

6.1.2 - Pressure Differential

This option causes a backwash cycle to be initiated when the difference between the influent and effluent pressures at the filter exceeds the set amount. The difference entered can range from 1 to 99 psi or kg/cm^2.

6.1.3 - Time and Pressure Differential

This option causes a backwash cycle to be initiated when BOTH the specified interval number of days has passed AND the specified difference between the INFLUENT and EFFLUENT pressures exceeds the set amount.

The default difference value is 5 psi or kg/cm2. It can be changed to any value in the range of 1 to 99 psi or kg/cm2.

The time interval between backwash cycles can range from 1 to 99 days.

6.1.4 - Time or Pressure Differential

This option causes a backwash cycle to be initiated when EITHER the specified interval number of days has passed OR the specified difference between the influent and effluent pressures exceeds the set amount.

The default difference value is 5 psi or kg/cm2. It can be changed to any value in the range of 1 to 99 psi or kg/cm2.

The time interval between backwash cycles can range from 1 to 99 days.

Submenu 6.1.1

TIMER BACKWASH

Days between Backwash Cycles: 14

Submenu 6.1.2

PRESSURE DIFFERENTIAL

Backwash starts when Influent Pressure minus Effluent Pressure exceeds Difference

Difference: 5 psi

Submenu 6.1.3

TIME AND PRESSURE
Backwash starts When BOTH Time AND Pressure Difference are reached.
Time (days): 7
Difference (psi): 5

Submenu 6.1.4

TIME AND PRESSURE
Backwash starts if EITHER Time OR Pressure Difference is reached.
Time (days): 7
Difference (psi): 5

- ADDITIVES MAIN MENU

Operation

The ADDITIVES menu is used to program the addition chemicals that cannot be controlled through sensor input, such as: corrosion and scale inhibitors, non-oxidizing biocides, flocculants, dispersants, etc.

The additive menus can be customized by selecting names in the Configuration/Initial Set Up/Model Options/Additives submenu 8.1.7.7 from a pre-defined list. Menu 7 on the right shows a typical customized menu but other names can be selected.

Menu 7 is used to access each ADDITIVE submenu to set the control mode, alarms, display of individual feed events and cumulative run times.

Because all additive submenus are identical, only the menu for the first additive is shown here.

7.1.1 - Control Mode

Line 1 shows the Control mode that is currently selected: OFF (X), Manual (M), AUTO (A), Cycle Timer (T), Percent of Flow (F), or Daily Schedule (S). To change the Control Mode, select the first line with the UP or DOWN ARROW keys and press the RIGHT ARROW key. The Control Mode screen is then displayed.

The control mode screen and selection procedures of modes OFF, Manual, Cycle Timer, Percent of Flow and Daily Schedule are common to all control functions. See CONTROL Submenu at the end of this Chapter for detailed explanations.

The AUTOMATIC control mode is different for Additives: The operator can select either Bleed-and-Feed or Bleed-then-Feed (post-bleed as a percent of bleed) control.

7.1.1.3.1 - Bleed and Feed

In the Bleed-and-Feed control mode, the controller activates the control outlet at the same time that water is bled.

In the Bleed and Feed Submenu 7.1.1.3.1, line 1 specifies the percentage of bleed time.

Line 2 shows the maximum time in minutes allowed for feeding.

If additional feeding is required, line 3 is used to set complementary feeding on a daily schedule.

7.1.1.3.2 - Bleed then Feed

To prevent the loss of additives with bleed water, Bleed-then-Feed can be used.

In the Bleed-then-Feed control mode, the controller activates the feed only after bleed is completed as a percentage of bleed time.

The Bleed-then-Feed submenu 7.1.1.3.2 includes the Bleed Lockout option (submenu 7.1.1.3.2.4).

Menu 7

ADDITIVES	
Inhibitor	F
Descaler	A
Biocide	S
Flocculant	T

Submenu 7.1

INIHIBITOR		FLOW
Time Limit	min	30
Run Time	10	125
Booster		NO

Submenu 7.1.1.3.1

BLEED AND FEED		
Feed %		100
Max Time	min	30
Daily Schedule		NO

Submenu 7.1.1.3.1

BLEED THEN FEED		
Feed %		50
Max Time	min	30
Daily Schedule		NO
Bleed Lockout		YES

7.1.1.3.2.4 - Bleed Lockout

The Bleed Lockout submenu 7.1.1.3.2.4 is used to prevent bleed during - or immediately after - feeding of chemicals and to specify pre-bleed and/or pre-pH feed operations.

Line 1 displays the **bleed lockout** time in percentage of feed time. A value superior to 100% prevents bleed during and after feed.

Line 2 displays the **lock memory** option to accumulate feed lockout time until bleed is completed.

Line 3 and 4 display the **pre-bleed** option to reduce the risk of deposits due to increasing conductivity or TDS level during a lockout period. The pre-bleed can be specified for a length of time and/or until a conductivity level is reached.

The **Pre-pH** option is used to adjust the pH level before additive feed. The pH feed can be set for a length of time (line 5) and/or until a pH level is reached (line 6). The controller maintains the pH level during the entire feed cycle.

7.1.2 - Time Limit

Line 2 shows the maximum amount of time in minutes that is allowed for continuous feeding of the additive. This is designed to alert the operator in case of a malfunction of the chemical feeder.

7.1.3 - Run Time

The RUN TIME displays the time in minutes for current activation and cumulative run time since last reset to zero.

To reset the cumulative run time, enter zero in the last column. To reset only the current run time, turn the control mode off and back on.

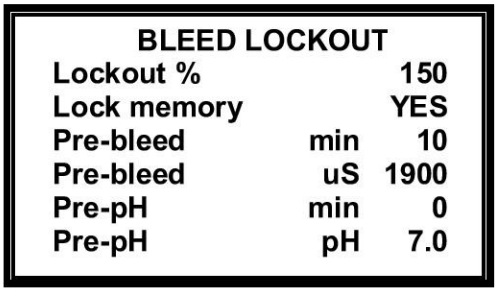
After the cumulative run time is reset, the TOTAL TIME ALARM submenu (see submenu 7.1.3) is displayed to set the Total Time Alarm option. It can be used to simulate a low chemical level alarm by entering the number of minutes needed to empty the chemical container: container volume divided by feeder rate (i.e.110 min = 55 ga / 0.5 gpm)

7.1.4 - Booster/Single Shot

The Booster (Single Shot) function is used to schedule a delayed one-time feed event (i.e. feeding the biocide at 1:00 AM for an hour). It is independent of the other control modes.

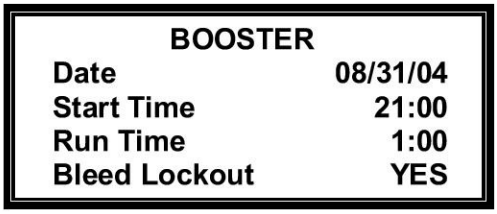
The Booster Submenu 7.1.4 allows selection of the date, start time and duration of the feed event. Selection of line 4 leads to the Bleed Lockout submenu 7.1.1.3.2.4.

Submenu 7.1.1.3.2.4



Submenu 7.1.3

Submenu 7.1.4



CONTROL SUBMENUS

The CONTROL Submenus for controls with sensor input (Conductivity, pH and ORP) are common to each other. The Additives Control submenus are also common, but Automatic control. Automatic control for additives is described in the ADDITIVES menu 7.

To simplify the presentation, the Control Submenus use the letters X and Y. X can be: 1 for Conductivity, 2 for pH or 3 for ORP. Y is for control type (ORP or pH only, see below): 1 for ON/OFF, 2 for Proportional and 3 for Progressive,

X.1 - Control Type

The first screen of the Control Submenu is used to select the control type: OFF (X), Manual (M), AUTO (A), Cycle Timer (T), Percent of Flow (F), Daily Schedule (S), or 2-Week Schedule (B). Use the UP and DOWN keys to highlight the desired selection and then press the RIGHT ARROW key to confirm the selection.

If the operator selects **OFF**, the controller turns off the feed control outlet immediately and returns to the previous menu.
If the operator selects **Manual**, the controller turns on the feed control outlet immediately and returns to the previous menu.

CAUTION: When set to Manual, the outlet *remains activated until reset* to off - regardless of the sensor readings. If the run time exceeds the Time Limit set by the operator in the specified submenu, the outlet will be turned off to prevent overfeeding.

X.Y.1 - Deadband

In all three automatic control modes (ON/OFF, Proportional and 4-20 mA), the controller uses a deadband zone near the setpoint to prevent chattering of the relay. The deadband is expressed as a percentage of the setpoint value and can be adjusted by the operator on the DEADBAND screen.

With the deadband, the outlet remains activated until the sensor reading reaches the setpoint, at which point it is de-activated. In order for the relay to be re-activated, the reading has to get outside the deadband, thus eliminating the effect of small fluctuations.

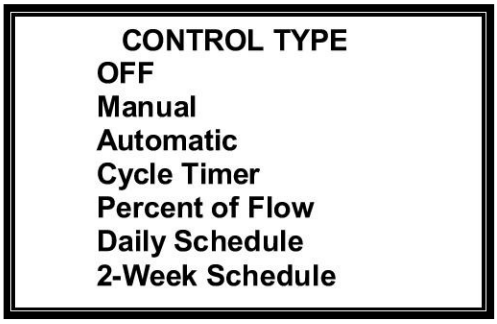
X.Y.2 - Progressive Zone

The PROGRESSIVE ZONE is a control zone around the setpoint where the outlet activation depends on how far the sensor reading is from the setpoint (see schematic above).

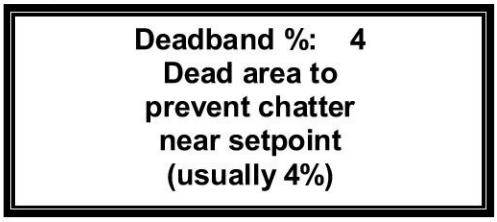
If the sensor reading is outside of the zone, then the outlet is turned on 100% of the time. The activation rate then decreases progressively as the reading nears the setpoint value. It reaches 0% when the reading enters the deadband zone near the setpoint.

This control mode is available in Proportional Control only (see next page). It provides more precise control than ON/OFF control and reduces overfeeding, particularly in smaller bodies of water.

Submenu X.1



Submenu X.0.1



Submenu X.0.2

X.1.3 - Automatic Sensor Control

In Automatic Control with pH or ORP sensor input, the operator can choose among two different Control Modes: ON/OFF, Proportional. Conductivity control uses only ON/OFF control.

X.1.3.1 - ON/OFF Control

In the ON/OFF Control mode, the controller activates the control outlet until the setpoint is reached, at which point it is turned off. It is turned on again when the reading is outside of the deadband.

Selection of the ON/OFF control mode leads to the DEADBAND submenu screen X.0.1 (see previous page).

The ON/OFF control mode is recommended to obtain fast corrections to return to the setpoint rapidly, if there is no concern about overshooting (overfeed). This is particularly applicable to larger bodies of water.

Proportional Control is recommended for more precise control, especially in smaller bodies of water,

X.1.3.2 - Proportional Control

In the Proportional Control mode, the controller turns the feed on and off at a rate varying from 0% to 100% of a 15-minute time cycle.

Proportional control applies only within the Progressive Zone (Submenu X.0.2 on previous page).

The wider the Progressive Zone is, the more slowly and precisely the controller will return to the setpoint. As the width of the Progressive Zone is decreased, the reaction becomes faster and faster until eventually one approaches the conditions of ON/OFF control.

X.1.3.3 - 4-20 mA Control

This type of control is designed for electronic pumps with linear response to current inputs. It appears on the display only when the option is installed.

Instead of relays, the controller sends an electronic signal from 4 to 20 mA. The output is proportional to the distance from the setpoint. For instance, a 4 mA output corresponds to a 0% feed rate, 12 mA to 50% and 20 mA corresponds to 100%. The values of the 0 and 100% limits are adjustable for each function, as shown in submenu X.1.3.3.1 for ORP.

X.1.4 - Cycle Timer

Timer Control mode is available as a temporary control mode if a sensor is defective or not available.

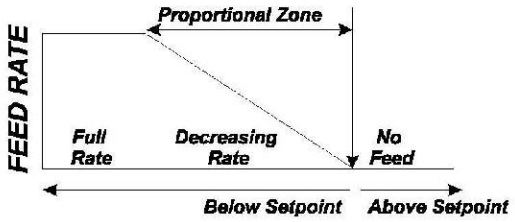
In this mode, the controller activates the control outlet according to fixed ON and OFF cycles. Each cycle is adjustable in 0.1 minutes increments.

Selection of the Bleed lockout function, displayed on line 3, is used when it is desirable to lock chemical feed during bleed and lock bleed during and after feed. It leads to the Bleed lockout Submenu X.1.4.2.3 (described above).

Submenu X.1.3.2.1

AUTOMATIC CONTROL
ON/OFF
Proportional
4-20 mA

Proportional Control



Submenu X.1.3.3.1

4-20 mA Limits	
ORP Top	850
ORP Bottom	650

Submenu X.1.4.1

CYCLE TIMER	
Cycle ON (min)	0.1
Cycle OFF (min)	1.0
Bleed Lockout	YES

X.1.4.2 - Percent of Flow

In this mode, the controller activates the control outlet for a length of time that is proportional to the volume of fill water as monitored by the fill flowmeter (gallons or liters).

The % Flow Submenu X.1.4.2 displays the amount of time in minute for the selected volume of water.

The Bleed lockout function on line 3 prevents bleed during and after feed and specifies pre-bleed and/or pre-pH functions. It leads to the Bleed lockout Submenu X.1.4.2.3.

X.1.4.2.3 Bleed Lockout

The Bleed Lockout submenu X.1.4.2.3 is the same as for the additives menu. It is used to prevent bleed during - or immediately after - feeding of chemicals and to specify pre-bleed and/or pre-pH feed operations.

Line 1 displays the **bleed lockout** time in percentage of feed time. A value superior to 100% prevents bleed during and after feed.

Line 2 displays the **lock memory** option to accumulate feed lockout time until bleed is completed.

Line 3 and 4 display the **pre-bleed** option to reduce the risk of deposits due to increasing conductivity or TDS level during a lockout period. The pre-bleed can be specified for a length of time and/or until a conductivity level is reached.

The **Pre-pH** option is used to adjust the pH level before additive feed. The pH feed can be set for a length of time (line 5) and/or until a pH level is reached (line 6). The controller maintains the pH level during the entire feed cycle.

X.1.5 - Daily Schedule Control

In the Daily Schedule Control mode, the controller activates the control outlet for selected daily intervals - regardless of sensor input. Selection of the Daily Schedule control mode leads to the Daily Schedule Submenu screen X.1.5.

The operator selects the date of the first treatment ("Next Date") and the cycle in days for repeat treatments. The operator also sets the start time and duration (in minutes) of the treatment. "Last Date" shows date of last treatment.

The Bleed lockout function on line 5 prevents bleed during and after feed and specifies pre-bleed and/or pre-pH functions. It leads to the Bleed lockout Submenu X.1.4.2.3.

X.1.6 – 2-Week Schedule

Much like the Daily Schedule Menu, the controller activated the control outlet for selected times. However, with this option, you can choose the days of the week that you want to feed. An important programming difference is that in this function, the Date field must be programmed to the **SUNDAY PRIOR TO THE FIRST FEED DATE.**

With this option, you select the feed days by highlighting the days line, and pushing the right arrow until the "0" above your desired day is blinking. Then, using the up arrow, change the "0" to a "1".

Submenu X.1.4.1

PERCENT OF FLOW		
Feed Time	min	0.5
Fill water	ga	10
Bleed Lockout		NO

Submenu X.1.4.2.3

BLEED LOCKOUT		
Lockout %		150
Lock memory		YES
Pre-bleed	min	10
Pre-bleed	uS	1900
Pre-pH	min	0
Pre-pH	pH	7.0

Submenu X.1.5

DAILY SCHEDULE	
Next date	08/31/04
Cycles (day)	2
Start Time	21:00
Run Time (min)	30
Bleed Lockout	YES
Last date	08/15/04

Submenu X.1.6

2 Week Schedule	
Date	02/17/13
Cycle (Days)	14
Start Time	06:00
Run Time	20
Bleed Lockout	YES
00000000000000	
SMTWT FSSMTWTF S	

CALIBRATION SUBMENUS

X.2 - Calibration Options

The CALIBRATION Submenu is common to all the functions that require sensor calibration. This includes Conductivity, pH, Temperature and ORP. Pressure and Flow have only direct 1-point calibration.

The CALIBRATION OPTION Submenu X.2 is used to select the number of calibration points desired. Most applications require only 1- Point calibration but any number up to three can be selected. If more than 1-point calibration is selected, the operator needs to use calibrated buffer solutions. These sample solutions must be spaced sufficiently from one another to yield meaningful calibration values.

X.2.1 - One-Point Calibration

When using 1-Point calibration, the conversion curve for the sensor readings is a straight line using the standard (default) slope built in the program.

1-Point calibration should be satisfactory for most applications. The operator places the sensor in a single water sample and tests it with an appropriate test kit. The value obtained is then entered on the calibration screen as the new display value.

The controller uses the calibration value that has been entered by the operator to calculate the origin “a” of the representative linear equation:

DISPLAY = a + SLOPE * INPUT

X.2.2 - Two-Point Calibration

With 2-Point calibration, the operator needs to use two different solutions with values that are spaced widely enough to show significant differences in the slope of the calibration curve.

The controller uses these values to compute the origin “a” and slope “b” in the equation:

DISPLAY = a + b * INPUT

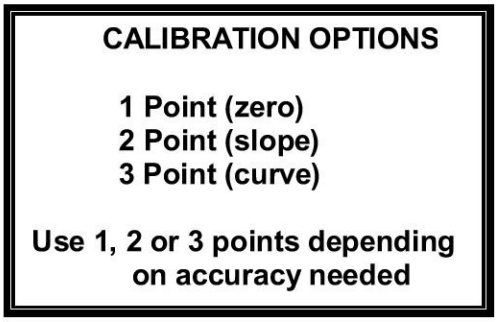
X.2.3 - Three-Point Calibration

With 3-Point calibration, the representative straight line is replaced by a second-degree polynomial curve. The operator needs three different solutions, again with values that are spaced widely enough to show differences in the curvature of the polynomial.

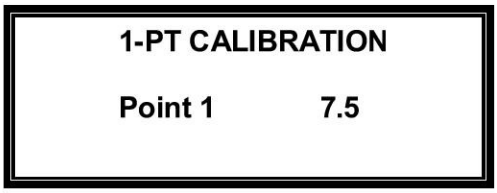
The controller uses these values to compute the origin “a”, slope “b” and curvature “c” in the equation:

DISPLAY = a + b * INPUT + c * INPUT*INPUT

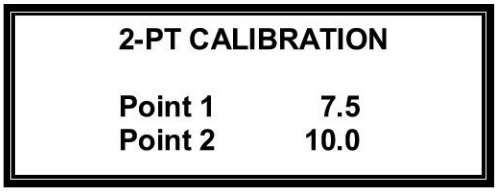
Submenu X.2



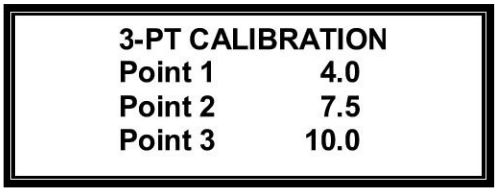
Submenu X.2.1



Submenu X.2.2



Submenu X.2.3



AND SAVINGS SUBMENUS 3.8 -

Treatment Selection

The various types of shock treatment and recovery are selected from the following menu screen.

The **Shock Treatment** program is used to raise the level of oxidizer or sanitizer in the water in order to destroy harmful elements - such as chloramines, germs and algae - that develop immunity to normal chemical levels.

The **Deshock** program normally follows the Shocking program automatically in order to return the concentration levels back to normal values.

The **Booster** program is used to is used to schedule a delayed one-time feed event, such as during nighttime or on weekends. It is independent of other control modes.

3.8.1 - ORP Shock Program

The Shock Treatment Submenu allows the operator to set the program to OFF, ON or AUTO.

When set to ON, the Shock Treatment program starts immediately. When set to Automatic, the operator selects the date of the first treatment and the cycle in weeks for repeat treatments. He also sets the time to start and time to stop as well as the level of shock treatment to reach, in mV for Shock Treatment or in ppm or mg/l for Superchlorination.

Chemical injection stops when either the set level is reached or the end time is reached.

3.8.2 - ORP Deshock Program

The deshock program is set to feed a reducing agent - such as Sodium Thiosulfate - to eliminate excessive amounts of sanitizer after superchlorination. The operator may set the desired level, and the time limit in hours for the deshock process. When enabled, deshock immediately follows the shock treatment process. It stops when either the set level or the time limit is reached.

3.8.3 - ORP Booster

The **Booster** program is used to is used to schedule a delayed one-time feed event, such as during nighttime or on weekends (i.e., feeding the oxidizing biocide at 1:00 AM for an hour). It is independent of other control modes.

The Booster Submenu allows selection of the date, start time, and duration of the feed event. Selection of line 4 leads to the bleed lockout submenu X.1.4.2.3.

Submenu 3.8

ORP SHOCK AND SHOTS
ORP Shock
ORP Deshock
ORP Booster

Submenu 3.8.1

ORP SHOCK	AUTO
Shock date	08/10/04
Cycle (weeks)	1
Time on	21:00
Time off	23:30
Level	850
Bleed lockout	NO

Submenu 3.8.3

ORP BOOSTER	
Date	08/31/04
Start Time	21:00
Run Time	1:00
Bleed Lockout	YES

CHAPTER III - COMMUNICATIONS

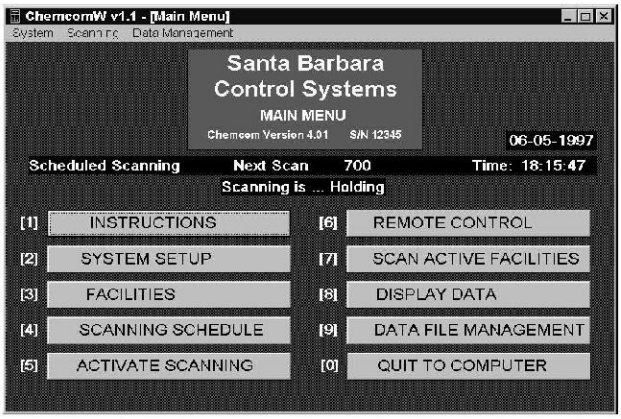


Figure 24 - CHEMCOM$_{TM}$ Program Main Menu

COMMUNICATION OPTIONS

The CHEMTROL® **CT Controller** offers several options for remote communications by computer or telephone:

- **Option RS485** includes an *RS485/RS232 converter* for on-site remote computer control with CHEMCOM$_{TM}$ Software,
- **Option ETHCOM** includes an Ethernet style connection, through the RS-485 port. This allows remote control using the internet as the primary mode of communication.
- **Option Wevserver** allows the controller to communicate through any web-capable device. This either requires the facility to provide access through any firewall or security; or a cellular modem to access the internet.
- **Option 420** converts sensor readings to 4-20mA signals.

REMOTE OPERATION OPTIONS

Direct Connection

The RS485 communication port for the RS485 option is located on the Mother Board. Although this option is requested infrequently these days, it is still available.

Computer Software Installation

The CHEMCOM$_{TM}$ computer software program for remote operation is provided on CD-ROM.

To install it in Windows®, click on Start/Run and type A:setup. The program gets installed in the Program Files / CHEMCOM directory.

It creates an icon that can be dragged to the Windows® Desktop screen using Windows® Explorer. To start the program, click on the CHEMCOM$_{TM}$ icon.

CHEMCOM$_{TM}$ Program

The main screen of the **CHEMCOM$_{TM}$** program is shown on Figure 24.

Menu 1 INSTRUCTIONS shows operating instructions.

Menu 2 SYSTEM SETUP is used to setup the communication port, i.e. COM1, COM2, COM3 or COM4.

Menu 3 FACILITIES is used to enter the name and phone number of each facility and the model number of the controller, i.e. **CT110**, **CT3000** or **CT6000**. Select "modem" for remote operation by modem connection or "direct" for remote operation by direct (RS485) connection.

For automatic scanning, the facility should be set to A (Active).

Menu 4 SCANNING SCHEDULE is used to select the automatic scanning mode: continuous, at regular intervals or on a set schedule.

Select either Menu 6 for REMOTE CONTROL of one facility or Menu 7 for AUTOMATIC SCANNING of multiple facilities.

The **Webserver** interface requires that you have the Username and Password, which is assigned at the facility level. When you sign on to the Webserver, you will see a list of the controllers for that facility or user. There is a drop-down box next to each controller on the list. In the drop-down box, you can download the accumulated data from the server.

By clicking on that controller, you will be shown the face of the controller in whatever status it is at the facility.

From this point, using the Webserver interface works very much the same as the Chemcom® software interface.

To establish connection from a remote computer, select Menu 6 on the Main Menu of the CHEMCOM$_{TM}$ program and click on the name of the remote facility.

The program will establish direct connection via the RS485 port to connect to the controller, showing a true duplex representation of the controller screen, as shown on Figure .

True duplex operation means that all the moves and operations on the remote computer screen are simultaneously executed in real time on the controller screen, and vice versa. This allows 100% remote control of all operating functions.

Navigation through the menus and submenus on the remote computer is done exactly as with the actual controller, by using the computer arrow keys or, under Windows®, by clicking on the arrows shown on the computer screen with the mouse.

With CHEMCOM$_{TM}$, the remote operator can verify all operating conditions at a glance.

Line 1 shows the **Conductivity readings at 2000 µS/cm** with the bleed valve on (>) in the automatic bleed mode (A).

Line 2 shows a **pH reading of 8.5** in the Automatic mode (A).

Line 3 shows an **ORP reading of 750 mV** with no oxidizer pump feeding (X).

Line 4 shows a **Temperature reading of 72 F**.

Line 5 shows the **Fill** and **Bleed flowrates of 15 and 10 gpm** respectively with the fill valve activated in the Automatic mode (A).

Line 6 shows that the **Filter Backwash** is in Manual mode (M) with influent and effluent pressures of 25 and 20 psi respectively.

Line 7 shows that the **Additive 1** is in the Timer mode (T), Additive 2 and 3 in Daily Schedule mode (S), and Additive 4 in OFF mode (X).

Line 8 shows the **Date and Time** and the saturation condition as OK. This last line also gives access to the Configuration Menu.

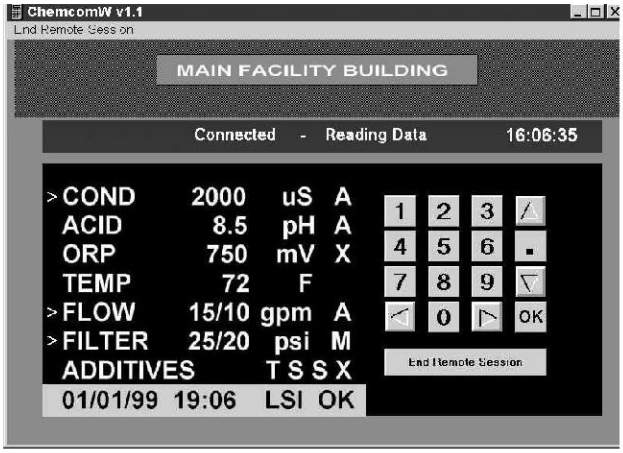


Figure 25 - CHEMCOM$_{TM}$ Remote Operation Screen

Automatic Scanning

To start automatic scanning, select Menu 7 on the CHEMCOM$_{TM}$ Main Menu. The modem on the computer automatically starts calling the remote facilities that have been marked as Active in the Facilities setup menu.

The operator can monitor single or multiple remote facilities from a remote PC computer screen, using a variety of scanning schedules. In the automatic mode, it scans all the facilities that have been set up as Active (A) in the FACILITY Menu (Figure).

When the remote controller is contacted, the test data is displayed on the computer screen, as shown below, and stored on disk file for later recall. Alarm conditions are alerted with flashing displays and audible beeps.

For unattended monitoring, a dedicated computer is recommended. However, the computer can also be used for other tasks under Windows® while the CHEMCOM$_{TM}$ program runs in the background.

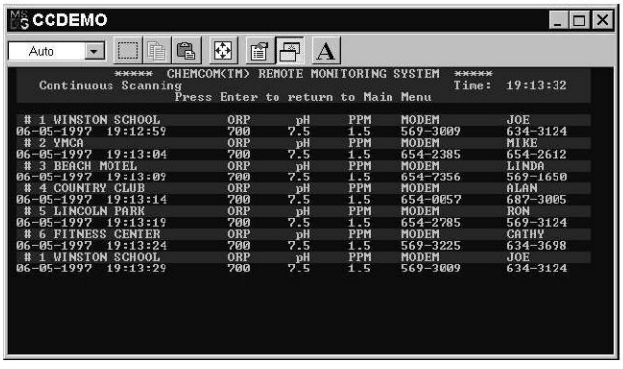


Figure 26 - CHEMCOM$_{TM}$ Remote Scanning Screen

Log Display

Data logged in the controller can be downloaded on site or remotely by computer, using the Submenu 8.2.4 for Operations/Print Reports, as explained in Chapter II.

The data is stored as a text file in the computer. It can be displayed as text data using any conventional word processor.

It can be displayed directly through the CHEMCOM$_{TM}$ program - as shown on Figure - using Menu 8 DISPLAY DATA and VIEW.

The test data can also be easily copied and incorporated into other documents, such as reports to management or to the health department.

Graphic Data Display

The data log can be displayed graphically with the CHEMCOM$_{TM}$ software program, using Menu 8 for DISPLAY DATA and GRAPH.

As shown on Figure , the graphics program displays two parameters simultaneously, such as ORP as a main variable and pH as an overlay, as shown on the right.

By clicking on the ZOOM ENABLE icon, windows can be drawn around parts of the graphs to display enlarged and more detailed views for selected dates or times. The left and right arrows allow scanning of the graph in either direction. To return to the full graph, click on ZOOM RESET.

The tool bar can be turned on to allow changes in scales, type of display and colors.

Using the ALT/Print Screen WINDOWS command, the graphic data display can also be copied as an image to other documents or reports.

CHEMTROL(TM) DATA LOG

	Time	ORP	San	pH	Cond	Tmp	Pump	Filt
04/29/97	12:15	753	1.3	7.5	3542	81	457	16
04/29/97	12:00	759	1.5	7.4	3541	81	457	16
04/29/97	11:45	762	1.6	7.4	3539	80	462	16
04/29/97	11:30	762	1.6	7.4	3538	80	452	16
04/29/97	11:15	762	1.6	7.4	3538	80	432	16
04/29/97	11:00	761	1.5	7.4	3537	80	472	16
04/29/97	10:45	757	1.4	7.4	3537	80	467	16
04/29/97	10:30	761	1.5	7.4	3537	80	462	16
04/29/97	10:15	762	1.6	7.4	3537	80	457	16
04/29/97	10:00	762	1.6	7.4	3537	80	447	16
04/29/97	09:45	764	1.7	7.4	3537	80	452	16
04/29/97	09:30	765	1.7	7.4	3536	81	462	16
04/29/97	09:15	768	1.8	7.4	3536	80	477	16
04/29/97	09:00	768	1.8	7.4	3536	80	427	16
04/29/97	08:45	769	1.8	7.4	3536	81	452	16
04/29/97	08:30	771	1.9	7.4	3536	81	437	16

F1=Help Enter=Display Menu Esc=Cancel Arrow=Nex

Figure 27 - Data Log Display

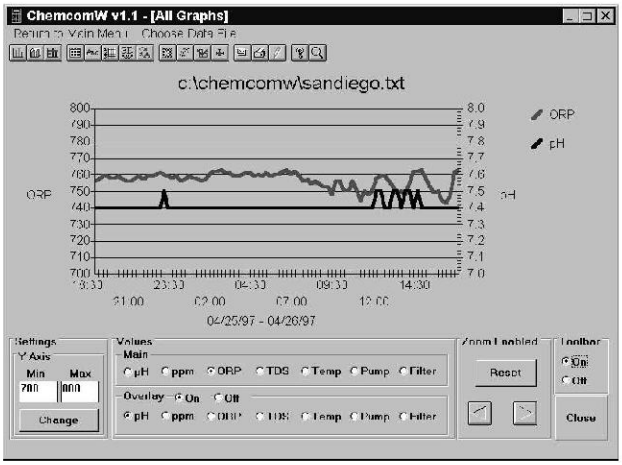


Figure 28 - Graphic Data Display

VOICE TELEPHONE STATUS REPORT

CONDUCTIVITY	*1500*	*OFF/MANUAL/AUTO/TIMER/FLOW/SCHEDULE*	*On/Off*
pH	*7.5*	*OFF/MANUAL/AUTO/TIMER/FLOW/SCHEDULE*	*On/Off*
ORP	*725*	*OFF/MANUAL/AUTO/TIMER/FLOW/SCHEDULE*	*On/Off*
TEMPERATURE	*78*		
PUMP	*15*	*OFF/MANUAL/AUTO*	*On/Off*
FILTER	*25*	*OFF/MANUAL/AUTO*	*On/Off*

TELEPHONE (OPTION TEL)

The Telephone (TEL) option supplements the Remote Operation (COMM) option. Available for the **CT3000** and **CT6000** controllers, it includes two forms of telephone communications using touch-tone phones:

- voice status reports,
- alarm callouts.

Voice Status Reports

The easiest way to communicate with the controller from a remote location is with a simple touch-tone telephone.

At any time, the CHEMTROL® **CT Controller** with the TEL option will answer an incoming phone call. The unit will first respond with modem tones, in an attempt to connect to a computer. If this connection has not been established after a few seconds, the voice announcement initiates the status report:

" CHEMTROL® *Unit* __"

using the unit identification number that has been specified in the Communications Submenu 8.3.2 (see Chapter II).

If code numbers have been specified in the Initial Setup Submenu, the controller waits without prompting until the caller enters his code number on the touch-tone phone. After a valid number is entered, the unit delivers the current status report.

As shown above, the status report includes:

- current value,
- applicable operating mode and
- applicable operational status.

The status report is repeated until the caller enters a number for a Main Menu or hangs up.

Alarm Callouts

Up to six different emergency phone numbers can be called when an alarm condition exists. The phone numbers are entered in the Telephone Data screen through the Configuration/Communications Submenu 8.3.1 (see Chapter II).

If any alarm occurs, the unit will dial in sequence the phone numbers entered in the Communication Submenu.

After dialing the unit ID and an alarm message is repeated verbally several times. When someone answers and enters a valid password, the unit stops calling and deliver the alarm message.

"*Alarm Unit* __"

4-20 mA SIGNAL (OPTION 420)

The 4-20 mA output is an option (OPTION 420) that includes one or two converter boards to convert sensor readings and/or control outputs into analog signals that can be fed into analog monitoring equipment (BMS) or control equipment (pumps or valves with analog control circuitry).

The converter boards plug into separate areas of the mother board of the controller (see Chapter IV - INSTALLATION).

The four analog signals for Conductivity, pH, ORP and temperature are set at the factory with the 4 mA and 20 mA limits corresponding to the Low and High alarm values for each parameter. These limits can be adjusted individually by the operator through the controller Submenu 8.3.4 (see Chapter III - OPERATION).

CHAPTER V - STARTUP

CONTROLLER STARTUP

Configuration Menu

The CHEMTROL® **CT Controller** is tested and shipped from the factory with the standard default values that are programmed in the controller.

Upon startup, it is recommended to verify the initial setup through the CONFIGURATION Menu (Submenu 8.1) and to adjust the values as required. This includes adjusting the clock for different time zones and selecting the proper language and units system.

Alarm Buzzer

To avoid unnecessary noise, the Audible Alarm option is normally turned off until the sensors are installed. Remember to turn it back on for normal operation (Submenu 8.2.1).

Bypass Line

The Bypass Line Option is normally turned off to allow initial chemical feeding upon startup. It is important to turn it back on (Submenu 8.2.2) as soon as the Safety Flow Switch is installed, to prevent accidental feeding when there is no water flow in the bypass line.

Battery Check

Check the condition of the Backup Battery. It prevents the loss of memory data in case of power shutdown. The voltage of the battery can be verified through the CONFIGURATION Menu (Submenu 8.2.6).

If the battery voltage is less than 2.5V, the battery should be replaced with a 3Vlithium battery, Panasonic CR2330 or equivalent.

BLEED AND CHEMICAL CONTROL

Initial Activation of Sensors

For a new installation, it is recommended to wait for a week or two after filtration is started (if filters are used on the system) before installing the sensors. This will prevent damage to the sensors until all the dirt and debris have been filtered out of the water.

When ready to start the CHEMTROL® **CT Controller**, install the sensors in the recirculation line and run the recirculation pump for 15 to 30 minutes or until the readings of the sensors stabilize.

Bypass Line Test

If there is a bypass line, open the sampling tap on the bypass line and adjust the two shutoff valves until there is a smooth flow of water coming out of the tap (no suction or excessive pressure).

Conductivity and Chemistry Adjustment

Before starting automatic control, the water chemistry should be adjusted to near the recommended values for conductivity/temperature, pH and ORP. The chemicals can be added manually or with the controller set on Manual Mode.

NOTE: *The controller will not operate in the Automatic Mode if the sensor readings are below or above the alarm settings.*

Water Sampling

Proper water sampling is essential for accurate calibration of the conductivity/temperature, pH and ORP sensors. The preferred method is to sample the water as close as possible to the location of the sensors, usually on the bypass line. The bypass line should be therefore equipped with a water sampling tap, which can consist simply of a ball valve.

Because of the instability of chlorine, particularly under sunlight, samples taken near the surface of the water can give false results.

Conductivity Calibration

Test the conductivity of the water at least twice with a portable conductivity meter or until you get consistent readings. Make sure that controller and portable meter use temperature compensation at 25oC.

If the portable meter value differs from the value shown on the controller display, using a calibrated standard solution, select Conductivity Menu and Calibration Submenu and enter the value indicated on the reference solution, using the 1-Point Calibration option. For more accurate calibration with 2 or 3 points, conduct the same process with two or three different conductivity values using calibrated standard solutions of appropriate values.

pH Calibration

NOTE: Always calibrate the pH sensor first, before the sanitizer.

Test the pH of the water at least twice with a fresh solution of a standard Phenol Red test kit, or until you get consistent readings.

- If the pH is below 7.0: **CAUTION: POSSIBLE CORROSIVE CONDITION**. Add a base (Soda Ash, Caustic Soda NaOH, pH PLUS, pH UP, etc.) to raise it.

- If the pH is above 8.0: **CAUTION: POSSIBLE SCALING CONDITION**. Add an acid (Muriatic Acid, Hypochloric Acid HCl, Sodium Bisulfate, etc.) to lower it.

If the test kit value differs from the value shown on the controller display, select pH Menu and Calibration Submenu and enter the value indicated by the test kit, using the 1-Point Calibration option.

For more accurate calibration with 2 or 3 points, repeat the same process at two or three different pH values using calibrated standard solutions of appropriate values. Most common values are for pH 4.0, 7.0 and 10.0.

pH Feed (Acid or Base)

The CHEMTROL® **CT Controller** has both Acid and Base feed outlets for pH control. Acid Feed is activated when the pH is **above** the setpoint and Base Feed when it is below the setpoint.

In most cases, only one type of chemical is required, i.e. either acid or base, depending mostly on the type of sanitizer used. Make sure to connect the acid or base chemical feeder to the proper outlet on the Power Board (see the INSTALLATION chapter).

pH Setpoint

The default value for the pH setpoint is 8.5. It can be modified at any time through the pH Menu.

ORP Calibration

The ORP sensor is direct reading and does not require calibration.

ORP Setpoint

The default value for the ORP setpoint is 700 mV. It can be modified at any time through the ORP Setpoint Submenu.

The controller will automatically activate the chlorinator, brominator or ozonator whenever the reading is below the ORP deadband. It will stop automatically as soon as the reading is above the ORP setpoint.

ADDITIVES Feed

The CHEMTROL® **CT Controller** has four (4) feed outlets for chemical additives such as inhibitors, biocides, descalers, etc. Each additive Feed can be controlled manually, automatically (bleed & feed, bleed-then-feed), on cycle timer, as a percent of flow, or following a daily schedule.

In most cases, corrosion and scale inhibitors are fed automatically or on percent of flow, while biocides are fed on daily schedule.

Time Limits

The Time Limits for each outlet should be set for the length of time that can be safely tolerated for chemical overfeeding - in case of equipment malfunction or operator error. This time varies with each installation, based on the size of the installation (gallons of water) and the feed rate of the chemical feeders.

If needed, see your CHEMTROL® **CT Controller** Qualified Dealer for assistance.

Shock Treatment

It is recommended to wait several weeks before using the automatic superoxidation cycle, or until all the other operating functions of the controller have been properly tested out.

SATURATION INDEX

The CHEMTROL® **CT Controller** features automatic calculation of the Langelier Saturation Index (Submenu 8.2.3).

It is recommended to check the water saturation as soon as possible after installation to prevent damage to the equipment through corrosion or scaling. This should be done immediately after calibration of the pH and temperature sensors, using a reliable test kit to obtain the alkalinity and calcium hardness values.

CHAPTER VI - MAINTENANCE

CONTROLLER MAINTENANCE

Regular Maintenance

The CHEMTROL® **CT Controller** requires very little maintenance besides cleaning of the sensors and replacement of the battery, if needed, after a long shutdown.

How often the sensors require cleaning depends on the quality and flow of water. Use the Acid Test below to check the pH and ORP sensors. It is recommended to schedule preventive cleaning programs on a weekly or monthly basis.

The Acid Test

The Acid Test can be used to check the pH and ORP sensors on line.

Carefully add a small amount (½ cup or less) of hydrochloric (muriatic) acid HCl in the intake side of the recirculation line, upstream of the sensors, and observe the pH and ORP readings on the Main Display. After a few minutes, the pH reading should go down and the ORP reading up. After several minutes, both readings should return to their original values.

Sensor Cleaning

The sensors may stop reading properly if they become coated with a film of oil, calcium or dirt.

To clean the **pH Sensor**, carefully remove it from the compression fitting and clean the tip in a liquid soap solution (such as Joy, Palmolive, etc.). If it still does not work, dip it again for 5 to 10 seconds in muriatic acid (hydrochloric acid HCl). Rinse in clean water and reinsert it in the fitting.

For the **ORP Sensor**, use the same procedure.

The electrodes of the **Conductivity Sensor** can be cleaned with a mild abrasive (brush or sandpaper) to remove non-conducting deposits.

The prism of the **Water Level Sensor** can be cleaned with a gentle soap solution and a soft tissue. *Do not use chlorinated hydrocarbons (acetone, gasoline, etc.).*

Winterizing

During cold weather, the sensors must be protected from freezing. Remove all sensors from the line and store them as follows:

- store at room temperature
- keep the protective cap on the sensor with a few drops of water to keep the tip moist. Check periodically that there is always some water inside the cap.
- store the sensors with the tips down to prevent the air bubble from migrating toward the junction,
- shock the sensor with chlorine if stored over 3 months.

Battery Replacement

The memory battery is located in the upper left corner of the Mother Board. It keeps the configuration, operational and calibration settings in memory if the power supply is shut down. A low battery condition does not affect the operation of the controller as long as the main power is on.

To check the voltage of the battery, go to Configuration / Operations / Battery to display Submenu 8.2.6.

If the battery shows a voltage below 2.5 V, it should be replaced with a 3V lithium battery, Panasonic CR 2330, SONY CR2032 or equivalent.

To replace the battery, turn off the power to the controller, slide out the old battery and insert the new one, making sure to set it in with the positive (+) side up.

After full power shutdown, the controller reverts to the original factory default settings. You must re-enter your own settings if they are different.

Software Upgrade

The software program in the CHEMTROL® **CT Controller** can be upgraded by replacing the program and display chips that are located on the Mother Board. To avoid damaging the chips, follow the procedure below carefully.

1. Disconnect all power to the unit and remove the jumper J1 (J3 for **CT110**) next to the battery on the motherboard.
2. Locate the Program Chip U2 and the Display Chip U3 (U28 and U8 for **CT110**) in the upper section of the board.
3. Insert a flat screwdriver under the old chip and pry it gently away from its socket. Store it as a backup.
4. Handle the new chip carefully and avoid electrostatic discharge. Identify the chip orientation with the small half-moon indent upward for the **CT3000** and **CT6000** (downward for **CT110**). CAREFUL: wrong installation will damage the program.
5. Make sure all the pins are straight. Insert the new chip in the socket by aligning all the pins on one side first, then on the other side, applying lateral pressure to facilitate insertion.
6. Replace the jumper in J1 (J3 for **CT110**) and restore power to the controller. You should see the CHEMTROL® logo displayed on the screen twice. When the display screen shows asterisks (***) for date and time, you are assured that the old program has been erased in its entirety.
7. Reprogram the controller to your desired parameters.

CHEMICAL MAINTENANCE

Overview

For best results, it is strongly recommended to have a primary operator in charge of water maintenance and testing, as different people can read the test kits differently.

Also, it is recommended to check the calibration of the controller at the same time of the day, preferably in the morning after a couple of hours of operation, but before full sun.

Finally, the system operator should become familiar with ORP technology (see below) and learn to trust the information it provides rather than less reliable test kits.

pH Control

The importance of proper pH control cannot be emphasized enough, as it affects every aspect of water chemistry.

When the pH is too low, the water becomes increasingly corrosive and causes stains or etching of plaster. When the pH is too high, the efficiency of the sanitizer decreases rapidly and the water becomes too alkaline - which causes cloudiness, stains and scaling.

pH control is also affected by Total Alkalinity (TA). If (TA) is too high, pH response is slow and requires more acid or base feed. If it is too low, pH control becomes very sensitive.

Because of the Time Lag for mixing of the chemicals in the water, there is always a fluctuation (0.1 to 0.2 pH units) above or below the setpoint, depending on the chemical feed rate.

If the pH tends to overshoot the setpoint, the Control Mode should be set to Proportional. Alternatively, the feed rate of the acid or soda feed pump can be reduced or a more dilute solution can be used (especially in a small body of water, like a spa). DO NOT CHANGE THE SETPOINT.

In an ACID FEED system, if the pH meter consistently reads too high (not enough acid), the feed rate of the acid feed pump should be increased, or a stronger solution should be used. DO NOT CHANGE THE SETPOINT.

In a SODA FEED system, if the pH meter consistently reads too low (not enough soda), the feed rate of the soda feed pump should be increased, or a stronger solution should be used. DO NOT CHANGE THE SETPOINT.

ORP Control

To be sure of proper sanitation, the ORP should always be above 650 mV. Even if using additional purification systems, such as ozone, UV systems or metal ion systems, **THE ORP READING MUST ALWAYS BE MAINTAINED ABOVE 650 mV.**

If the meter shows too much overshoot, the Control Mode should be set to Proportional to reduce the feed rate. DO NOT CHANGE THE SETPOINT.

If the meter consistently reads below the set point, reduce the width of the Progressive Zone or set the control mode to ON/OFF to increase the feed rate. DO NOT CHANGE THE SETPOINT.

The sensor reads ORP (Oxidation-Reduction Potential) which is closely related to the FAST ACTING FREE CHLORINE (HOCl), the most effective sanitizer. The DPD and FACTS test kits - and most other controllers - however read only the combination of FAST ACTING and SLOW ACTING FREE CHLORINE (HOCl and OCl^-). This is not very meaningful because the slow acting form of chlorine is about 80 to 100 times slower than HOCl in killing bacteria.

If the ORP reading is maintained above the recommended minimum of 650 mV, the water should be free of germs and bacteria. Below 650 mV, germs and bacteria will develop.

ORP readings are closely tied to the concentration of Fast Acting Free Chlorine (HOCl), which is affected by pH and by the cyanuric acid level. If the pH and/or cyanuric acid level are too high, the ORP will be reduced even with high levels of chlorine.

With stabilized forms of chlorine (dichlor powder or trichlor tablets), it is important to test the **cyanuric acid level** in the water regularly and to bleed or replace part of the water.

If other purification systems are used (**ozone, UV** or **metal ions systems**), it is very important to maintain the proper ORP level at all times with chlorine or bromine residuals.

NOTE: Never use **sequestering agents** with ORP sensors as they will coat the platinum ring and prevent it from reading.

Limit Timers (Overfeed Safety)

The Time Limit settings are designed to automatically disable the feeders or other equipment in the event of equipment failure or operator error such as:

- sensor or electronics failure,
- chemical feeder malfunction,
- improper valving of the recirculation system,
- manual override of automatic control by untrained or unauthorized personnel,
- depletion of chemical supply.

In normal operation, the chemical feeders are activated only for a short period of time - that is until the chemical level in the water has returned to the proper value. As soon as the chemical feeder is activated, the safety timer is turned on. Normally, feeding stops before the time limit is reached. The timer then resets to zero and waits for the next activation cycle.

However, if feeding continues over the preset time, the timer immediately stops the feeder and activates the overfeed alarm. It must then be reset manually by resetting the limit timer to 0 (see Chapter II) after the cause of the malfunction has been corrected.

Timer Settings

To select the proper setting for each safety timer, the operator must take into consideration the size of the system and the feed rate of the chemical feeder. In case of doubt, make sure to consult a qualified CHEMTROL® representative or call the factory.

NOTE 1: The chemical feeders should be properly sized for the installation so that they do not have to feed continuously for more than 3 hours - even during peak usage periods.

NOTE 2: Once tripped, the safety timer has to be reset manually by the operator after investigation and correction of the malfunction.

PERIODIC MAINTENANCE

Water Testing

1. Test the water with a reliable and fresh test kit daily or as often as required by the local health department.
2. Adjust the reading of the display if needed.
3. If the PPM or pH readings are out-of-range:
   a. Investigate and correct the cause of the problem immediately,
   b. Readjust the water manually if needed and recalibrate the displays.
4. If the displays cannot be recalibrated after adjustment of the water chemistry, clean the sensor tips and recalibrate the meters.
5. If the displays still cannot be calibrated, see the TROUBLESHOOTING section.

Shock Treatment

Even when maintaining the proper chlorine residual level with Chemical Automation, it is recommended to shock or superchlorinate the water periodically for the following reasons:

1. To prevent algae growth resulting from genetic adaptation of algae species to chlorine, i.e. becoming chlorine resistant.
2. If the chlorine level is allowed to fall below the normal level, even for a short period of time (due to exhaustion of chemicals or technical malfunction), there can be formation of chloramines, which can be destroyed only by breakpoint superchlorination.

WARNING:

If there is a concentration of chloramines of 0.2 PPM (mg/l) or more, a superchlorination level of 10 times the combined chlorine level is required.

The shock treatment program can be set up either through the ORP Menu or the SANITIZER Menu, depending on the choice of chemicals.

The weekly cycle, date and time should be selected based on the particular requirements and utilization schedule of the facility.

Precautions

A. During superchlorination, the Time Limit safety is bypassed.
B. A SHOCK treatment warning is displayed on the Display Screen when activated.
C. The out-of-range alarms stay on as long as the oxidizer or sanitizer levels are above the high limits.

Deshock (Dechlorination)

Following shock treatment, or superchlorination, it may be necessary to reduce the excess chlorine to allow swimming.

This can be done with a reducing agent such as Use Sodium Thiosulfate (Photographer's Hypo) with the Deshock program.

For faster results, it can also be done manually as follows:

Add 4.5oz (130 g) per 10,000 gallons (40 cubic meters) of water for each 1 PPM (mg/l) of chlorine to reduce.

Add half of the required amount first, allow time to react and test the water before adding the rest.

MAKE SURE TO TURN OFF THE CONTROLLER AND SHUT OFF THE BYPASS LINE WHEN DOING GENERAL MAINTENANCE SUCH AS BACKWASHING OR REPAIRS.

PORTABLE TESTER

The PORTA-PROBE™

The PORTA-PROBE™ II (Figure) is a battery-operated digital portable tester/signal generator. It is designed to test the ORP, pH, conductivity and temperature sensors and to generate calibrated signals to test the controller. It is supplied with a 9V battery and a pair of shielded cables with BNC connectors.

The PORTA-PROBE™ II is not used to calibrate the ORP and pH sensors. This should be done with a chemical test kit, such as DPD for Free Chlorine and Phenol Red for pH.

ORP and pH Simulation

Set the Mode Switch to SIMULATOR.

Use the two coaxial cables to connect the BNC connectors on the tester to the respective BNC connectors on the controller.

Set the Selector Knob to either pH or ORP Simulator. The readings on the controller should match the readings of the tester display (unless offset by calibration of the pH probe).

The outputs of the ORP and pH simulators can be adjusted with the two small knobs located below the digital display.

The ORP range is 0 to 1,000 mV.

As shown in Table III, the pH range is from -180 to + 180 mV (10 to 4 on the pH scale).

These outputs can be used to test for proper operation of the feed and alarm features of the controller.

> NOTE 1: Due to signal stabilization, the readings on the controller may take up to 10 seconds to reach full value.
>
> NOTE 2: ORP and pH signals can be generated simultaneously but only one signal is displayed.

Conductivity Testing

Connect the conductivity connectors on the portable tester to the controller input and perform the required simulation and testing.

Temperature Testing

Connect the temperature connectors on the portable tester to the controller input and perform the required simulation and testing.

Figure 29 - PORTA-PROBE™ Portable Tester

Table III - pH/mV Scale

pH Scale at 20°C		
mV	***pH***	
+420	0	A
+180	4.0	C
+60	6.0	I
+30	6.5	D
0	**7.0**	**NEUTRAL**
-6	7.1	B
-12	7.2	A
-18	7.3	S
-24	7.4	I
-30	7.5	C
-60	8.0	
-90	8.5	
-180	10.0	
-420	14.0	

ORP Sensor Testing

Set the Mode Switch to TESTING. Connect the ORP sensor to the ORP BNC connector on the tester. Turn the Selector Knob to ORP.

Place the sensor in balanced water (pH = 7.5 / PPM = 1.0 Cl). You should get an ORP reading within 650 to 750 mV.

Place the sensor in an acid solution. You should get a HIGH POSITIVE reading (Table IV).

Place the sensor in a BLEACH (liquid chlorine) solution. You should get a LOW POSITIVE reading (Table IV).

pH Sensor Testing

The PORTA-PROBE$_{TM}$ II shows actual pH sensor readings in millivolts, as shown on the pH Scale Table.

Set the Mode Switch to TESTING. Connect the pH sensor to the pH BNC connector on the tester. Turn the Selector Knob to pH.

Place the pH sensor in nearly neutral water (pH = 7.5). You should get a pH reading of about -30 mV.

Place the sensor in an acid solution. You should get a HIGH POSITIVE reading (Table IV).

Place the sensor in a BLEACH solution. You should get a HIGH NEGATIVE reading (Table IV).

The pH scale on Table III shows the conversion of Millville readings into pH units.

Table IV - ORP and pH Sensor Testing

TEST SOLUTION	*ORP SENSOR READING*	*pH SENSOR READING*
BALANCED WATER pH = 7.5 PPM = 1.0	Calibration OK	Calibration OK
MURIATIC ACID	HIGH	LOW
BASIC SOLUTION Soda Ash or CL Bleach	LOW	HIGH

TROUBLESHOOTING

Problems	Solutions
1. NO DISPLAY.	1a. Check power to system. 1b. Check On/Off Switch on right side of cabinet. 1b. Check Voltage Selector Switch in upper section of Power Board. Verify proper input voltage 110V or 230V. 1d. Check Fuse F2 on Power Board. If blown, replace with AGC1 fast blow fuse.
2. FAINT OR DARK DISPLAY	2a. Adjust contrast with Display Potentiometer R39 in center of Mother Board.
3. ERRATIC DISPLAY.	3a. Turn Power Switch off for 10 seconds and back on. 3b. Check power cable contacts. 3c. Check power strip connecting Mother Board and Power Board. 3d. Press program and memory chips on Mother Board to assure proper contacts.
4. NO EVENT ACTIVATION	4a. If PUMP Option is not available, set N.A. in Setup/Options submenu. 4b. If PUMP Option is available, verify that pump is ON.
5. NO CHEMICAL FEED NO BLEED	5a. Check flashing line in Main Display Screen. Highlight flashing line with UP or DOWN arrow. Press RIGHT arrow to enter submenu. Check flashing line in Submenu. 5b. If LOW or HIGH ALARM is flashing: Adjust water chemistry manually. Press RIGHT arrow to change alarm limits. Set Feed Lockout to Off (CAUTION !!!). 5c. If RUN TIME line is flashing: Increase chemical feeder rate. Increase Limit Timer setting. Reset Run Time with AUTO setting. 5d. If BYPASS LINE is flashing on Main Display: Check water flow in bypass line. Check Safety Flow Switch in bypass line. Set Bypass Line to Off in Operations Submenu (CAUTION !!!). 5e. Set Feed Mode to MANUAL. Feed Indicator on Main Display should turn on. 5f. Check Relay Fuses on Power Board. ORP Fuses F4 and F5 Sanitizer Fuses F10 and F11 pH Fuses F8 and F9
6. CANNOT CALIBRATE	6a. Check water balance and adjust if needed. 6b. Clean faulty sensor as indicated. 6c. Check sensor connections. 6d. Check sensor with the PORTAPROBE$_{TM}$. 6e. Test electronics with the PORTAPROBE$_{TM}$.
7. CHLORINE OR pH OVERFEED	7a. Clean and test the faulty sensor. 7b. Check and adjust the calibration. 7c. Check and adjust the setpoint. 7d. Check the relay. 7e. Check the chemical feeder for leaks. 7f. Reduce feed rate or dilute the solution. 7g. Check the Superchlorination Program.
8. IMPROPER READINGS	8a. Clean the faulty sensor. 8b. Test the sensor with the PORTAPROBE$_{TM}$. 8c. Test the electronics with the PORTAPROBE$_{TM}$.

PARTS AND ACCESSORIES

ORP	ORP SENSOR with 10-ft (3-m) shielded cable and BNC connector.
pH	pH SENSOR with 10-ft (3-m) shielded cable and BNC connector.
TEMP	TEMPERATURE SENSOR, 1/4" MPT, 10-ft (3-m) cable
C/T	TEMPERATURE + CONDUCTIVITY SENSOR with 10-ft (3m) cable.
FS	ON/OFF SAFETY FLOW SWITCH, 3/4" FPT, for bypass line.
PSI	PRESSURE TRANSDUCER, piezoelectric, 1/4" MPT.
138167	WATER LEVEL SENSOR, electro-optical, 1/4" MPT.
MB **CT110**	MOTHER PC BOARD, electronic PC board for **CT110** with microprocessor.
MB **CT3000**	MOTHER PC BOARD, electronic PC board for **CT3000** with microprocessor.
MB **CT6000**	MOTHER PC BOARD, electronic PC board for **CT6000** with microprocessor.
PB **CT110**	POWER PC BOARD, electronic PC board for **CT110** with relays (specify).
PB **CT3000**	POWER PC BOARD, electronic PC board for **CT3000** with relays (specify).
PB **CT6000**	POWER PC BOARD, electronic PC board for **CT6000** with relays (specify).
4-20MA	COMMUNICATIONS PC BOARD, 4-20 mA, 5 channels (for **CT3000** and **CT6000** only).
OM3212S	PRINTER, thermal, 40-column, 110V, with 6' (2m) cable and RS-232 connector.
FSLYCT	FLOW SWITCH LINE ASSY, 3/4"
205T	PVC SOLENOID VALVE, 1" or 3/4" FPT (specify 24 V or 110VAC).