MANUALPC2-2003

PRICE US$ 30

INSTRUCTION MANUAL

CHEMTROL$_{TM}$ PC2000 PROGRAMMABLE CONTROLLER

S/N_____

WARRANTY

This CHEMTROL$_{TM}$ 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$_{TM}$ Dealer or to our factory postpaid with a copy of your purchase receipt and a description of the malfunction.

TECHNICAL SUPPORT

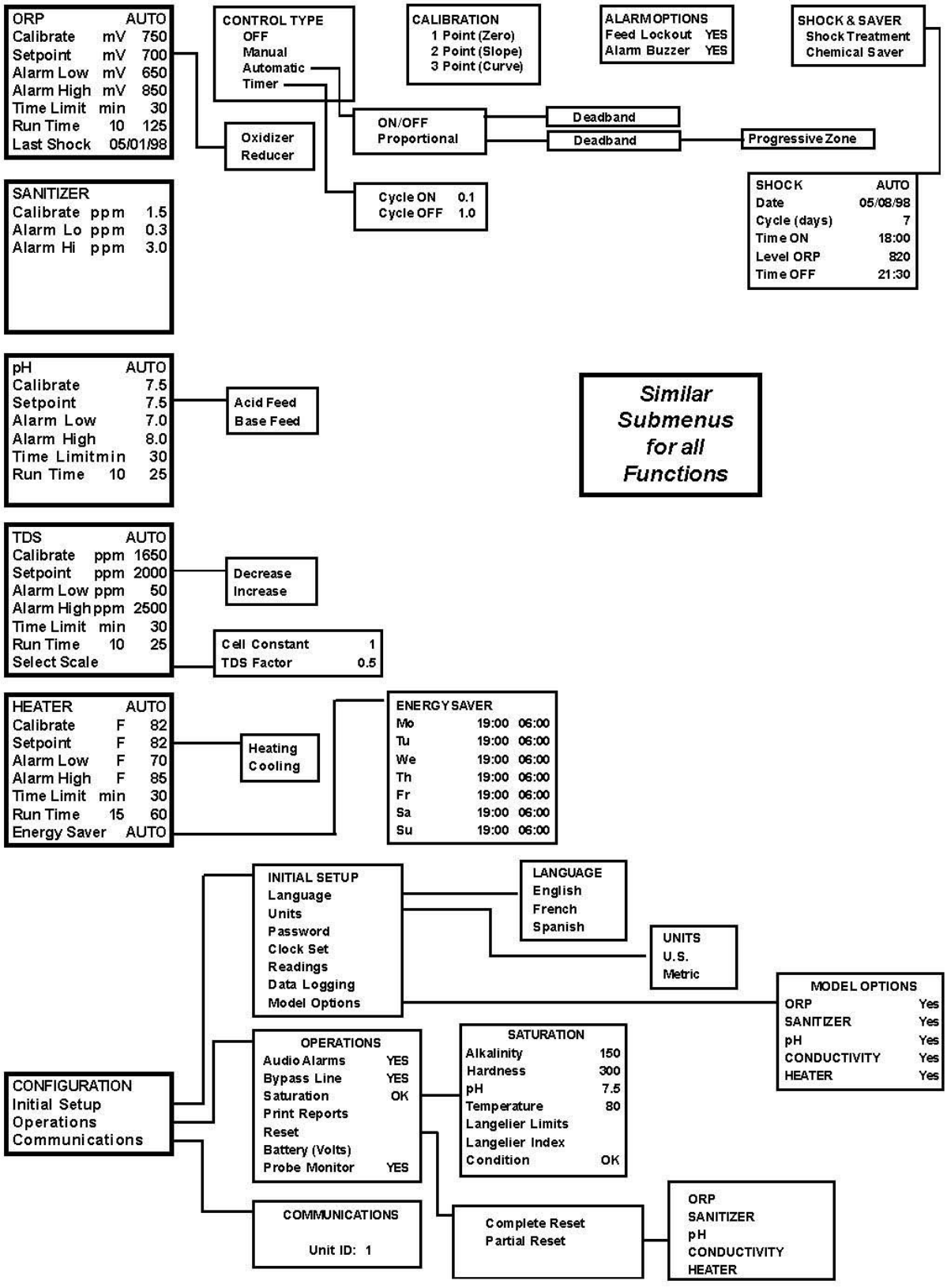
US/CANADA	***800-621-2279***
OTHER COUNTRIES	***805-683-8833***
FAX	***805-683-1893***
INTERNET	***support@sbcontrol.com***

Chemtrol™

SANTA BARBARA CONTROL SYSTEMS

5375 Overpass Road – Santa Barbara, CA 93111

MENU TREE CHEMTROL$_{TM}$ PC2000



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 tub or spa using nonmetallic plumbing.

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 a spa or hot tub.

8. WARNING - To reduce the risk of injury:

   a) The water in a spa should never exceed 40 ^{o}C (104 ^{o}F). Water temperatures between 38 ^{o}C (100 ^{o}F) and 40 ^{o}C (104 ^{o}F) are considered safe for a healthy adult. Lower water temperatures are recommended for young children and when spa use exceeds 10 minutes.

   b) Since excessive water temperatures have a high potential for causing fetal damage during early months of pregnancy, pregnant or possibly pregnant women should limit spa water temperatures to 38 ^{o}C (100 ^{o}F).

   c) Before entering a spa or hot tub, the user should measure the water temperature with an accurate thermometer since the tolerance of water temperature-regulating devices varies.

   d) The use of alcohol, drugs or medication before or during spa or hot tub use may lead to unconsciousness with the possibility of drowning.

   e) Persons suffering from obesity or with a medical history of heart disease, low or high blood pressure, circulatory system problems or diabetes should consult a physician before using a spa.

   f) Persons using medication should consult a physician before using a spa or hot tub since some medication may induce drowsiness while other medications may affect heart rate, blood pressures and circulation.

9. SAVE THESE INSTRUCTIONS

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CHAPTER I - INTRODUCTION

Congratulations on your selection of the CHEMTROL$_{TM}$ PC2000 Programmable Controller for your water treatment facility.

CHEMTROL$_{TM}$ Automation uses advanced electronic sensing technology to monitor and control critical parameters in water, such as sanitizer activity, pH, temperature, conductivity or total dissolved solids (TDS). These are all essential to maintaining safe and enjoyable water.

Water Maintenance

The primary purpose of water maintenance is to maintain clean and safe water that meets the bacteriological and physiological requirements of state and local Health Departments, as shown, for example, in the table for the State of California.

Equally important is protection of the equipment from the aggressiveness of water and its constituents.

The guidelines adopted by the National Spa and Pool Institute (NSPI), as shown in the second table.

For chemical automation, we recommend:

- adequate filtration with a maximum turnover rate of six hours for a pool or 30 minutes for a spa,
- proper water balance with a pH between 7.4 and 7.6, alkalinity between 80 and 120 ppm (mg/l) and Langelier Saturation Index between 0 and 0.3,
- proper sanitation with an Oxidation-Reduction Potential (ORP) above 650 mV and a cyanuric acid level below 40 ppm (mg/l),
- proper water quality with Total Dissolved Solids (TDS) less than 1,500 ppm (mg/l).

The CHEMTROL$_{TM}$ PC2000 is designed to automate and facilitate the attainment of these goals.

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:

- ***"Basic Pool and Spa Technology***"
  National Spa and Pool Institute (NSPI)

- ***"Pool/Spa Operators Handbook***"
  National Swimming Pool Foundation(NSPF)

- ***"Aquatic Facility Operator Manual***
  National Recreation and Park Association (NRPA).

1986 CALIFORNIA HEALTH CODE for Swimming Pools	
CLARITY	Main drain to be visible from deck.
STANDARD PLATE COUNT at 35^{O}, per ml	Less than 200 Bacteria
TOTAL COLIFORM COUNT per 100 ml	Less than 2.2 organisms
PHYSIOLOGICAL QUALITY	No eye or skin irritation. No objectionable physiological effect.

TEST	**MIN**	**IDEAL**	**MAX**
pH	7.2	7.5	7.6
FREE CL, ppm			
Non-stabilized	1	1.5	2
Stabilized	1.5	2	3
Spa	2	3	5
COMBINED CL, ppm	0	0	0.2
BROMINE, ppm	2	3	4
OZONE, ppm	0.01	-	1
ORP, mV	650	750	-
CYANURIC ACID, ppm Outdoor Pool Indoor Pool Spa	3000	4000	100010 0
TOTAL ALKALINITY, ppm	100	125	150
TDS, ppm	300	1000	3000
Based on Standards for Public Pools and Spas. Published in 1988 by the **NATIONAL SPA AND POOL INSTITUTE**			

CONTROLLER FEATURES

Automated Water Treatment

The CHEMTROL$_{TM}$ PC2000 controller (Figure 1) is an advanced automation system for chemical maintenance in water. Designed around a sophisticated microprocessor, it displays user-friendly menus and submenus on an easy-to-read LCD (Liquid Crystal Display) screen. 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 central control module. That 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.

Control Functions

The following display and control functions are available on the CHEMTROL$_{TM}$ PC2000:

- **Oxidation-Reduction Potential (ORP or Redox)** in millivolts with programmable oxidizer feed, shock treatment and chemical savings program,

- **Sanitizer Concentration** display in parts per million (ppm) or milligrams per liter (mg/l),

- **pH** from 0 to 14 with capability for acid or base feed,

- Selectable **Conductivity** in microsiemens/cm or **Total Dissolved Solids** (TDS) in ppm or mg/l with control of dumping of water or filling replacement of brine solution,

- **Temperature** display in degrees Fahrenheit or Celsius, and heater control with energy saver program,

- **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.

Probe Failure Analysis

The PC2000 controller features the new CHEMTROL$_{TM}$ proprietary technology (US Patent No. 5,895,565) called Probe Failure Analysis. This feature (see page 23) allows dynamic testing of the response of the ORP and pH sensors.

the controller detects probe failure situations as soon as the sensor fails to respond properly, therefore avoiding dangerous out-of-range conditions.

Other controllers have to wait until there is an out-of-range or an alarm condition in order to alert the operator. This could result in serious damage and liability.

Figure 1 – PC2000 Controller

Remote Communications

The CHEMTROL$_{TM}$ PC2000 features remote operation of the controller with exact duplication of the LCD screen display and full access to all the menus and submenus.

Unlike controllers that provide only a simulated representation of the display screen, the CHEMTROL$_{TM}$ PC2000 features true remote duplication of the controller screen.

This means that any change on the CHEMTROL$_{TM}$ PC2000 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.

CONTROL PANEL

LCD Display Screen

The operator interacts with the controller with the LCD display screen and 16-key data entry keyboard on the front panel, as shown in Figure 2.

The display shows four lines of text that can be scrolled up and down with the UP and DOWN ARROW keys to display additional menu lines.

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

The brightness of the LCD display screen is adjusted at the factory before shipping. If required, it can be re-adjusted at any time with the potentiometer inside the cabinet on the Mother Board. It is located at the top right corner of the board and marked R36.

The LCD display screen features backlight illumination for better viewing at night and in dark areas.

Display Readings

As shown on the Display Screen (Figure 2), the operator can check all operating parameters at a glance.

Line 1 shows an **ORP reading of 750 mV** with the feed pump in Automatic mode (A) and pump not running (no >).
Line 2 shows a **pH reading of 7.5** with the Acid feed mode in Automatic (A) and the pump running (>).
Line 4 shows the **Total Dissolved Solids (TDS)** at 801 ppm.
Line 5 shows a **Temperature reading of 82 F**.

Data Entry Keyboard

The data entry keyboard replaces the knobs and switches of conventional controllers. All operational entries such as choice of operational mode, calibration, control setpoints, alarms and programming are performed with the 16 keys of the 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.

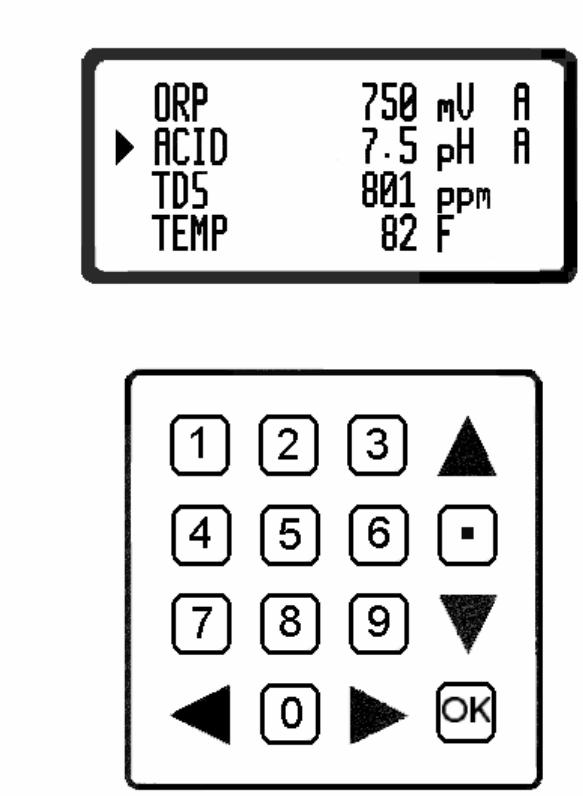


Figure 2 - Control Panel

PROGRAM MENUS

Initial Screens

When power is first applied to the controller, it displays the Welcome Screen showing the version of operating software that is installed in the controller.

This first screen is immediately followed by the Technical Support Screen showing the access numbers for technical support 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.

These screens can also be accessed at any time from the Main Display Screen by pressing the LEFT ARROW key.

Display Screens

The initial screens are followed by the Main Display Screen, as shown on the right. It shows four lines of text. Additional lines can be displayed by scrolling down with the DOWN ARROW key.

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: ORP, SANITIZER, pH, CONDUCTIVITY and TEMPERATURE,
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 timer control,
    X for OFF.

Main Menus and Submenus

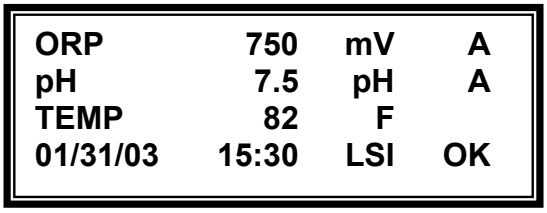
As shown on the Menu Tree at the beginning of the manual, there are several Main Menus that are accessed directly from the Display Screen, one for each operating function and one for system configuration. The submenus are additional menus that are accessed from one of the main menus or other submenus.

Navigation through the menus is done with the four arrow keys located on the front panel keypad. To access any menu or submenu, use the UP and DOWN ARROW keys to highlight the desired line and press the RIGHT ARROW key. To exit from any menu or submenu, press the LEFT ARROW key.

In this chapter, each menus and submenus is identified by its on line number. It provides a road map for quick location.

Welcome Screen

Technical Support Screen



PC2000 Main Display

Alarm Displays

Probe failure, out-of-range and overfeed 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.

If the display shows an out-of-range or overfeed alarm condition, press the DOWN ARROW key to the flashing line and enter the submenu with the RIGHT ARROW key to determine the cause of alarm.

CHAPTER II - INSTALLATION

SAFETY NOTICE

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, voltage, tee size and feed mode. Unpack the carton carefully, taking care not to lose any of the smaller parts, such PVC fittings.

The controller carton should include the following:

- Controller Cabinet,
- Sensors as required for selected model,
- Instruction Manual,
- Installation & Warranty Report to be mailed back to factory upon completion of installation,
- Bypass Line Assembly or Flow Cell Assembly Optional).

INSTALLATION & WARRANTY 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.

Upon completion of installation, it must be filled out and signed by the Qualified Dealer and by the facilities manager.

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$_{TM}$ Representative, call our Technical Department toll free at 800-621-2279 or send us an e-mail at support@sbcontrol.com.

PRINCIPLE OF INSTALLATION

The CHEMTROL$_{TM}$ PC2000 is designed to monitor and control the water chemistry in swimming pools, spas and other water treatment applications. Optional features include monitoring and control of temperature or conductivity.

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

The schematic of installation in Figure 3 shows the principle of installation with all options installed. See below for installation with an optional bypass line or sensor cell assembly.

CONTROLLER CABINET

The CHEMTROL$_{TM}$ PC2000 controller is contained in a rain proof and splash proof NEMA Type 4X cabinet.

The external dimensions of the cabinets and the positioning of the mounting holes as shown in Figure 4.

For ease of installation, there are two external mounting ears on the top of the cabinet.

If security is a concern, there are four additional mounting holes accessible only from the inside of the cabinet, in order to deter unauthorized removal.

All the electronic and electrical components are mounted inside the cabinet on two separate PC Boards, the Mother Board (Figure 5) and the Power Board (Figure 6). Outlets are provided on the bottom of the cabinet for ½" conduits connectors.

LOCATION

Mount the cabinet on a wall in a secure location:

- more than 10' (3 m) away from the water edge to comply with 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 (see Sensor Cables),
- 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

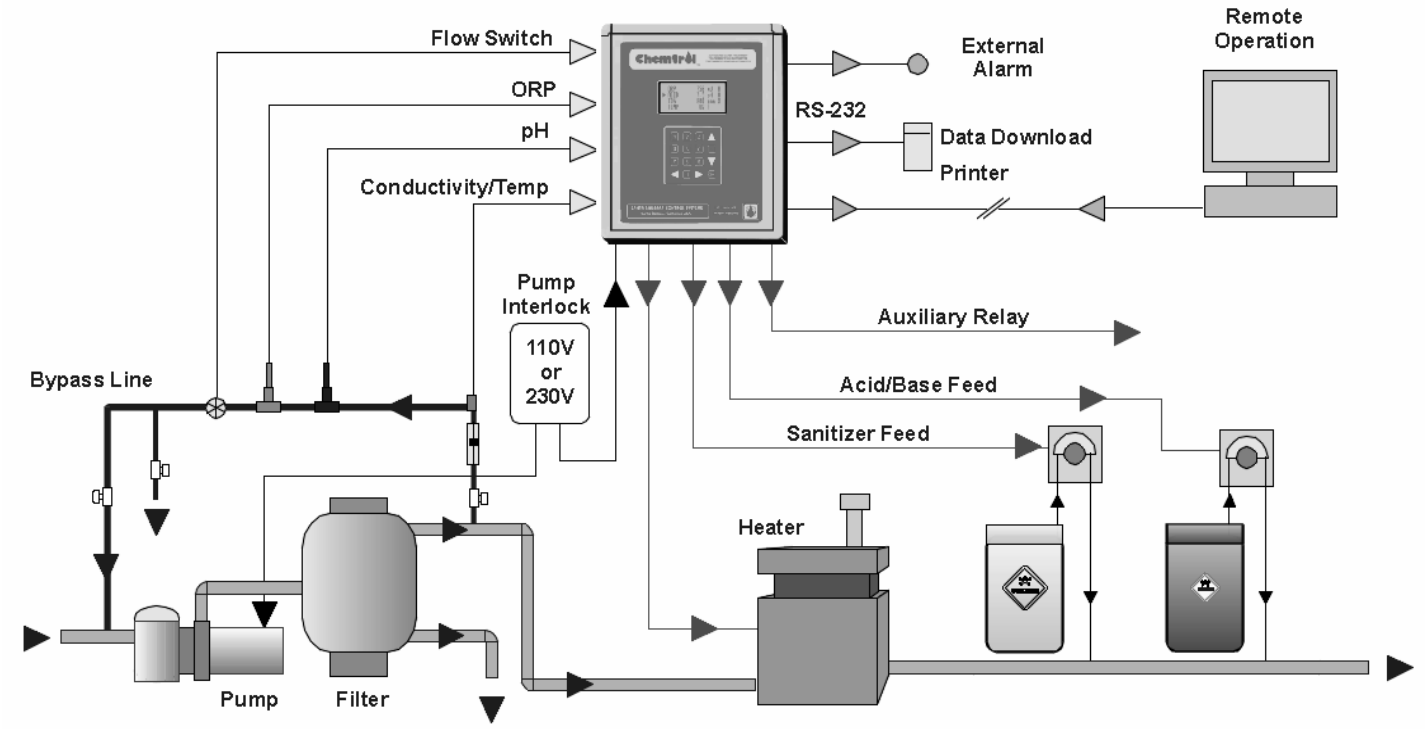


Figure 3 - Schematic of Installation

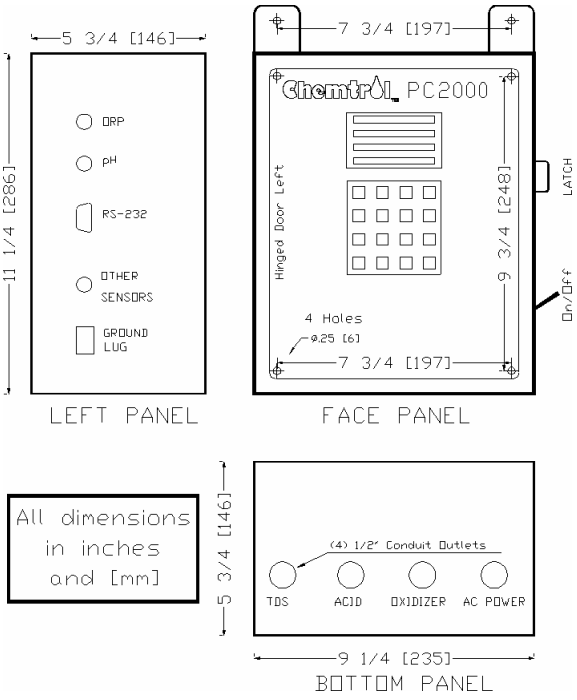


Figure 4 - Controller Cabinet

ELECTRICAL

Electrical Codes

INSTALLATION MUST FOLLOW ALL APPLICABLE 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 and labeling on the power board of the controller (Figure 6) are as follows:

		RELAYS	POWER IN
GREEN	GROUND	GND	GND
BLACK	HOT	NO1/NC1	L2
WHITE	NEUTRAL	NO2/NC2	L1

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$_{TM}$ PC is a dual-voltage controller with a voltage selector switch located inside the cabinet on the Power Board (see Figure 6). 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. This prevents feeding chemicals when 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

The CHEMTROL$_{TM}$ PC2000 uses two PC boards:

- the Mother Board (Figure 5) located behind the front panel contains the software, memories and operating electronics,

- the Power Board (Figure 6) located in the back of the cabinet and containing the power input and the output relays.

The two boards are connected together with a flexible ribbon connector.

The schematics in Figure 5 and Figure 6 show the location of the key components. In addition, the components are also labeled on the PC boards themselves.

The PC boards are protected with a 1 A fuse located on the Power board. It is mounted on the lower right of the Power Board and marked F1. If the fuse needs to be replaced, make sure to use a 1 A fuse only. The use of a larger fuse may cause irreparable damage to the electronic boards.

Power Board

The Power Board (Figure 6) 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$_{TM}$ PC 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.

Relays and Fuses

NOTE: *The fuses for the Power Supply to each PC board are AGC-1 Fast Blow. The two modem fuses are 250 mA Fast Blow.*

All other fuses for relay outputs are 5A Slow Blow. Two fuses are used for each relay, one each for the hot and common sides.

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

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

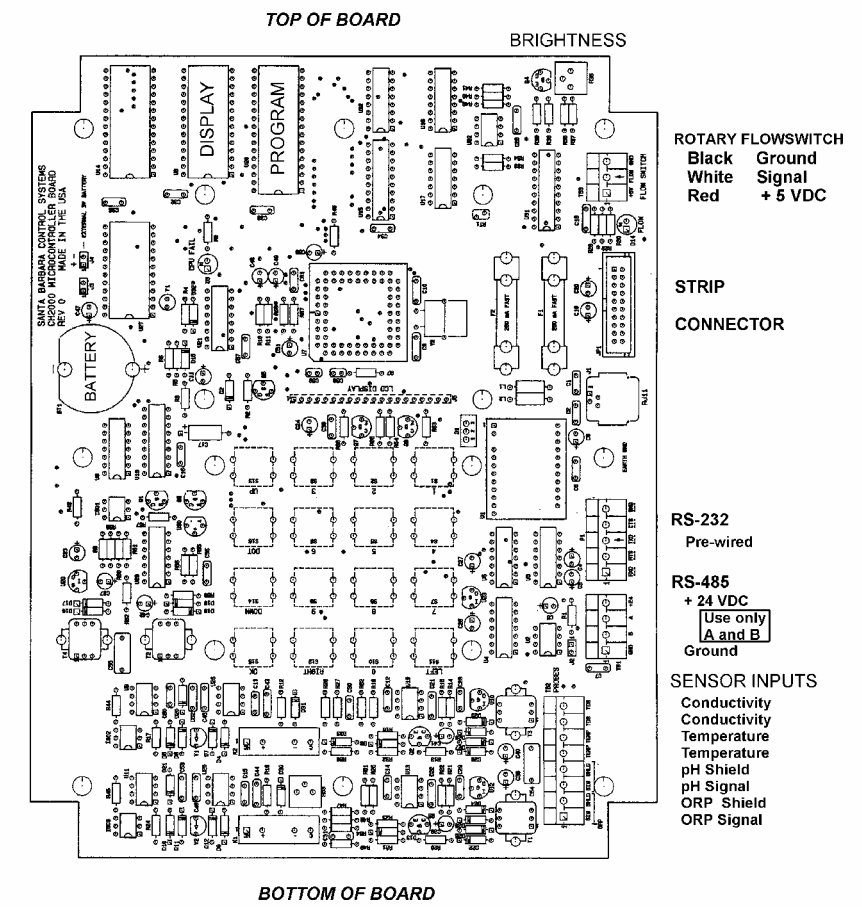


Figure 5 - Mother Board

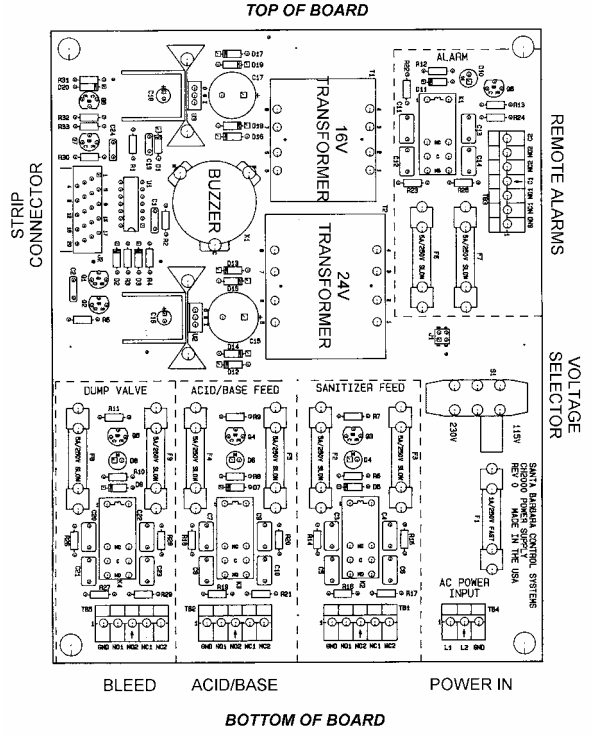


Figure 6 - Power Board

Remote Alarm

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 of the controller (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 two shunts from J1 located just below the 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 5) 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. It is also used to connect all the sensor inputs.

The key electronic components are the microprocessor and the programmable chips for Program, Display and Memory. The program chips are located in the center at the very top of the board. They can be replaced for upgrading of the software program, which should be done only by an experienced technician.

Sensor Connections

All sensor connections are on the Terminal Barrier strips on the Mother Board, as shown on Figure 5. The pH and ORP sensors are connected externally to the bulkhead BNC connectors on the left side of the cabinet.

The temperature sensor has two leads, black and red. The combined conductivity/temperature sensor has four leads: white, green, red and black. Connect all leads as shown on the Mother Board schematic (Figure 5).

Buzzer

The buzzer is located near the top of the Mother Board, as shown on Figure 5. It can be turned on for specific alarm conditions through the software program or for all alarms using the Audio Alarm Submenu 6.2.1 (see page 21).

Display Brightness

The brightness of the display can be adjusted with the potentiometer marked R-36 that is located in the upper right corner of the Mother Board (Figure 5).

Backup Battery

The 3V Backup Battery is located on the left side of the Mother Board (Figure 5). 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. Replace the battery if the voltage falls below 2.6 V. The voltage is displayed in Configuration Menu / Battery Submenu.

Remote Communications

Several Remote Communications options are available for the CHEMTROL$_{TM}$ PC controllers:

Option REM uses modem-to-modem communication between the remote computer and the on-board data modem connected to a standard US-type, 6-position RJ12 phone jack located on the middle right hand side of the Mother Board (Figure 5). If possible, connect the controller to an analog outside telephone line dedicated for remote operation. If the line is also used for voice communications, users should wait for at least three rings to allow the modem to answer a call.

The modem is a combination Data/Fax/Voice multimedia device registered by the Federal Communications Commission (FCC), Number B46USA-22429-MN-E.

MODEM SPECIFICATIONS	
FCC Registration Number B46USA-22429-MN-E	Ring Equivalency Number (REN) 0.2 A

The Ring Equivalency Number (REN) is 0.2 A. Most telephone companies require that the sum of all devices connected to a telephone line do not exceed 5. If a problem arises as a result of operating this equipment, you may have to provide information about this modem to the Phone Company or to the FCC. If the equipment causes disruption to the telephone network, the Phone Company may disconnect your service.

Option ETHCOM uses Ethernet / Internet communication between the remote computer and the on-board Ethernet modem. Connect the controller RS485 A & B ports to the Black and Red wires of the cable provided with the Ethernet modem. Set the controller as a slave by orienting the jumper J9 as marked on the motherboard (Figure 5). Then, connect the Ethernet modem to the TCP/IP network via its standard RJ45 TCP/IP jack.

Option RS485 establishes a direct connection between one on-site computer and the controller through a dedicated pair of wires (3,000 feet maximum). Connect the controller RS485 A & B ports to the computer RS485/RS232 converter. Set the controller as a slave by orienting the jumper J9 as marked on the motherboard (Figure 5).

Multiple Serial Connections

Up to thirty (30) CHEMTROL$_{TM}$ PC controllers can be multiplexed to a single phone line, a single Ethernet address, or a single computer line by using a network consisting of a host and several slaves. The connections are made through the controllers RS485 Ports.

Different models of CHEMTROL$_{TM}$ PC controllers can be mixed and matched in a network. Each controller is identified by its own ID number. This number is set up through software in the Communications Submenu 6.3.1 (see page 23).

The host controller needs one of the three remote communication options described above (REM, ETHCOM or RS485).

The slave units need only an RS485 connection (Option MULTI) and an internal ID number. The slave units must be located within 3,000 feet of the host controller and connected with two Category 5 wires (one pair). The RS485 terminal has four terminals, only two of which, marked A and B, are used. Each unit must be wired A to A and B to B for proper communications. The slave units can be connected directly to the host unit or through any other slave units.

Any controller can be set up at any time as either host or slave by orienting the jumper JP3 as marked on the motherboard (Figure 5).

CAUTION: *Do not wire the connections marked 24 VDC or GND on the RS485 terminal. This could cause serious damage to the terminal.*

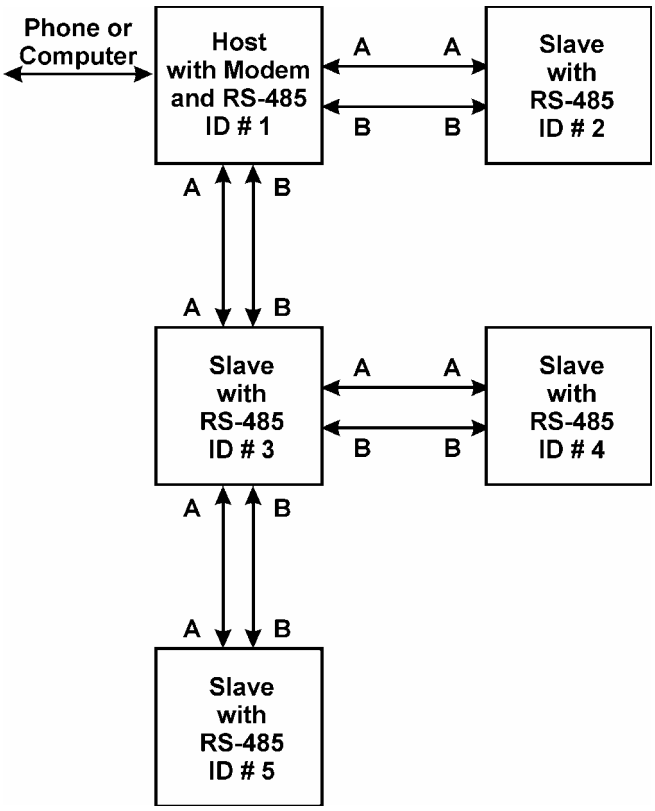


Figure 7 - Multiplex Connections

PLUMBING

This section covers installation of the sensors and chemical feeders. Before starting installation, make sure to keep in mind that all chemicals must be injected downstream of the sensors and pool equipment (pump, filter, etc.). This minimizes corrosion and ensures that the sensors are reading representative water samples.

Installation of Sensors

The CHEMTROL$_{TM}$ PC2000 controller uses up to four different sensors for measurement of water chemistry and temperature:

- a potentiometric ORP sensor,
- a potentiometric pH sensor,
- a thermistor for temperature, and
- a conductivity sensor for Total Dissolved Solids.

On small recirculation lines (2-inch pipe), the sensors can be installed directly on the main line using PVC reducing tees (Figure 8).

On large diameter lines, they must be mounted on a ½-inch Bypass Line (Figure 9), or a Flow Cell Assembly (Figure 10) or a Sensor Cell Cabinet (Figure 11).

In-line Installation (2" Pipe)

On smaller installations (2 " pipe diameter), the sensors can be mounted directly on the main recirculation line.

Install the sensors at least 10 pipe diameters downstream from an elbow or constriction to minimize turbulence in the water. Mount only in standard 2x2x½ in. SST reducing tees. Do not use reducers. They would prevent the sensors from reaching the water!

Install the tees in a vertical position with the tip of the sensor oriented downward - as shown in Figure 8 to avoid formation of air pockets inside the sensor. They should be readily accessible for servicing but not exposed to physical damage.

After inserting the sensor, tighten up the compression fitting by hand. Make it finger tight only. Do not overtighten it to avoid crushing the small glass tube inside the sensor. Do not use a wrench!

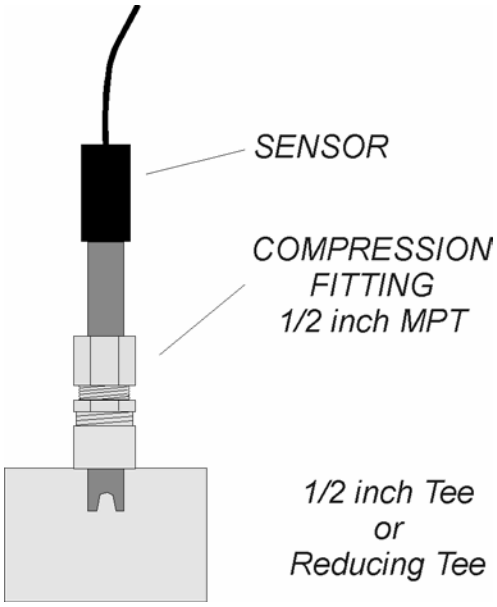


Figure 8 - Sensor Installation

Bypass Line Installation (Option)

The CHEMTROL$_{TM}$ Bypass Line Assembly (P/N BPL not assembled) is designed to facilitate installation of the sensors and to assure a smooth and steady flow of water.

It includes:

- two (2) ½" MPT compression gland fittings,
- two (2) ½" SST PVC tees,
- a 3/4" MPT in-line Y-filter,
- a ½" FPT in-line flowmeter,
- a ½" FPT rotary safety flow switch,
- two (2) ½" SxS ball valves for flow adjustment and for isolating the bypass line during backwashing of the filter and other maintenance operations,
- a ½" SxS ball valve for water sampling and testing.

Install the Bypass Line Assembly as shown on Figure 9. In particular, make sure to install:

- the flowmeter in a vertical position,
- the ORP and pH sensors more than 10 pipe diameters from an elbow or constriction,
- the flow switch downstream of (after) the sensors.

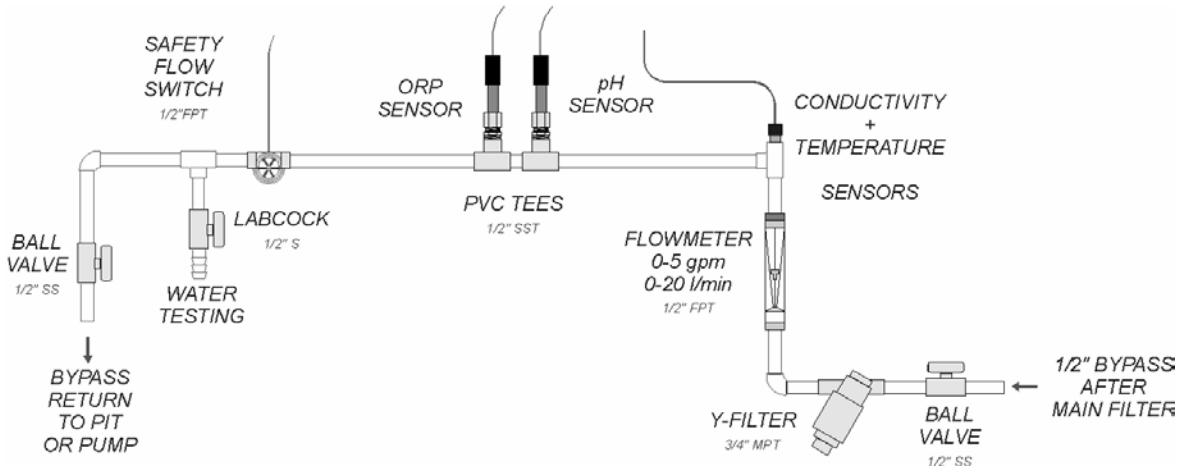


Figure 9 - Bypass Line assembly

Flow Cell Assembly (Option)

For ease of installation and maintenance, the sensors can be mounted on an optional Flow Cell Assembly, as shown in Figure 10. It includes a sensor cell with air vent and clear cover, two compression fittings for the ORP and pH sensors, a water sampling tap and two ball valves for controlling the water flow in and out.

Sensor Cell Cabinet (Option)

For even better ease of installation and maintenance, the components of the bypass line assembly can be supplied in a pre-plumbed Sensor Cell Cabinet (also called Wet Box). The Flow Cell Assembly is mounted in a fiberglass cabinet containing the sensor cell assembly. Also included is a Y-filter, a flowmeter and a paddle wheel safety flow switch. Install on a ½" bypass line, as shown in Figure 11,

Make sure that the Sensor Cell Cabinet is located within 10' (3 m) of the controller cabinet or order sensor extension cables (see Sensor Cables). See wiring instructions in the ELECTRICAL section and 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 both the intake and the return valves on the bypass line and read the flow rate on the flowmeter. It should be in the middle of the range, i.e. about 2-3 gpm (about 8 to 12 l/min). If the water flow is too high, reduce it by closing down the valve on the RETURN SIDE of the bypass line. 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 bypass line is properly connected. The intake side should be off the pressure side of the recirculation system, i.e. after the filter. The return side should be to a low-pressure area - such as the vacuum side before the recirculation pump, or downstream after the heater, or atmospheric pressure in the pit of a vacuum sand filter.

Paddle Wheel Rotary Flow Switch

The Rotary Flow Switch is a safety switch for the bypass line.

The switch contains a transducer that generates an electrical signal proportional to the water flow. This signal controls the opening or closing of an internal relay which is wired in series with the chemical feed relays. The relay trip point is factory adjusted for a minimum flow rate of 1 gpm (about 4 l/min). (*Make sure to use the flow restrictor included in package*).

CAUTION: *Improper wiring will result in switch burnout (not covered under warranty).*

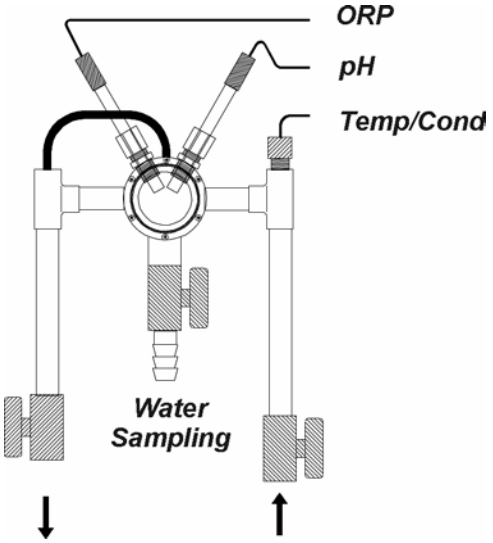


Figure 10 - Flow cell Assembly (Option)

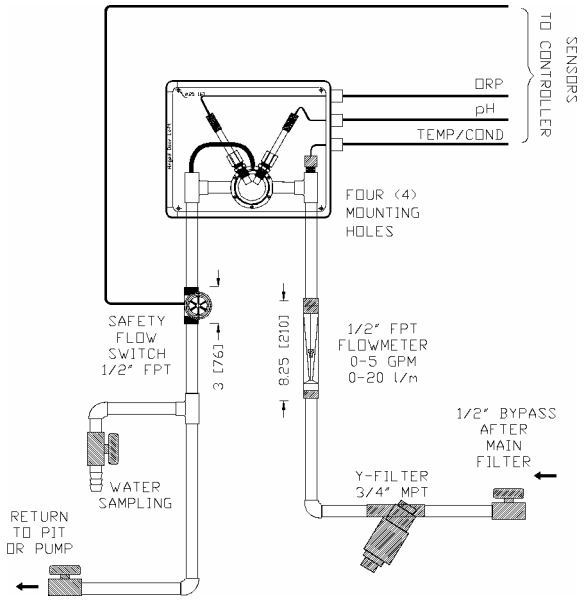


Figure 11 - Sensor Cell Cabinet (Option)

The black, red and white leads should be connected to the contacts marked “FLOW SWITCH” on the terminal board marked TB3 on the right side of the Mother Board (Figure 5), as indicated:

BLACK	Ground
WHITE	Signal
RED	+ 5VDC or +24 VDC

WATER CHEMISTRY SENSORS

Sensor Properties

The ORP and pH sensors are non-corroding sealed combination electrodes (Figure 11). They do not require refilling. Each sensor has an external plastic body and an inner glass tube that 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 mega-ohms), 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.

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.

pH Sensor

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

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 that is used for shipping. It does not affect the performance of the sensor.

For installation of a sensor, the ½" compression fitting should first be screwed in the PVC Tee (Figure 8).

Teflon tape can be used but it should not be overtightened. The sensor should be carefully inserted through the fitting, as shown on the schematic above, being careful not to bend or overtighten it, to avoid breaking the small glass tube inside. The 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

The potentiometric sensors are 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.

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.

Figure 12 - ORP and pH Sensors

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 pool equipment, such as the 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 pool or spa. 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 ORP and pH 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.

Freezing can damage the ORP and pH sensors. They should be removed from the line and stored at room temperature whenever freezing is expected.

Sensor Warranty

The ORP and pH 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.

TEMPERATURE SENSOR (Option)

If the CONDUCTIVITY option is not included, the Temperature Sensor is supplied separately as a thermistor imbedded inside a ¼" MPT fitting with a 10-ft (3 m) connecting cable (Figure 13). A 1/4" reducer epoxied to a ½" SxS PVC tee is also supplied.

Install the sensor near the ORP and pH sensors, either directly on the main line or on the bypass line (Figure 9), flow cell (Figure 10) or sensor cell cabinet (Figure 11).

Connect the red and black leads to the Terminal Barrier strip TB5 as indicated on the schematic of the Mother Board (Figure 5).

NOTE: When the CONDUCTIVITY option (TDS) is specified, the temperature sensor is incorporated in the conductivity sensor (Figure 14). This simplifies installation, as only one sensor fitting is required.

Figure 13 – Temperature Sensor

CONDUCTIVITY SENSOR (Option)

The Conductivity or TDS (Total Dissolved Solids) Sensor consists of two graphite electrodes forming the measuring cell. It also contains a thermistor that is embedded inside the sensor. The sensor is supplied with a 10-ft (3-m) connecting cable and a specially drilled ½" MPT PVC fitting, as shown on Figure 14.

Using a ½" FPT PVC tee, install the sensor near the ORP and pH sensors, either directly on the main line or in a 90^{O} elbow on the bypass line (Figure 9), flow cell (Figure 10) or sensor cell cabinet (Figure 11). Make sure that the sensor is oriented so that the water flows smoothly through the measuring cell.

The three leads from the conductivity sensor must be connected to the Terminal Barrier strip TB5 on the Mother Board (Figure 5).

When the temperature sensor is incorporated inside the conductivity sensor, two extra leads should also be connected as shown on the Mother Board (Figure 5).

Figure 14 - Conductivity Sensor

CHEMICAL FEEDERS

WARNING: Tank Sizing

The CHEMTROL$_{TM}$ PC2000 contains many safeguards to prevent overfeeding of chemicals. However, there is always a risk of physical failure of the electronics or feed equipment that could cause overfeeding of chemicals. To prevent damage or injury to persons, it is imperative to size the chemical tanks so that no dangerous amount of chemicals will be fed in case of equipment failure.

Chemical Feed Pumps

Chemical feed pumps are used to feed liquid sanitizers, such as sodium hypochlorite NaOCl, 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 Figure 3, following the electrical code and the pump manufacturer's instructions.

Carbonic Acid (CO2) 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.

Gas Chlorinator

NOTE: Use of Chlorine gas is very dangerous.
Make sure to follow all local safety codes.

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

If required, the injection line for chlorine gas 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.

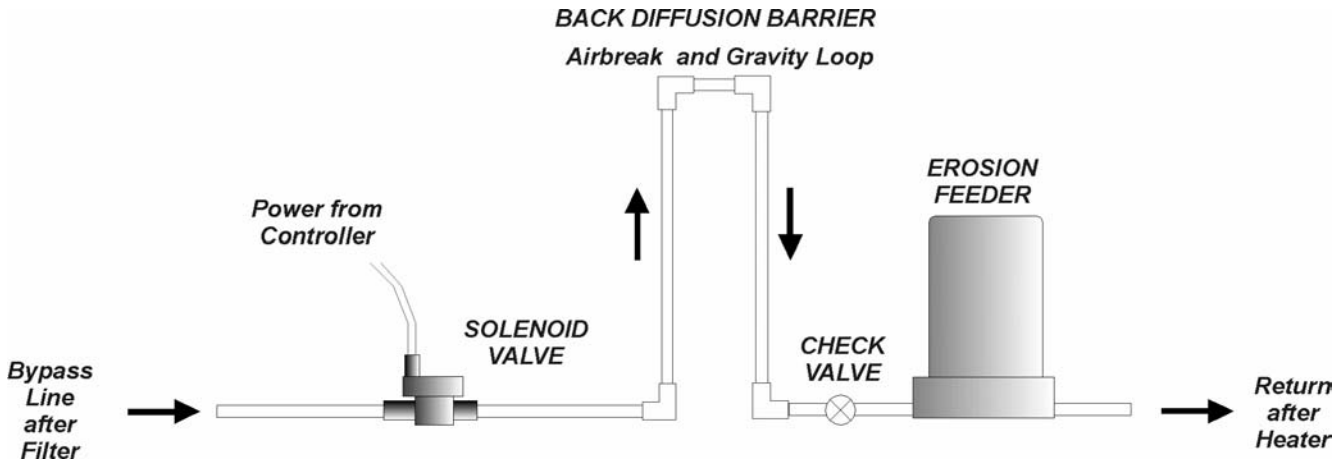


Figure 15 - Erosion Feeder Control

Erosion Feeders

Erosion feeders for bromine, chorine or cal hypo tablets can be controlled with a solenoid valve that is mounted on the intake side of the bypass line before the feeder (Figure 15). This allows the controller to modulate the flow of water through the feeder.

For proper valve operation, the pressure differential through the feeder must be at least 15 psi (1 kPa). This may require installation of a pump on the bypass line.

With less corrosive chemicals, such as bromine dihalo or cal hypo tablets, the solenoid valve can be mounted before the erosion feeder.

Back Diffusion

With corrosive trichlor tablets, it is recommended to protect the solenoid valve with a check valve and an anti-diffusion loop, as shown in Figure 15.

The loop must be narrow to facilitate formation of an air break and tall to maximize the effect of the gravity barrier.

This design reduces – but does not eliminate – corrosive back diffusion. A better idea is to switch to a less aggressive sanitizer.

CHAPTER III - STARTUP

CONTROLLER STARTUP

Initial Reset

Before powering up the controller, remove the Battery Jumper J3, wait one minute and reinstall it. This will clear up any unwanted changes in the program and reset the program to the original default values.

With the front door open, verify that the CPU Fail Light on the microprocessor, turns ON and OFF when power to the unit is turned ON and OFF.

Configuration Menu

Upon startup, verify the initial setup through the CONFIGURATION Menu 6.1 (see page 18) and adjust the values as required. This includes adjusting the clock for different time zones and selecting the proper language and units system.

Alarm Buzzer

The Audible Alarm option is normally turned off until the sensors are installed. Submenu 6.2.1 (page 21) to turn it on for normal operation with

Bypass Line

By default, the Bypass Line Option is factory-set to YES to prevent accidental feeding when there is no water flow in the bypass line. To turn it off, set the Option to “NO” in Submenu 6.2.2 (page 21).

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/BATTERY Submenu 6.2.6 (page 23).

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

CHEMICAL CONTROL

Initial Activation of Sensors

For a new pool or spa, it is recommended to wait for a week or two after filtration is started 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$_{TM}$ PC, install the sensors in the recirculation line and run the recirculation pump for 30 to 60 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).

Water Chemistry Adjustment

Before starting automatic control, the water chemistry should be adjusted to near the recommended values of 7.5 for pH and about 1 ppm for chlorine (2 ppm for bromine). 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.*

Also, verify that the cyanuric acid level is below 40 ppm, the Alkalinity between 80-120 ppm and the Total Dissolved Solids (TDS) level below 1,500 ppm. If either one of these limits is exceeded, the water is contaminated. It should be replaced with as much fresh water as needed.

Water Sampling

Proper water sampling is essential for accurate calibration of the 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.

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.

The pH of the water should be near 7.4 to 7.5. If not, adjust it manually or with manual feed control:

If the pH is below 7.0:

CAUTION: CORROSIVE CONDITION. Add a base (Soda Ash, Caustic Soda NaOH, pH PLUS, pH UP, etc.) to raise it as soon as possible.

If the pH is above 8.0:

CAUTION: SCALING CONDITION. Add an acid (Muriatic Acid, Hypochloric Acid HCl, Sodium Bisulfate, pH MINUS, pH DOWN, etc.) to lower it.

If the test kit value differs from the value shown on the controller display, select the pH Calibration Submenu 3.2 (see page 27) and enter the value indicated by the test kit, using the 1-Point Calibration option.

For more accurate calibration with two or three 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$_{TM}$ PC2000 has a pH control outlet that can be set to either Acid or Base feed. 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 (Figure 6).

pH Setpoint

The default value for the pH setpoint is 7.5. 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 1.3 (page 24).

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.

Sanitizer Calibration (Option PPM)

NOTE: *Make sure to adjust the pH between 7.4 to 7.5 before calibration of the sanitizer*.

Test the water with a DPD or FACTS test kit for Free Chlorine or Bromine. Do not use an OTO (Total Chlorine) test kit. Make sure that the test solution is fresh and test at least twice or until you get consistent readings.

The water should test close to 1.5 ppm for chlorine or 3.0 PPM for bromine.

- If the water tests below these values: Add sanitizer as needed to bring the PPM reading to a proper value.

- If the water tests above 3.0 ppm for chlorine or 6.0 ppm for bromine:

  a. wait until the level is reduced to below these values,
  b. add a reducing agent (Sodium Thiosulfate), or
  c. replace part or all of the water.

Select the Sanitizer Calibration Submenu 2.1 (page 26) and enter the value indicated by the test kit.

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$_{TM}$ PC Qualified Dealer for assistance.

Shock Treatment

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

Chemical Saver

The Chemical Saver program is used to lower the oxidizer or sanitizer level when there is little use, such as at night or on weekends.

Chlorination should be prevented completely whenever a pool cover is in place.

It is also recommended to stop sanitizer feed for pools where there is insufficient mixing of water at night - due to the lack of water mixing by swimmers or convection currents. This can lead to stratification of the chemicals in the water and eventual overchlorination.

WATER SATURATION

The CHEMTROL$_{TM}$ PC features automatic calculation of the Langelier Saturation Index Submenu 6.2.3 (page21).

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 I V - CONTROLLER OPERATION

Chapter IV describes the menus and submenus used to operate the CHEMTROL$_{TM}$ PC2000. For an overview, refer to the Menu Tree at the beginning of this manual.

Each screen displays four lines of text at a time, as shown by the dashed line. Additional lines can be displayed by scrolling down with the DOWN ARROW key on the keyboard.

On the right are shown screens for the standard version and for two options:

- Option PPM/TEMP for PPM display, temperature display plus heater control,
- Option COND/TDS for conductivity/TDS display plus bleed/fill valve control.

Access

The submenus are accessed by first highlighting a line in the Main Display screen with the UP and DOWN ARROW keys and then pressing the RIGHT ARROW key to enter the submenu. Each menu or submenu is therefore identified by a series of numbers - from 1 to 6 - which correspond to the display lines that are used to access it. For instance, Submenu 6.1.4 for Configuration/Initial Setup/Clock is accessed by scrolling down to and pressing on line 6 on the Main Display Screen, then line 1 on the Configuration Menu and finally line 4 on the Initial Setup Submenu. To return to any previous menu, press the UP ARROW key.

For ease of operation, the Configuration and Setup (Menu 6) is discussed first. The other menus are discussed afterwards in numerical order.

Default Setup

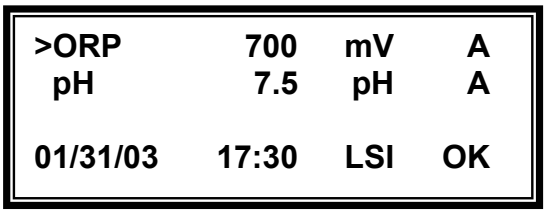
The CHEMTROL$_{TM}$ PC2000 controller is initially loaded with standard default values that allow it to start operating normally. It is therefore not required to initialize it in order to operate the controller, as it defaults automatically to standard setup values, such as “English” language, “U.S. Units”, “No password”, as well as standard setpoints and alarm values.

The operator can change the original default settings at any time to fit his preferences. If needed, the original default values can also be restored through the Reset Submenu. They will always be automatically restored in case of complete loss of power, including backup battery power.

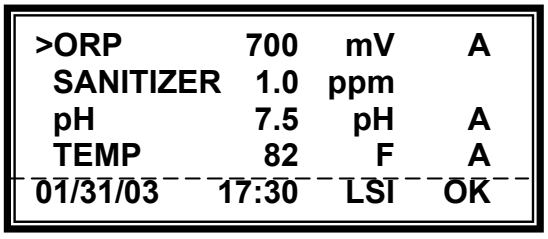
6 - CONFIGURATION MAIN MENU

As shown on Menu 6, the Configuration Menu is used to view or edit the parameters for Initial Setup, Operations and Communications.

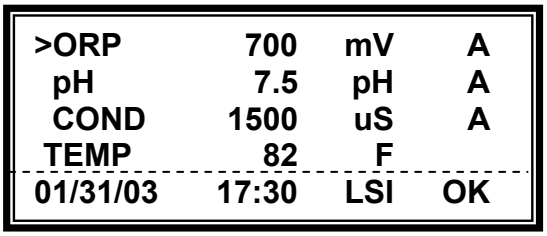
To access the Configuration Menu, use the DOWN ARROW key on the Main Display screen to highlight the time/date line and then press the RIGHT ARROW key to show the next menu. It includes the three submenus shown on the right (Menu 6).



PC2000 Main Display (Standard)



PC2000 Main Display (PPM & TEMP Options)



PC2000 Main Display (TDS Option)

IMPORTANT NOTE
Heater control and conductivity control share the same output relay. Their operation is therefore mutually exclusive. If both options are needed, specify a CHEMTROL$_{TM}$ PC3000.

Menu 6

6.1 - INITIAL SETUP SUBMENU

The Initial Setup Submenu is used to specify basic operating conditions of the CHEMTROL$_{TM}$ PC2000. It is accessed through the Configuration Menu on the last line of the Display Screen.

6.1.1 - 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.

6.1.2 - 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.

Unit equivalencies are as follows:

	U.S.	METRIC
ORP	mV	mV
Sanitizer	ppm	mg/l
pH	pH	pH
Conductivity	µS	µS
TDS	ppm	mg/l
Temperature	F	C

6.1.3 - 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.

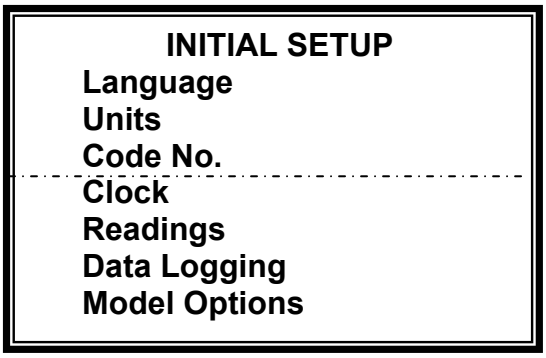
Up to ten Code NUMBERS (of two to five digits each - no letters) may be entered, along with an associated access level from one to three. Make sure to select an easy to remember number, such as a familiar name on a standard telephone keypad.

The following access levels are available:

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

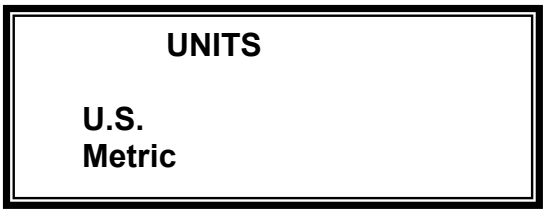
To clear an existing Code Number, its access level is set to zero.

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.

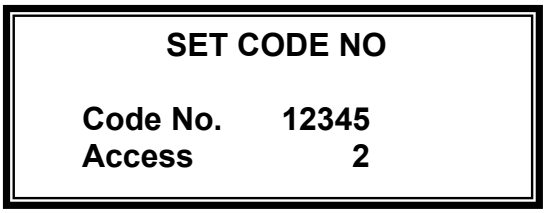


Submenu 6.1

Submenu 6.1.1



Submenu 6.1.2



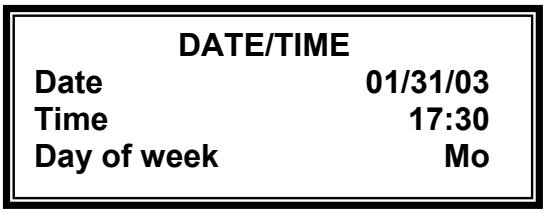
Submenu 6.1.3

6.1.4 - Clock

The clock/calendar is used for programming of daily and weekly schedules. It keeps track of odd months and leap years. In case of power shutdown, the backup battery maintains power to the board. The clock needs to be reset only in case of complete power shutoff with loss of battery power.

The Clock Submenu is used to set the DATE, TIME and DAY of the week.

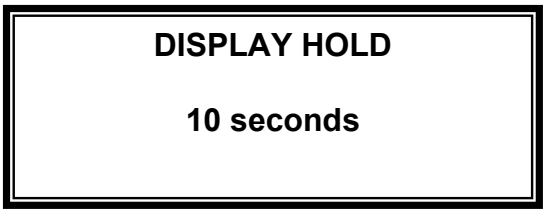
NOTE: The date display uses the MM/DD/YY (Month/Day/Year) format and the time display, the 24:00 hour format.



Submenu 6.1.4.

6.1.5 - Readings

The DISPLAY HOLD parameter is used to stabilize the readings of the sensors and to eliminate excessive random fluctuations. It specifies the time interval over which the sensor data is averaged before the screen is updated. It can be set between 1 and 60 seconds with a default value of 10 seconds,



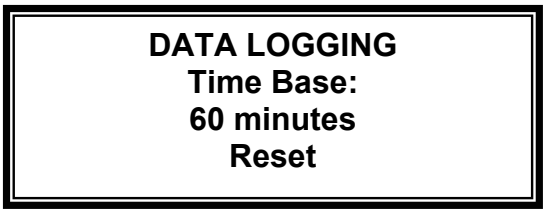
Submenu 6.1.5

6.1.6 - Data Logging

The DATA LOGGING screen selects the time interval for storing test data in the controller memory. Intervals can be between 1 to 999 minutes, with a default value of 60 minutes.

The memory chip can store up to 999 test results. When full, the oldest entries are overwritten by the new ones. Therefore the greater the interval is, the longer it takes to fill the memory. For instance, an interval of 60 minutes (one hour) fills the memory in 41 days. With data logging every four hours, the memory holds 5 ½ months of data.

To avoid losing test data, remember to print it or download it to a computer before the memory is full (see Submenu 6.2.4 - Print Reports). After data download is completed, the Reset function in Submenu 6.1.6 can be used to remove all data and start with a clean slate.

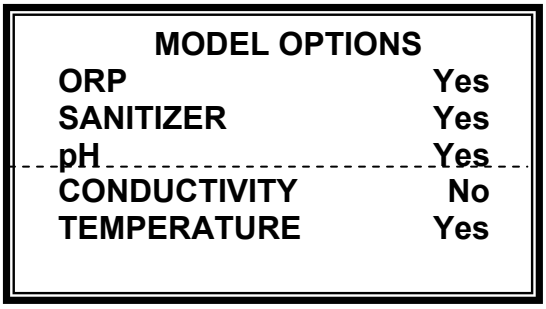


Submenu 6.1.6

6.1.7 - 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 corresponding line is removed from the Main Display Screen instead of meaningless 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.



Submenu 6.1.7

6.2 - OPERATIONS SUBMENU

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

6.2.1 - Audio Alarms

This option is used to disconnect the audio alarm (buzzer) and remote alarm in case of out-of-range or other alarm conditions. All visual alarms, such as flashing on the screen, still remain operative. When the DURATION value is set to a value different from zero, the audio alarms are activated for 10 seconds then forced off for the Duration value to create intermittent reminders of alarm.

6.2.2 - Bypass Line

The bypass line is a highly recommended feature for installations of the sensors, especially on large recirculation lines, i.e. over 2 inches in diameter.

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

The standard flow switch provided with the CHEMTROL$_{TM}$ PC2000 is a rotary flowmeter with a paddle wheel. The shutoff is set at 1 gpm (about 4 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 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:

> WARNING: Feeding chemicals when there is no water running in the bypass line may cause dangerous chemical reactions.

6.2.3 - Langelier Saturation Index

The Langelier Saturation Index is used for monitoring the development of corrosive or scaling tendencies in water. The Saturation Index SI 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$_{TM}$ PC2000 calculates the Saturation Index automatically using sensor input for pH and Temperature and operator data input for Alkalinity and Calcium Hardness.

The microprocessor calculates the factors TF, AF and CF directly from raw data input for temperature, alkalinity and hardness, without complicated conversion tables.

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

Submenu 6.2

ALARM LOCKOUT	
Audio Alarms	YES
Duration (min.)	2

Submenu 6.2.1

SATURATION	
Alkalinity (ppm)	150
Hardness (ppm)	300
pH	7.5
Temperature	80
Limits	
Langelier Index	0.23
Condition	OK

Submenu 6.2.3

LANGELIER LIMITS	
Scaling above	+ 0.3
Corrosive below	- 0.0

Submenu 6.2.3.5

Langelier Limits

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

The above values are the generally accepted limits for water saturation. Some experts however, recommend different values, such as -0.3 and +0.3 instead. The limits can therefore be changed by in Submenu 6.2.3. 5.

6.2.4 - Print Reports

The Print Reports Submenu is used to download the test data that has been logged in the internal memory chip of the controller (see Submenu 6.1.6 - Data Logging).

The data is saved in memory in standard ASCII. It can be printed on site or downloaded to a computer using three different methods:

- on-site printing to a serial printer,
- on-site downloading to a computer or laptop,
- remote downloading by modem, Ethernet or Internet to a computer using the CHEMCOM$_{TM}$ program.

After downloading into a computer, the data log can be displayed, edited and printed in text format using a text editor, such as *Windows Notepad*, or *Microsoft Word* as shown in Figure 16.

NOTE: In the COMMUNICATIONS Chapter (Page 35), it can be seen that the same data log can be displayed directly through the CHEMCOM$_{TM}$ software program, either as text (Figure 22, page 38) or as graphical display (Figure 23, page 38).

Since a maximum number of 999 sets of test data can be stored in the memory chip, it is recommended to download the data periodically in order not to lose it.

Downloading the data does not erase it from the memory chip. To erase all data in memory, use Submenu 6.1.6 - Data Logging and select Reset.

For printing, use the desired setup below, then enter Submenu 6.2.4 - 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.

On-Site Printing

For on-site printing, connect a serial printer (usually a thermal printer) to the RS-232 serial outlet on the left side of the controller.

On-Site Download

For direct download to a computer (that is without a modem), you must first set up communication parameters as shown below for DOS or *Windows*. Then connect the serial port on the computer (COM1: or other) to the RS-232 serial outlet on the CHEMTROL$_{TM}$ PC2000, using a null-modem connector, or an adapter available from local electronics stores, or from your CHEMTROL$_{TM}$ dealer.

Communication Parameters

The computer communication parameters must be set up as: 1200,8,n,1,none. The following setups are shown for DOS and *Windows*, using the serial port COM1 as an example.

DOS Operating System

Use a DOS communications program, such as Procomm Plus or similar. Select Line Port Setup and enter: 1200, N, 8, 1, COM1. Save the settings with ALT-S.

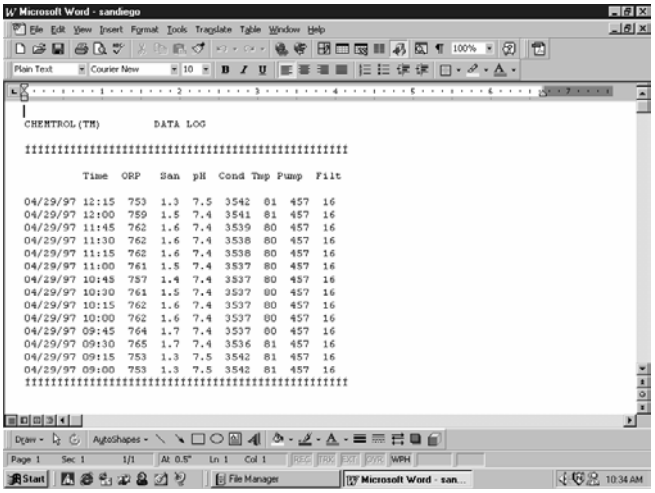


Figure 16 - Data Log

PRINT DATALOG

Print Data Log	
Start Date	**07/24/01**
End Date	**07/25/01**

Submenu 6.2.4

Windows 3.1 Download

Click on the icons ACCESSORIES, TERMINAL, SETTINGS, COMMUNICATIONS and select COM1: 1200, 8, None, 1.

Windows 95/98/NT/2000/XP Download

Windows 95/98/NT/2000/XP requires configuration of a HyperTerminal to be called CHEMTROL.

On the Windows desktop, click on the START menu, then PROGRAMS, ACCESSORIES, COMMUNICATIONS and HYPERTERMINAL. Click on the icon marked “Hypertrm”, enter the name “CHEMTROL” and select one of the icons for identification. On the next window named “Phone Number”, click on the bottom line and select “Direct to Com1" and OK. In the next window named “Port Settings”, select 1200 bits per second, 8 data bits, parity none, one stop bit, flow control hardware. Click on OK. Select File and Save.

To create the Shortcut for the CHEMTROL$_{TM}$ HyperTerminal, click on START, PROGRAMS, ACCESSORIES, and HYPERTERMINAL. Click on the CHEMTROL$_{TM}$ icon with the right mouse key, click on “Create a Shortcut” and drag out the icon to the main window. To start the connection click on the CHEMTROL$_{TM}$ Shortcut icon, select “Transfer” and “Capture Text”.

Remote Download

Logged data can be more easily downloaded by remote computer using the CHEMCOM$_{TM}$ software program for *Windows*^{TM} (Options REM, ETHCOM or RS485). See the COMMUNICATIONS Chapter (page 35) for details.

6.2.5 - 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 incorrect parameters have been entered. **Complete Reset** resets all system parameters to their initial "default" settings. **Partial Reset** allows partial resetting of individual functions, such as ORP, Sanitizer, pH, etc.

RESET

Complete Reset
Partial reset

Submenu 6.2.5

6.2.6 - Backup Battery

The CHEMTROL$_{TM}$ PC2000 uses a 3 V 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.

BATTERY: 3.0 V

Minimum voltage required: 2.5 V

Submenu 6.2.6

If power to the memory is completely discontinued, all settings revert automatically to the initial default values. If required, they may 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.

6.2.7 - Probe Monitor

Probe monitoring is a **very useful patented** CHEMTROL$_{TM}$ PC2000 feature (US Patent No. 5,895,565) that allows dynamic monitoring of the ORP and pH sensors to alert a probe failure as soon as it happens.

Other controllers have to wait until there is an out-of-range or alarm condition in order to alert the operator. This could result in serious damage and liability.

To activate or disable the Probe Monitor function, use the RIGHT ARROW to select YES or NO in Submenu 6.2, line 7.

6.3 - COMMUNICATIONS SUBMENU

The details of the communications features are discussed in the COMMUNICATIONS Chapter (page 35).

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

6.3.1 - Unit Identification

The unit identification number is used to identify individual controllers in multiple unit facilities that are connected to the same phone line. The default value is 1.

It should be set correctly for each controller to be able to be accessed individually in remote multiplex operation.

COMMUNICATIONS

Unit I.D.: 1

Submenu 6.3

1 - ORP 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, setpoint and alarm settings as well as 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.

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		**00/00/00**

Menu 1

1.1 - Control Mode

Line 1 shows the Control mode that is currently selected to control the ORP relay outlet: OFF, Manual, AUTO or Timer.

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 submenu 1.1 is then displayed.

The selection procedures for control are common to all the control functions. See the CONTROL Submenu further down.

Off
Manual
Auto
Timer

Submenu 1.1

1.2 - Display and Calibration

The second line displays the current reading of the ORP sensor in mV. There is no calibration menu for ORP since there are no readily available calibration solutions in the range of operation for water treatment.

CALIBRATION

Do not change
ORP calibration

Submenu 1.2

1.3 - Setpoint

The ORP SETPOINT determines the ORP level that the CHEMTROL$_{TM}$ PC2000 maintains automatically when placed in the Automatic control mode.

To change the setpoint, press the RIGHT ARROW key and enter the desired value. After pressing the OK key, the SETPOINT Submenu 1.3 is displayed asking whether the control is to be set for an Oxidizer or a Reducer. Use the UP and DOWN keys to highlight the desired selection. Then press the RIGHT ARROW key to confirm the selection (Oxidizer or Reducer).

SETPOINT

Oxidizer
Reducer

Submenu 1.3

The CHEMTROL$_{TM}$ PC2000 includes one relay outlet that can be set for either oxidizer or 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. If set for a reducer, the de-oxidizer outlet is activated when the sensor reading is above the setpoint.

1.4 - Low Alarm

The ALARM LOW value is set to generate an alarm when the ORP reading falls below the set value. To change the value, press the RIGHT ARROW key and enter the numerical value with the digital keypad.

After the alarm value is set, the ALARM OPTIONS Submenu 1.4.1 is displayed, to set the feed interlock and alarm buzzer options. Use the UP and DOWN keys to highlight the desired selection and press the RIGHT ARROW key to change to Yes or No.

Selecting YES for FEED LOCKOUT will inhibit any chemical feed from occurring in case of alarm. Selecting NO will allow feeding to continue. This may be used to continue feeding an oxidizer or sanitizer even if the sensor reading is sometimes low, such as in an overcrowded spa.

Setting ALARM BUZZER to NO disables the buzzer in an alarm condition. There is also a general buzzer shutoff option in the Configuration Menu.

1.5 - 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 screen is shown, asking whether a high alarm condition should stop the feeder and activate the alarm buzzer.

1.6 - Time Limit

The TIME LIMIT sets the maximum allowed time (in minutes) for continuous oxidizer feed. 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. The standard (default) value for ORP is 15 minutes.

When in alarm, Time Limit is reset by highlighting the value and pressing "OK". To defeat the safety timer, enter zero (0).

1.7 - Run Time

The RUN TIME line displays two separate values: the amount of running time in minutes for each current activation event and the total run time since last reset to zero.

To reset the cumulative runtime, enter zero in the far right column. To reset only the current run time, highlight Time Limit value and press “OK”.

The Total Feed Time submenu 1.7.1 is used to show the feed time from a tank since last reset to zero. Knowing the pump feed rate, it can be used to monitor the emptying of the tank and set a low-level alarm. This feature is particularly useful for remote monitoring of the chemical tanks.

1.8 - 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 1.8 for Shock Treatment, De-shock and Chemical Saver.

1.8.1 - Shock Treatment

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

Submenu 1.8.1 is used to set the parameters for the shock treatment program.

1.8.2 - Chemical Saver

Submenu 1.8.2 is a weekly program to reduce chemical usage by stopping chemical feed when the facility is not in use, such as at nighttime or on weekends.

ALARM OPTIONS	
Feed lockout	YES
Alarm buzzer	YES

Submenu 1.4.1

Total Feed Time	
Max (min)	120
Actual (min)	17

Submenu 1.7.1

SHOCK AND SAVER MENU
Shock Treatment
Chemical Saver

Submenu 1.8

ORP SHOCK	AUTO
Date	02/05/03
Cycle (weeks)	1
Time ON	21:00
Time OFF	22:00
Level (mV)	850

Submenu 1.8.1

SAVER	ON	OFF
MO	06:00	06:30
TU	08:00	08:30
WE	10:00	10:30
TH	11:00	11:30
FR	12:00	12:30
SA	13:00	13:30
SU	14:00	14:30

Submenu 1.8.2

2 - SANITIZER MENU (OPTION PPM)

Operation

The SANITIZER function is used to monitor the concentration of chlorine (or bromine) through the oxidation-reduction potential (ORP) that it generates in water.

The SANITIZER Menu screen is used to access the three sanitizer submenus for sensor calibration and low and high alarms..

PPM Readings

The Free Chlorine (or Bromine) concentration values are derived from ORP and pH readings - using a proprietary algorithm based on ORP variations **in clean water**. However, the relationship between ORP and PPM can be significantly affected by the presence of organic and inorganic contaminants (including cyanuric acid).

In general, clean water shows higher ORP values at lower ppm values. The dirtier the water gets, the more ppm it takes to generates the same ORP level. This is usually an indication that the water needs shock treatment, or even replacement.

2.1 - Display and Calibration

Line 2 displays the computed SANITIZER concentration in ppm (parts per million) or mg/l (milligrams per liter), as shown on the Main Display screen.

For calibration - as with all other functions - the operator can chose between 1, 2 or 3-point calibration (see CALIBRATION Submenus, page34).

2.1.1 - One-Point Calibration

In most cases, satisfactory PPM calibration can be obtained with one-point calibration, using a DPD (Diethyl-p-phenylene-diamine) test kit for free chlorine. Enter the value obtained with the test kit in submenu 2.1.1, as shown.

2.1.2 - Two-Point Calibration

A special 2-point calibration procedure is available for PPM, as shown on submenus 2.1.2.1 and 2.1.2.2.

NOTE: Before recalibration, always do a partial reset of PPM readings using Operations Menu 6.2.5.

For a pH of 7.5, the calibration algorithm assumes a baseline default value of 635 mV of ORP for 0 ppm (Submenu 2.1.2.1).

For heavily contaminated water, the baseline can be readjusted to lower values. For instance, if the controller readings are too low by 1 to 2 ppm, a baseline value of 600 mV gives better results. For more than 2 ppm, use 575 mV.

SANITIZER		
Calibrate	ppm	1.5
Alarm Low	ppm	0.3
Alarm High	ppm	3.0

Menu 2

1-PT CALIBRATION
Enter Measurement
from Test Kit:
1.5 ppm

Submenu 2.1.1

2-PT CALIBRATION
Enter ORP value for
0 PPM and pH=7.5:
600 mV

Submenu 2.1.2.1

Enter PPM measurement
from test kit:

1.5 ppm

Submenu 2.1.2.2

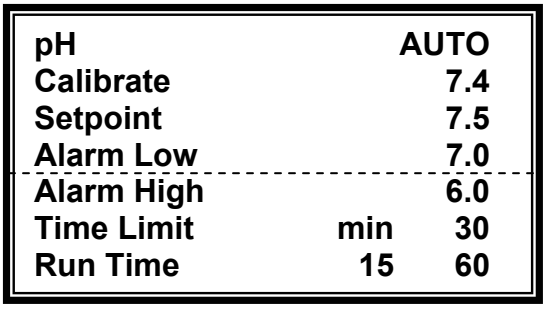
3 - pH MENU

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.



Menu 3

3.1- Control Mode

Line 1 shows the pH Control mode that is currently selected: OFF, Manual, AUTO or Timer.

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 Submenu 3.1 is then displayed.

The control mode screen and selection procedures are common to all control functions. See CONTROL Submenus, page 32.

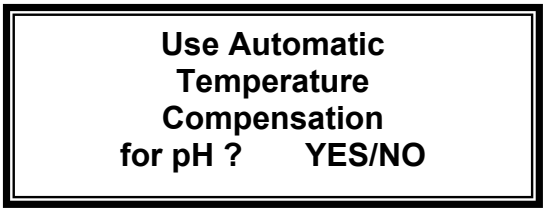
Submenu 3.1

3.2 - Display and Calibration

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

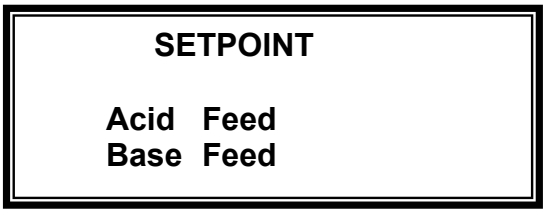
The pH sensor is best calibrated by testing the sample solution with a Phenol Red test kit. If needed, the CALIBRATION value may be adjusted to allow for differences or changes in pH sensor readings.

The pH sensor can be calibrated with 1, 2 or 3-Point calibration for origin, slope and curvature. First, press the RIGHT ARROW key to enter the CALIBRATION Submenu. The calibration procedure is common to all control functions. See CALIBRATION Submenu, page 34.



Submenu 3.2.1

After calibration, the operator is shown the Submenu 3.2.1 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.



Submenu 3.3.1

3.3 - 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, first press the RIGHT ARROW key and enter the numerical value with the digital keypad.

After pressing the OK key, the SETPOINT TYPE Submenu 3.3.1 is displayed asking whether the control is for Acid or Base. 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 set for base feed, the outlet is activated when the pH reading is 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. To change the value, press the RIGHT ARROW key and enter the numerical value with the digital keypad.

After the alarm value is set, the ALARM OPTIONS Submenu 1.4.1 is displayed, to set the feed interlock and alarm buzzer options. Use the UP and DOWN keys to highlight the desired selection and press the RIGHT ARROW key to change to Yes or No.

If the Sanitizer Lock option is set to YES, a low pH condition disables the sanitizer feed.

3.5 - High Alarm

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.

If the Sanitizer Lock option is set to YES, a high pH condition disables the sanitizer feed.

3.6 - Time Limit

The TIME LIMIT sets the maximum allowed time (in minutes) for continuous acid or base feed. 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. The standard (default) value for pH is 5 minutes.

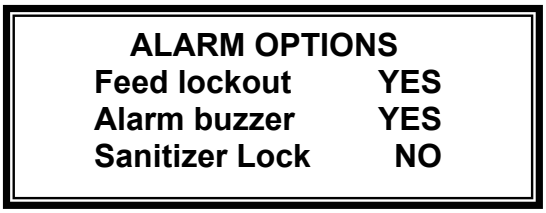
When in alarm, Time Limit is reset by highlighting the value and pressing "OK". To defeat the safety timer, enter zero (0).

3.7 - Run Time

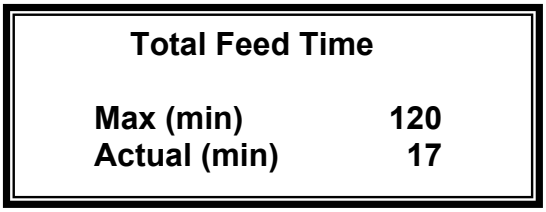
The RUN TIME line displays two separate values: the amount of running time in minutes for each current activation event and the total run time since last reset to zero.

To reset the cumulative runtime, enter zero in the far right column. To reset only the current run time, highlight Time Limit value and press “OK”.

The Total Feed Time submenu 3.7.1 is used to show the feed time from a tank since last reset to zero. Knowing the pump feed rate, it can be used to monitor the emptying of the tank and set a low-level alarm. This feature is particularly useful for remote monitoring of the chemical tanks.



Submenu 3.4.1



Submenu 3.7.1

4 - CONDUCTIVITY MENU (OPTION TDS)

Conductivity and TDS

The Conductivity sensor monitors the concentration of **Total Dissolved Solids (TDS)** in the water. The conductivity of the water - in microsiemens per centimeter (µS/cm) - is converted into ppm or mg/l of TDS with a conversion factor that depends on the type of ionic species that are present in the water. Normally, a value of 0.5 is used for water solutions containing different species of carbonate and chloride ions (see 4.8 - Select Scale).

Control of Conductivity or TDS can be used in two different ways:

- for bleeding water when the TDS level gets too high, or

- for adding a salt brine solution for an electrolytic generator when the TDS level gets too low.

IMPORTANT NOTE: Conductivity control is available ONLY when the heater control relay is not used. If both controls are required, specify a CHEMTROL$_{TM}$ PC3000 or 6000 controller.

Conductivity or TDS Displays

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.

To change the displays from conductivity to TDS, one simply enters a TDS factor different from 1 in Submenu (see 4.8 and 4.8.2). If the TDS Factor is 1, the display shows Conductivity in µS/cm. If different from 1, it shows TDS in ppm or mg/l.

The CONDUCTIVITY or TDS Main Menu screens are similar to the ones used for other functions, except for the extra line for SELECT SCALE.

CONDUCTIVITY		**AUTO**
Calibrate	**uS**	**1500**
Setpoint	**uS**	**1500**
Alarm Low	**uS**	**100**
Alarm High	**uS**	**3000**
Time Limit	**min**	**30**
Run Time	**15**	**30**
Select Scale		

Menu 4

TDS		**AUTO**
Calibrate	**ppm**	**750**
Setpoint	**ppm**	**750**
Alarm Low	**ppm**	**50**
Alarm High	**ppm**	**1500**
Time Limit	**min**	**30**
Run Time	**15**	**30**
Select Scale		

Menu 4 (TDS Alternate)

SETPOINT

Decreasing (Bleed)
Increasing (Add)

Submenu 4.3.1

4.1- Control Mode

NOTE: Remember that conductivity control can be used only if temperature control is set to OFF (X on menu screen).

Line 1 shows the Control mode that is currently selected: OFF, Manual, AUTO or Timer. 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 Submenus, page 32.

4.2 - Display and Calibration

Submenu 4.2 displays the current reading of conductivity in µS/cm or TDS in ppm or mg/l. The conductivity or TDS readings are best calibrated with standard calibrated test solutions. If needed, the CALIBRATION value may be adjusted to allow for differences or changes in sensor readings.

As with all sensor calibrations, the conductivity sensor can be calibrated with 1, 2 or 3-Point calibration for origin, slope and curvature. Press the RIGHT ARROW key to enter the CALIBRATION Submenu 4.1. The calibration procedure is common to all control functions. See CALIBRATION details, page 34.

4.3 - Setpoint

The SETPOINT determines the conductivity or TDS level that will be maintained automatically by either dumping (bleeding) water or adding a brine solution - as determined in submenu 4.3.1. To change the setpoint, press the RIGHT ARROW key and enter the desired value with the digital keypad.

4.4 - Low Alarm

The ALARM LOW value is set to generate an alarm when the conductivity or TDS reading falls below the set value. After the alarm value is set, the ALARM OPTIONS screen is shown, asking whether a low alarm condition should stop the dump valve and activate the alarm buzzer. There is no particular danger resulting from a low TDS condition but it may be an indication of a faulty sensor.

4.5 - High Alarm

The ALARM HIGH value is set to generate an alarm when the conductivity or TDS 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 dump valve and activate the alarm buzzer.

4.6 - 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.

When in alarm, Time Limit is reset by highlighting the value and pressing "OK". To defeat the safety timer, enter zero (0).

4.7 - Run Time

The RUN TIME line displays two separate values: the amount of running time in minutes for each current activation event and the total run time since last reset to zero.

To reset the cumulative runtime, enter zero in the far right column. To reset only the current run time, highlight Time Limit value and press “OK”.

4.8 - Select Scale

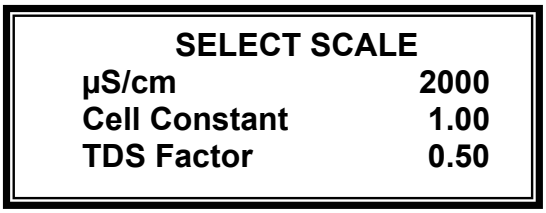
The Select Scale prompt takes the operator to the SELECT SCALE Submenu 4.8.

4.8.1 - Scale Selection

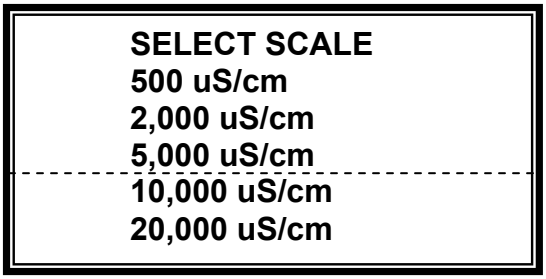
Submenu 4.8.1 is used to select the conversion parameters for different types of conductivity sensors. The SCALE may be set to 500, 2000, 5000, 10000, or 20000 µS/cm.

4.8.2 - Cell Constant

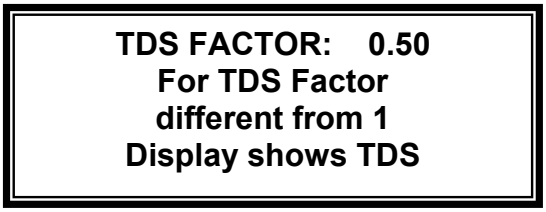
The Cell Constant is the aspect ratio of the conductivity sensor (length divided by cross sectional area) in cm^{-1}. It should be set according to the probe manufacturer specifications.



Submenu 4.8



Submenu 4.8.1



Submenu 4.8.3

4.8.3 - 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).

Because the conductivity of ionic species varies with the type of electronic charges, the TDS factor is somewhat empirical. For typical water treatment solutions, it is about 0.5. For instance, a Sodium Chloride solution with a conductivity of 2,000 µS/cm contains about 1,020 ppm (mg/l) of NaCl. This indicates a TDS factor of 1020/2000 or about 0.5.

Entering a TDS Factor different from 1 automatically changes all readings and displays from conductivity to TDS. They can be changed back to conductivity by re-entering a value of 1 for the TDS factor.

5 - TEMPERATURE MENU (Option TEMP)

Operation

The Temperature Menu, or Heater Menu, is used to control the operation of the heater with the temperature sensor. All displays can be shown in either degrees Fahrenheit or Celsius.

The Temperature Menu screen is used to access all the Temperature submenus for Control Mode, sensor calibration, setpoint and alarm settings. It also displays the actual run time for the heater and the cumulative run time since last reset to zero.

5.1 - Control Mode

NOTE: Remember that heater control can be used only if conductivity control is set to OFF (X on menu screen).

Line 1 shows the Control mode that is currently selected: OFF, Manual, AUTO or Timer. 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 and selection procedures are common to all control functions. See CONTROL Submenus, page 32.

5.2 - Display and Calibration

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

The temperature sensor can be calibrated with 1, 2 or 3-Point calibration for origin, slope and curvature. Press the RIGHT ARROW key to enter the CALIBRATION Submenu. The calibration procedure is common to all control functions. See CALIBRATION Submenus, page 34I.

5.3 - Setpoint

The SETPOINT determines the temperature level 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 5.3.1 is displayed asking whether the control is for Heating or Cooling.

The normal (default) setting is for Heating. This means that the heater is automatically activated when the temperature sensor reading falls below the setpoint. If it is set for Cooling, the cooler is activated when the temperature sensor reading is above the setpoint.

5.4 - 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 is shown, asking whether a low alarm condition should stop the heater and activate the alarm buzzer.

5.5 - 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 is shown, asking whether a high alarm condition should stop the heater and activate the alarm buzzer.

HEATER		**AUTO**
Calibrate	**F**	**80**
Setpoint	**F**	**80**
Alarm Low	**F**	**70**
Alarm High	**F**	**85**
Time Limit	**min**	**30**
Run Time	**15**	**60**
Energy Saver		**OFF**

Menu 5 (Heater Control Mode)

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

Menu 5 (Temperature Monitoring Only)

SETPOINT

Heating
Cooling

Submenu 5.3.1

5.6 - Time Limit

The TIME LIMIT sets the maximum amount of time in minutes that is allowed for continuous heating to correct a low temperature reading. This acts as a safety feature to prevent overheating in case of a malfunction of the heater or sensor.

When in alarm, Time Limit is reset by highlighting the value and pressing "OK". To defeat the safety timer, enter zero (0).

5.7 - Run Time

The RUN TIME line displays two separate values: the amount of running time in minutes for each current activation event and the total run time since last reset to zero.

To reset the cumulative runtime, enter zero in the far right column. To reset only the current run time, highlight Time Limit value and press “OK”.

5.8 - Energy Saver

The Energy Saver program is used to reduce the temperature when the pool is not in use in order to save energy costs. It includes a seven-day programmer for OFF and ON times and a temperature level adjustment.

CONTROL SUBMENUS

Features

The CONTROL Submenus are common to all the functions that require control of the operating variable at a fixed setpoint. This includes ORP, pH, Conductivity and Temperature.

For all functions, control can be made more effective and precise with the use of a deadband and a progressive zone.

Since they are the same for each variable, the Control Submenus are identified below with the generic letter X.

X.1 - Control Type

The Control Submenu X.1 is used to select the control type: OFF, Manual, Automatic or Timer. 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: On Manual setting, the outlet stays on until turned off regardless of 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 accidental overfeeding.

X.0.1 - Deadband

In both automatic control modes (ON/OFF and Proportional), the controller uses a deadband zone near the setpoint. This feature is designed 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.

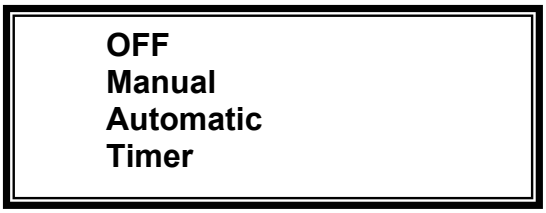
With the deadband, the outlet remains activated until the sensor reading reaches the setpoint, at which point it is de-activated. In order for the relay to be re-activated, the reading has to get outside the deadband, thus eliminating the effect of small fluctuations.

X.0.2 - Progressive Zone

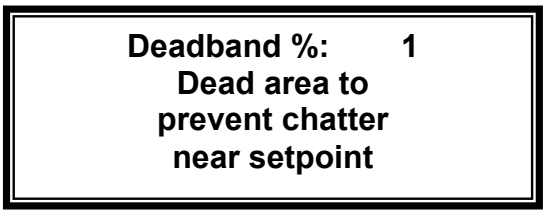
The **PROGRESSIVE ZONE** is a control zone around the setpoint where the outlet activation depends on how far the sensor reading is from the setpoint (see Figure 17).

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 goes to 0% when the reading reaches the setpoint.

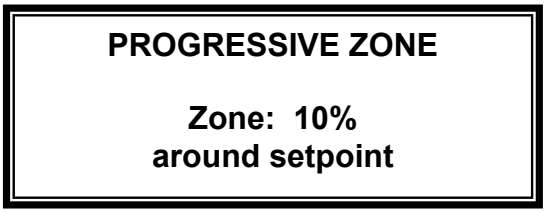
This control mode is available in Proportional Control only (see next page). It provides more precise control than ON/OFF control and reduces overfeeding, particularly in small bodies of water.



Submenu X.1



Submenu X.0.1



Submenu X.0.2

X.1.3 - Automatic Control

In the **Automatic Control Type**, the operator can choose among two different Control Modes: ON/OFF or, as shown on Submenu X.1.3.

AUTOMATIC CONTROL
ON/OFF Proportional

Submenu X.1.3

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 discussed above.

The ON/OFF control mode is recommended to obtain a fast control reaction in order to return to the setpoint rapidly, if there is no concern about overshooting it (overfeed). This is particularly applicable to large bodies of water, such as public pools.

If more precise control is required, especially in small bodies of water, like a spa, Proportional Control is preferred.

Proportional Control

The Proportional Control mode is recommended only for small pools and spas to prevent overfeeding from oversized feeders. In this mode, the outlet relay is turned ON and OFF at a rate that decreases as the setpoint is neared. The rate goes down from 100% ON in a 100-second CYCLE TIME at the edge of the Progressive Zone to 0% at the setpoint (see Figure 17).

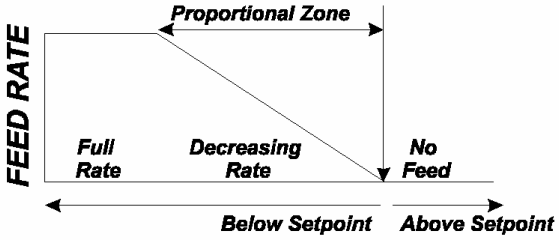


Figure 17 - Proportional Feed Rate

Proportional control operates only within the defined Progressive Zone (see Submenu X.0.2 on previous page). Outside the zone, control reverts to standard ON/OFF mode.

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 gets near the conditions of ON/OFF control.

It should be noted that longer time limits may be required to account for the slower effective feed rates.

X.1.4 - Timer Control

In the Timer Control mode, the controller activates the control outlet according to fixed ON and OFF cycles (in minutes), regardless of sensor input. This allows programmable metered operation in case of sensor failure.

It can also be used to feed a supplementary oxidizer, as with the Automated Chloramine Treatment (ACT) program.

TIMER CONTROL		
Cycle ON	min	0.1
Cycle OFF	min	1.0

Submenu X.1.4

CALIBRATION SUBMENUS

X.2 - Calibration Options

The CALIBRATION Submenu is common to all the functions that require sensor calibration. This includes Sanitizer, pH, Conductivity and Temperature. It allows calibration for 1, 2 or 3-point - depending on the degree of accuracy that is required.

The CALIBRATION OPTION Submenu 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 the required number of sample 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. The slope is a default value that is 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 calculate the origin “a” and slope “b” in the equation:

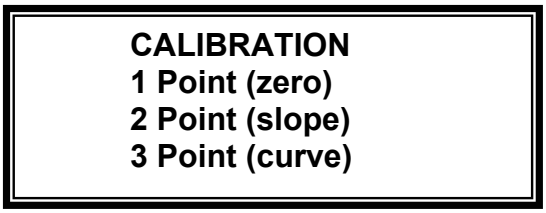
DISPLAY = a + b * INPUT

X.2.3 - Three-Point Calibration

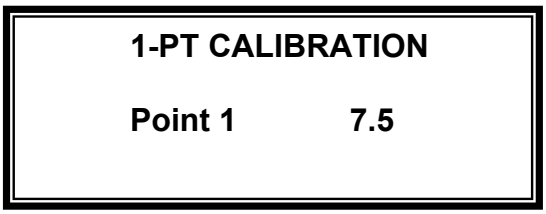
With 3-Point calibration, the straight line is replaced by a second-degree polynomial curve. The operator needs three calibration solutions with values that are sufficiently spaced apart to show differences in the curvature of the polynomial.

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

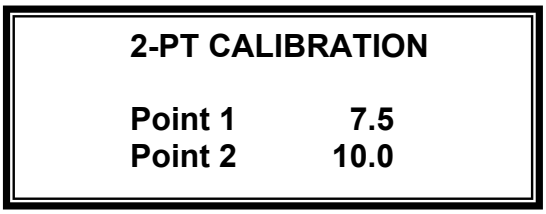
DISPLAY = a + b * INPUT + c * INPUT*INPUT



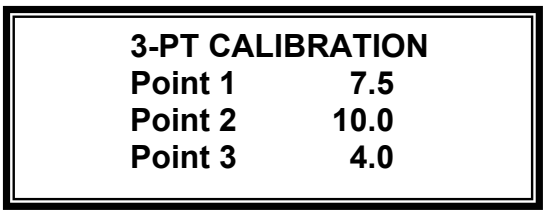
Submenu X.2



Submenu X.2.1



Submenu X.2.2



Submenu X.2.3

CHAPTER V - COMMUNICATIONS

CHEMCOM$_{TM}$ REMOTE OPERATION

The CHEMTROL$_{TM}$ PC2000 controller features remote operation by Windows^{TM}-based computers via modem-to-modem, ethernet / internet or direct connections, using the proprietary CHEMCOM$_{TM}$ software program.

The CHEMCOM$_{TM}$ program is a program for Windows^{TM} computers that features true duplex operation. This means that any action on the remote computer is immediately implemented on the screen of the controller, and vice versa.

This unique feature is particularly useful for remote monitoring, operator training and troubleshooting.

CHEMCOM$_{TM}$ Program

The menu screen on Figure 18 shows that the CHEMCOM$_{TM}$ program is fully menu-driven and easy to use, even by staff without computer experience.

Menu 1 INSTRUCTIONS gives access to basic printable operation information.

Menu 2 SYSTEM SETUP is used primarily to setup the system communications options when connecting to controllers via modem or direct (RS-485). If unsure about the communication port setting, try COM1. If you get an error message when trying remote communications, try COM2, etc.

Menu 3 FACILITIES is the master list of facilities. Changes to individual facilities occur in this submenu. It is important to specify the model number of the controller, i.e. PC2000. To be included in automatic scanning, set the facility to A (Active).

Menu 4 SCANNING SCHEDULE is used to select the automatic scanning mode. It does not affect the Remote Operation mode.

Menu 5 ACTIVATE SCANNING is used to initiate automatic scanning or data-log download of “ACTIVE” remote facilities.

Menu 6 REMOTE CONTROL is used to access and operate any of the remote facilities.

Menu 7 SCAN FACILITIES is used to manually connect to “ACTIVE” controllers for scanning and/or data-log download.

Menu 8 DISPLAY DATA is used to display downloaded data either in graphical, “scan” table or text format.

Menu 9 FILE MANAGEMENT is used to manage downloaded data files including selective copying and erasing.

Menu 10 QUIT is used to exit the CHEMCOM$_{TM}$ program and return to *Windows*.

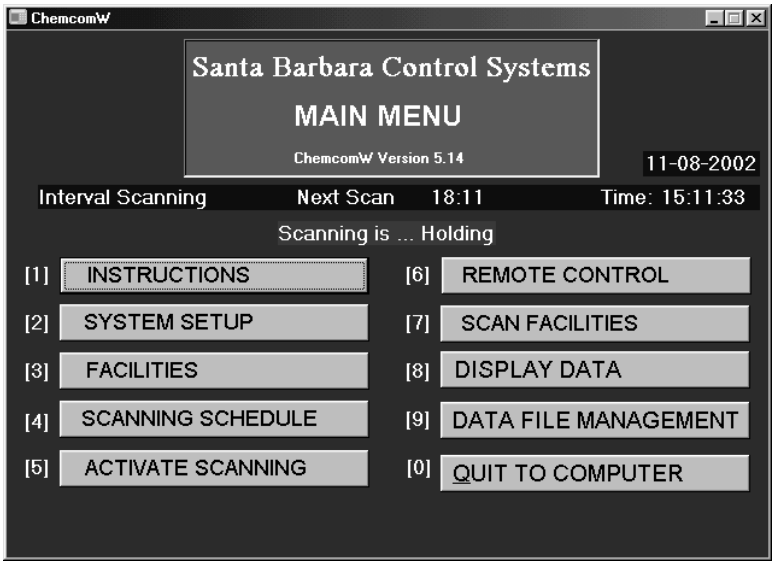


Figure 18 - CHEMCOM Program Menu

Computer Software Installation

The CHEMCOM$_{TM}$ computer software program used for remote operation is supplied on a CD-ROM. The program is self-installing and runs under *Windows*.

To install the program on the remote computer, click on Run on the Desktop screen and select the CDROM drive where the CHEMCOM$_{TM}$ program disk is located. Then click on Setup.

To start the program, double-click the CHEMCOM shortcut on the desktop or go to the Start/Program menu and click on the CHEMCOM icon.

To learn more about the CHEMCOM$_{TM}$ program, open the instructions file located on the CDROM. The file is saved in RTF (Rich Text Format) to be read or printed by any word processor.

Remote Communications

Several Remote Communications options are available for the CHEMTROL$_{TM}$ PC controllers:

Modem Connections

Option REM uses modem-to-modem communication between the remote computer and the on-board data modem. On CHEMTROL$_{TM}$ PC2000 controllers, the data modem and the standard US-type RJ11 phone jack are located on the middle right hand side of the Mother Board (see Figure 5).

Using the phone extension cable, connect the jack on the CHEMTROL$_{TM}$ PC to an analog telephone line (no switchboard). The phone line does not have to be a dedicated line and it can be used for other communications when not in

use for the controller. When called by a remote computer, the controller answers on the first ring, unless somebody else answers the call.

The modem on the remote computer is connected to one of the communication ports. The CHEMCOM$_{TM}$ program will need to know which one is used. It is usually COM1 or COM2. To confirm, click on START/Settings/Control Panel and double-click the "modems" icon.

Ethernet / Internet Connections

Option ETHCOM uses Ethernet / Internet communication between the remote computer and the on-board Ethernet modem. The Ethernet modem is typically installed inside the controller enclosure but does not install directly on the controller board.

Connect the Black and Red wires of the cable provided with the Ethernet modem to the controller RS485 A (black) & B (red) ports. Set the controller as a slave by orienting the jumper J9 as marked on the motherboard (Figure 5). Then, power and connect the Ethernet modem to the TCP/IP network via its standard RJ45 TCP/IP jack.

Direct Connections

Option RS485 establishes a direct connection between one on-site computer and the controller through a dedicated pair of wires (3,000 feet maximum) using RS485-based communication.

Connect the controller RS485 A & B ports to the computer RS485/RS232 converter through the dedicated pair of wires. Set the controller as a slave by orienting the jumper J9 as marked on the motherboard (Figure 5).

The RS485/RS232 converter on the remote computer is connected to one of the external communication ports. The CHEMCOM$_{TM}$ program will need to know which one is used. It is usually COM1.

Remote Operation

To establish connection from a remote computer, select Menu 6 REMOTE CONTROL on the CHEMCOM$_{TM}$ menu screen (Figure 18) and click on the name of the facility (Figure 19).

The computer then connects to the controller and displays an image of the actual controller screen in **true duplex representation**, as shown on Figure 20.

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.

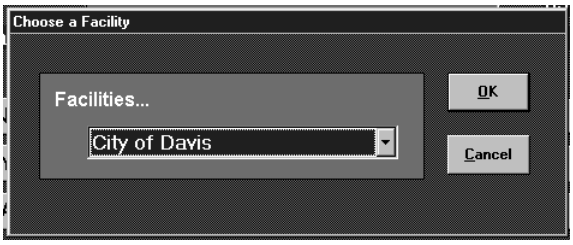


Figure 19 - CHEMCOM$_{TM}$ Facility Selection

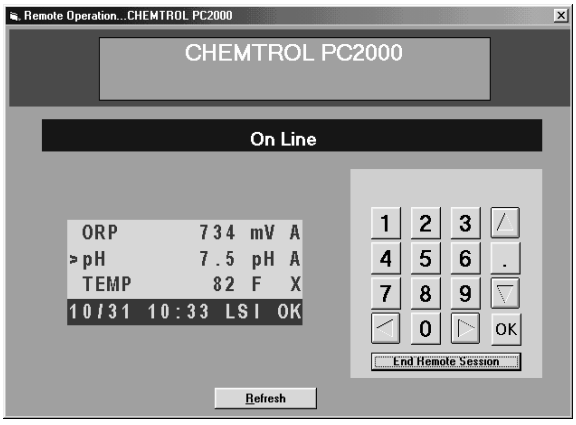


Figure 20 – CHEMCOM$_{TM}$ Remote Operation Screen

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

Line 1 shows an ORP reading of 734 mV with no pump feeding (no >) in Automatic mode (A).

Line 2 shows a pH reading of 7.5 with the acid pump feeding (>) in the Automatic mode (A).

Line 3 shows a Temperature reading of 82 F with heater control off (X).

Line 4 shows a date of 10/31, time of 10:33 AM and saturation index OK.

Scanning Facilities

CHEMCOM offers automatic and manual scanning of facilities to connect to "ACTIVE" controllers for scanning and/or data-log downloads. When the remote controller is contacted, the test data is displayed on the computer screen and stored on disk file for later recall.

Automatic Scanning

Through Menu 4, you select and set-up the automatic scanning modes:

- Continuous: CHEMCOM scans all "ACTIVE" controllers continuously.
- Interval Scanning: Select the preferred interval (every 15 minutes, every 3 hours, etc.)
- Scheduled Scanning: Enter exact times of the day you wish scanning to occur.

Menu 5 is used to activate scanning or data-log download, following the scanning schedule set in Menu 4.

After clicking "Activate Scanning", you must choose one of two scanning options:

1. Data-log: to download the data-logs following the start and stop dates entered.
2. Scanning: to scan the readings at the time the computer connects to them

When a scanning option is accepted, the phrase "scanning ... holding" on the Main Menu changes to "scanning is active".

Manual Scanning

After clicking Menu 7-"Scan Facilities", you must choose to scan all facilities or just one using one of two scanning options:

1. DATALOG: to download the controllers' data-logs following the start and stop dates entered.
2. SCAN DATA: to scan the controllers' readings at the time the computer connects to them.

Display of Scanning Data

When the remote controller is contacted, the test data is displayed on the computer screen indicating "successful scan", as shown below, and stored on disk file for later review.

The three most recent stored scans of all ACTIVE facilities can be accessed by selecting the DISPLAY DATA / RECENT SCANS menu. Alarm conditions (out-of-range) are marked in red cells to facilitate the review.

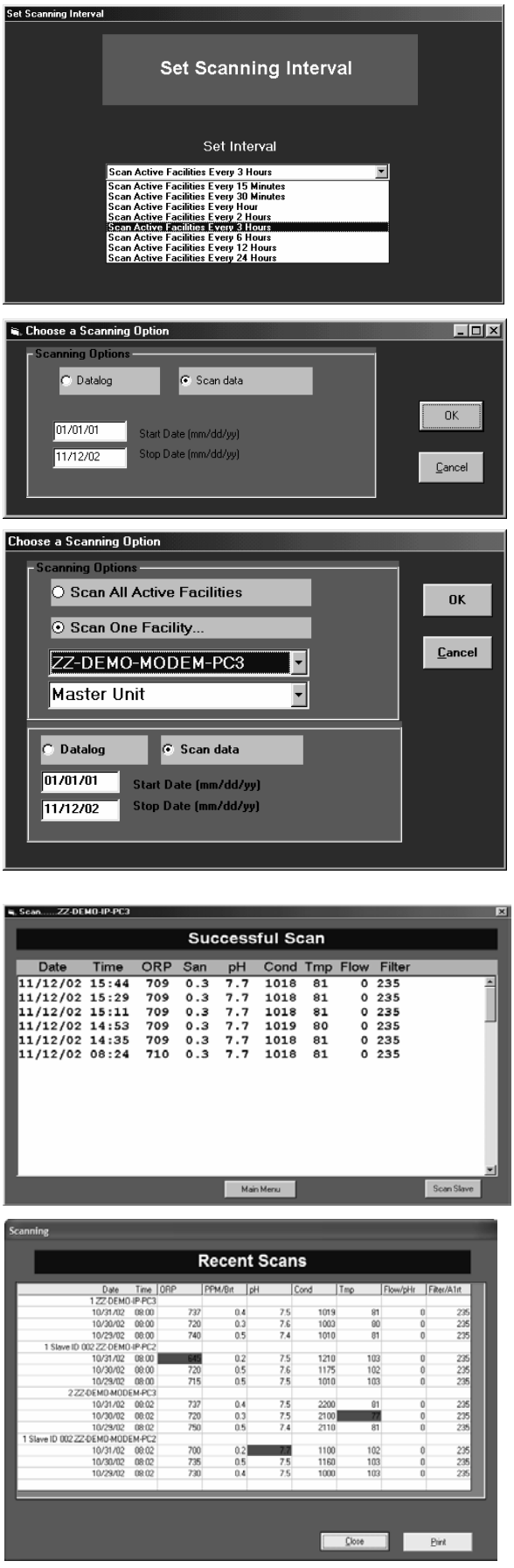


Figure 21 - CHEMCOM$_{TM}$ Automatic & Manual Scanning

Data Log Download

Logged data can be downloaded by remote computer via the CHEMCOM$_{TM}$ program, using Menu 6-REMOTE CONTROL or Menu 7-SCAN FACILITIES.

Remote Control

After connecting to the controller, navigate remotely through the controller menus to reach the OPERATIONS / PRINT REPORT submenu. Select the desired START and END dates, move to Print Data Log and press the RIGHT ARROW. A counter shows the number of tests being printed and saved on the remote computer.

Scan Facilities

After clicking "Scan Facilities", choose to scan all facilities or just one using the datalog option to download the controllers' data-logs following the start and stop dates entered.

On-site Download

Logged data can also be downloaded or printed on-site using the controller RS232 serial port, through the controller OPERATIONS/PRINT REPORT Submenu 6.2.4, as explained in the OPERATIONS Chapter, page22.

Text Data Display

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

It can also be displayed directly in two formats through the CHEMCOM$_{TM}$ program - as shown in Figure 22 - using Menu 8 DISPLAY DATA and VIEW.
- TEXT: It is displayed as text data using the "TEXT" button;
- SCAN TABLE: It can be displayed as a "Scan table" using Menu 2 - System Setup using the established High and Low alarm values.

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

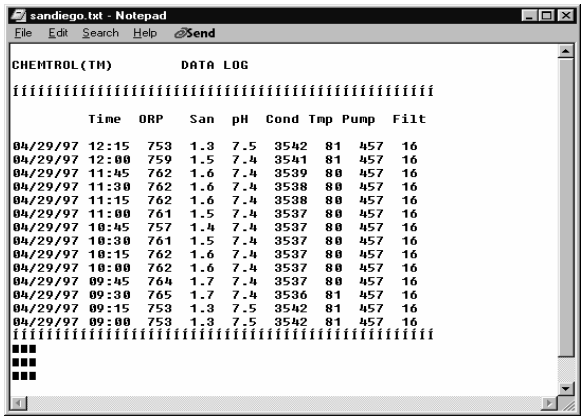
Graphic Data Display

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

As shown on Figure 23, 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.



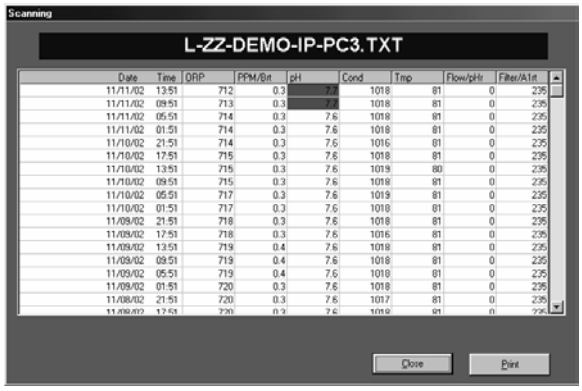


Figure 22 - CHEMCOMTM Text Data Display

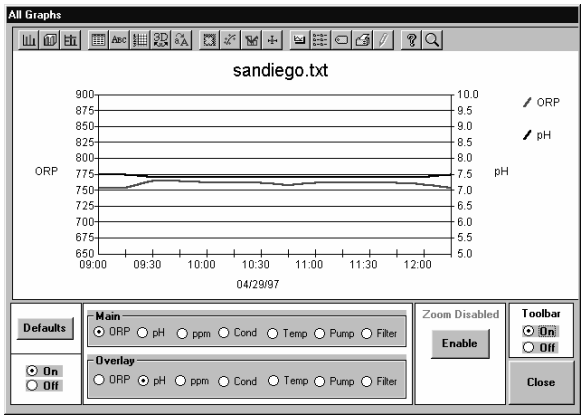


Figure 23 - CHEMCOM$_{TM}$ Graphic Data Display

CHAPTER VI - MAINTENANCE

CONTROLLER MAINTENANCE

Regular Maintenance

The CHEMTROL$_{TM}$ PC2000 controller requires 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 ORP and pH sensors. For commercial and public pools or spas, It is recommended to schedule preventive cleaning programs on a weekly or monthly basis.

The Acid Test

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

Carefully add a small amount (½ cup or less for a public pool, a small capful for a spa) of hydrochloric (muriatic) acid HCl in the intake side of the recirculation line, upstream of the sensors, and observe the ORP and pH 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

WARNING: The sensors stop reading when they become coated with oil, calcium or dirt.

To clean the ORP 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 pH Sensor, use the same procedure.

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

Winterizing

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

- store at room temperature,
- keep the protective cap on the sensor filled with 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,
- soak the sensor in a salt solution if stored over 3 months.

Battery Replacement

The memory battery is located in the upper left corner of the Mother Board. It keeps the settings for configuration, operation and calibration 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 6.2.6 (page 23).

If the battery shows a voltage below 2.5 V, it should be replaced with a 3Vlithium battery, Panasonic CR 2330 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$_{TM}$ PC 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 J3 next to the battery on the motherboard.

2. Locate the Program Chip U28 and the Display Chip U8 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 downward. CAREFUL: wrong installation can 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 J3 and restore power to the controller. You should see the CHEMTROL$_{TM}$ logo displayed on the screen twice. When the display screen shows asterisks (***) for date and time, you can be assured that the old program has been erased in its entirety.

7. Reprogram the controller to the desired parameters.

CHEMICAL MAINTENANCE
Overview

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

In addition, 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. This is especially important for pools stabilized with cyanuric acid as the effects of sunlight on chlorine activity are not detected by the test kits and may lead to false and unnecessary readjustments.
Finally, the pool 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 over emphasized, as it affects every aspect of water chemistry.

For pools and spas, the recommended pH setpoint is between 7.4 and 7.6. Below 7.4, the water becomes increasingly corrosive and causes stains, etching of plaster and eye irritation. Above 7.5, 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 it is too high (above 150 ppm), pH response is slow and requires more acid or base feed. If it is too low (under 100 ppm), 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 display 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 display 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 and Sanitizer Control

The recommended control level is 1.5 to 2.0 ppm of chlorine or 3.0 to 4.0 ppm of bromine at a pH of 7.5. 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.**
Because of the Time Lag between injection of chemicals, mixing in pool water, and return to the sensors, it is normal to see a variation of a few tenths of a PPM around the setpoint, depending on the feed rate of the chlorinator or brominator.

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

If the display 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 then HOCl in killing bacteria.

With proper automatic pH control, the reading on the sanitizer display is very close to test kit readings. If the pH varies too much however, the CHEMTROL$_{TM}$ controller will show the variations in HOCl - which are not shown by normal test kits. It is normal therefore to see small differences in readings between display and test kit if the pH varies.

If the ORP reading is maintained above the recommended minimum of 650 to 750 mV, the water should be free of germs and bacteria. Below 650 mV, germs and bacteria will develop rapidly.

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 is 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 dump or replace part of the water when it gets over 40 ppm - especially in spas.

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: Shut off the Bypass Line when adding sequestering agents as they will coat the platinum ring of the ORP sensor, resulting in false readings.

Limit Timers (**Overfeed Safety**)
The Time Limit settings are designed to disable the feeders or other equipment in case 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 - 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. After correcting the malfunction, reset the timer by momentarily setting the limit to 0 (see Chapter IV – Operation, page 18).

Timer Settings

To select the proper setting for each safety timer, the operator must take into consideration the size of the pool or spa and the feed rate of the chemical feeder. In case of doubt, make sure to consult a qualified CHEMTROL$_{TM}$ 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 displays.

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. In the event that the chlorine level is allowed to fall below the normal level, even for a short period (due to exhaustion of chemicals or technical malfunction), there can be formation of chloramines. These can be destroyed only by breakpoint superchlorination.

WARNING:
If the chloramine concentration exceeds 0.2 PPM (mg/l), superchlorination at 10 times the combined chlorine level is recommended.

The shock treatment program can be set up either through the ORP Menu, using the proper daily or weekly program schedule.

Precautions

A. During superchlorination, the Limit Safety Timer is disabled.

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.

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

PORTABLE TESTER

The PORTA-PROBE™

The PORTA-PROBE II (Figure 24) is a convenient battery-operated portable tester and signal simulator that is designed to test the readings of the ORP, pH, TDS and Temperature sensors and to simulate calibrated signals for testing of the controller. It is not used to calibrate the sensors. This is done with a test kit for Free Chlorine and pH.

Figure 24 - Portable Tester

Battery Check

Before using the tester, it is a good idea to make sure that its 9 VDC battery is in good operating condition.

NOTE: Remember to turn off the POWER SWITCH to OFF after testing to avoid discharging the battery.

Self-Test

The PORTA-PROBE$_{TM}$ tester features a convenient self-testing capability. With the Power Switch ON, connect the two shielded jumper cables from each BNC simulator output to the corresponding BNC sensor input. Using the calibration screw on the front panel, you should be able to adjust the meter reading to the center of the scale. If not, the tester should be sent back for repair.

Testing of Sensors

Set the Mode Switch to TESTING.

ORP SENSOR

Connect the ORP sensor to the ORP BNC connector on top left of 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.

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

pH SENSOR

Connect the pH sensor to the pH BNC connector on top of the tester. Turn the Selector Knob to pH.

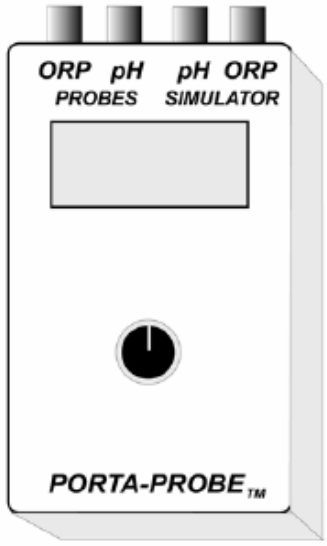
Place the sensor in nearly neutral water (pH = 7.5). You should get a pH reading of about -30 mV.

Place the sensor in an acid solution. You should get a HIGH POSITIVE reading.

Place the sensor in a BLEACH solution. You should get a HIGH NEGATIVE reading.

The linear scale on the right shows the conversion of millivolt readings into pH units.

To sensors



pH Scale

mV	*pH*
+420	0
+30	6.5
0	7.0
-6	7.1
-12	7.2
-18	7.3
-24	7.4
-30	7.5
-60	8.0
-90	8.5
-420	14.0

TEMPERATURE SENSOR

Connect the sensor to the quick connector on the left side of the instrument. Turn the Selector Knob to TEMP READING. Place the sensor in ambient temperature water. You should be getting a correct temperature reading.

CONDUCTIVITY SENSOR

Connect the sensor to the quick connector on the left side of the instrument. Turn the Selector Knob to COND. Place the sensor in tap water. You should be getting a reading between 1,000 and 2000 µSiemens.

To convert conductivity readings to TDS values, use a conversion factor of 0.5. For instance, a conductivity of 2,000 corresponds to a TDS value of 1,000 ppm or mg/l.

Testing the Controller

Set the Mode Switch to SIMULATOR.

ORP AND pH SIMULATION

Before starting ORP and pH simulation, turn off the *Probe Monitor* option on the controller.

Use the two coaxial cables to connect the BNC connectors on the top right of 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.. The pH range is -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: The ORP and pH signals can be simulated at the same time but only one signal is shown on the tester display.

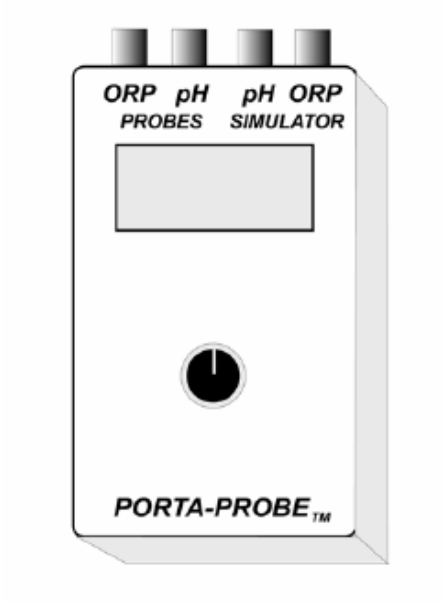
TEMPERATURE AND TDS SIMULATION

Use the jumper wires to connect the quick connectors on the *right side* of the tester to the temperature and conductivity inputs on the motherboard inside the controller.

The temperature simulator is set for a fixed output of 80 ^{O}F (26.7 ^{O}C).

The conductivity simulator is set for a fixed output of 2,000 µSiemens or about 1,000 ppm (mg/l) of Total Dissolved Solids.

To controller



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 F1 on Power Board. If blown, replace with AGC1 fast blow fuse..
2. FAINT OR DARK DISPLAY	2a. Adjust contrast with Display Potentiometer R36 in top right 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 CHEMICAL FEED NO HEATER ACTIVATION NO VALVE ACTIVATION	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 TIME LIMIT line is flashing: Increase chemical feeder rate. Increase Limit Timer setting. Reset Time Limit 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 F2 and F3 pH: Fuses F4 and F5 Heater: Fuses F8 and F9 TDS: Fuses F4 and F5
6. CANNOT CALIBRATE	NOTE: The ORP needs to be above 650 mV for Sanitizer calibration. 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, ACCESSORIES AND UPGRADES

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
T/C	TEMPERATURE + CONDUCTIVITY SENSOR with 10-ft (3m) cable.
PWFS	ROTARY SAFETY FLOW SWITCH, 1/2" FPT, for bypass line.
MB2000	MOTHER PC BOARD, electronic PC board for PC2000 with microprocessor.
PB2000	POWER PC BOARD, electronic PC board for PC2000 with relays (specify).
PTR	THERMAL PRINTER, 40-column digital, 110V or 230V (specify)
BPL	BYPASS LINE ASSEMBLY, ½-in with Y-filter, flowmeter, safety flow switch, three (3) ball valves ...
FC	FLOW CELL, 3 1/2-inch PVC cell, clear cover, two (2) ½-inch compression fittings,
FCA	FLOW CELL ASSEMBLY, PVC sensor cell, two (2) ½-inch compression fittings, sampling tap, two (2) 1/2-inch ball valves.
SCA	SENSOR CELL ASSEMBLY with Flow Cell Assembly.
205T	PVC SOLENOID VALVE for erosion feeder, 1" or 3/4" FPT (specify 24 V or 110VAC).
PPM2	UPGRADE for PPM display
TEMP2	UPGRADE for temperature display and control
TDS2	UPGRADE for TDS and Conductivity monitoring
REM2	UPGRADE for remote operation via modem with true duplex CHEMCOM$_{TM}$ software
ETHCOM2	UPGRADE for remote operation via Ethernet with true duplex CHEMCOM$_{TM}$ software
RS485	UPGRADE for direct computer operation with communication converter and true duplex CHEMCOM$_{TM}$ *Windows* software
MULTI2	UPGRADE for Multiplex communications through host controller with RS485 and modem

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