Chemtrol Installation Guide

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Version 2.01

Santa Barbara Control Systems
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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.

8. 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 °C (104 °F). Water temperatures between 38 °C (100 °F) and 40 °C (104 °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 °C (100 °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

Chemtrol®

WARRANTY

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

NEITHER SANTA BARBARA CONTROL SYSTEMS CORPORATION NOR ANY OF ITS EMPLOYEES SHALL BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF ITS INSTRUMENTS AND SOFTWARE EVEN IF SANTA BARBARA CONTROL SYSTEMS CORPORATION HAS BEEN ADVISED IN ADVANCE OF THE POSSIBILITY OF SUCH DAMAGES. SUCH EXCLUDED DAMAGES SHALL INCLUDE, BUT ARE NOT LIMITED TO: COSTS OF REMOVAL AND INSTALLATION, LOSSES SUSTAINED AS THE RESULT OF INJURY TO ANY PERSON, OR DAMAGE TO PROPERTY.

Document Revisions

Date	Version Number	Document Changes
07/13/2017	0.1	Initial Draft CN3022
06/10/20	0.1	Minor updates

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1 Installation

1.1 Siting (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,
- at a safe distance from power transformers, pump motors or high voltage power lines,
- safe from unauthorized access or vandalism

1.1.1 General Layout

There are three basic configurations for the bypass line. The exact configuration used depends upon several considerations determined by each site. The three configurations are:

- Pressure to Vacuum
- Pressure to Atmosphere
- Pressure to Pressure

1.1.1.1 Pressure to Vacuum

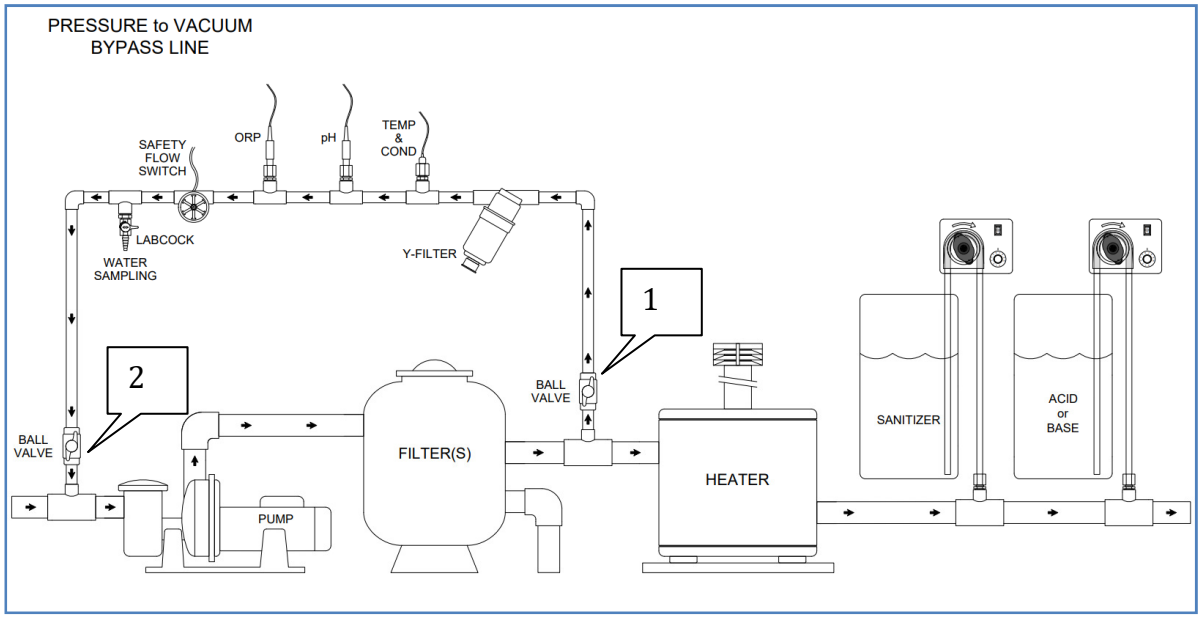


Figure 1. Pressure to Vacuum Bypass Line

In this configuration, the bypass line connects between the output of the filter and the input to the pump. The pressure at the filter (downstream from the pump) is higher than the input side of the pump thus providing the pressure differential necessary to cause flow through the bypass line. It is recommended to provide a self-priming pump.

Procedure to set is to

1. Turn the ball-valve fully on with the inlet open
2. Regulate the flow with the ball-valve on the vacuum side.

1.1.1.2 Pressure to Atmosphere

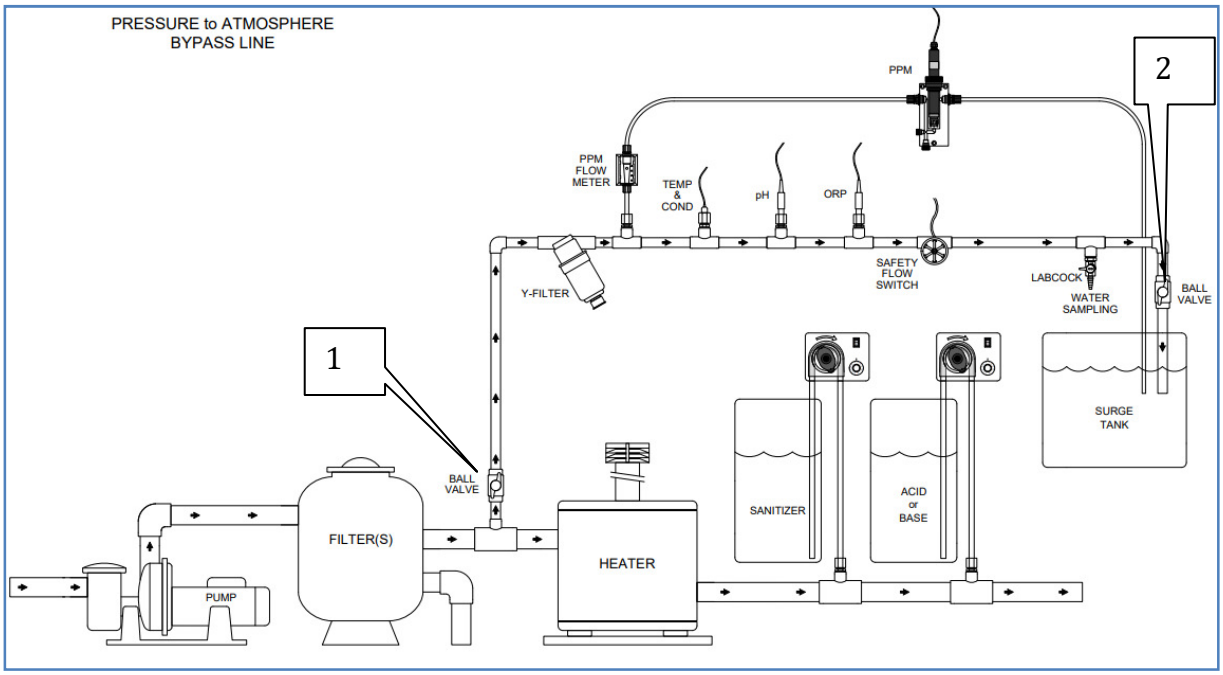


Figure 2. Pressure to Atmosphere Bypass Line

In this configuration, the bypass line connects between the output of the filter and the surge tank. The pressure at the filter (downstream from the pump) is higher than the outside pressure thus providing the pressure differential necessary to cause flow through the bypass line.

Procedure to set is to

1. Turn the ball-valve fully on with the supply side
2. Regulate the flow with the ball-#2,.

1.1.1.3 Pressure to Pressure

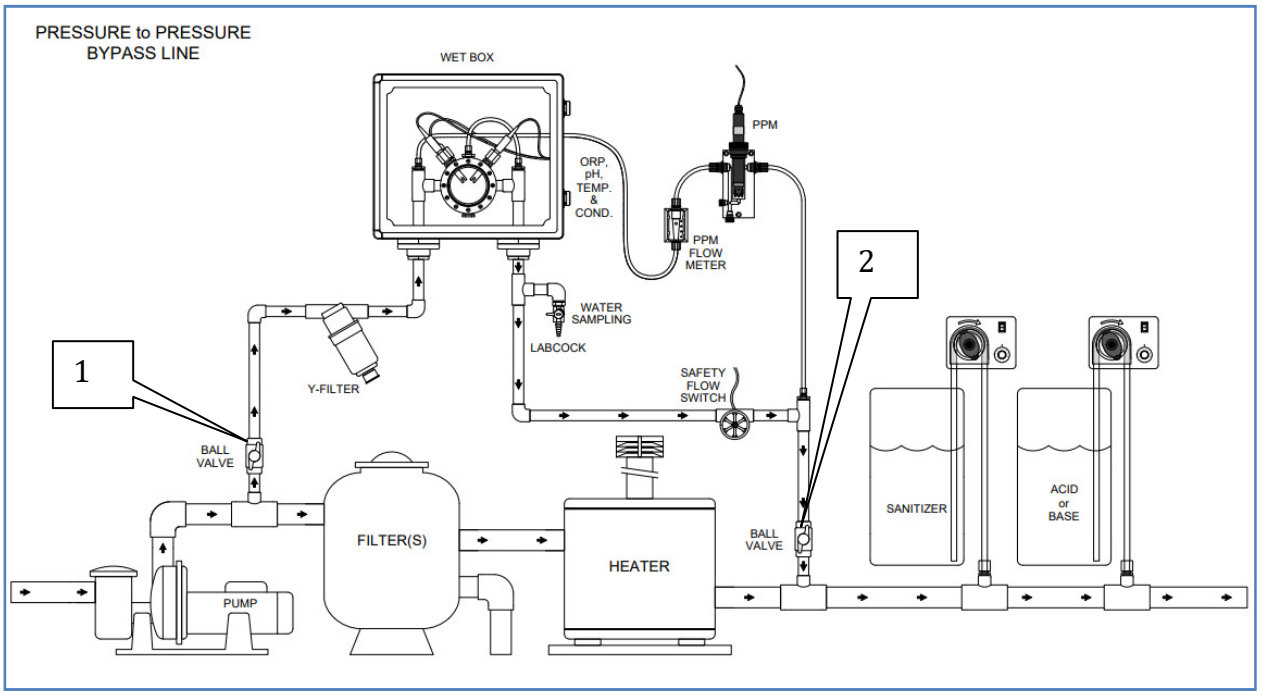


Figure 3. Pressure to Pressure Bypass Line

In this configuration, the bypass line connects between the output of the pump and the output of the heater. The hydrodynamic resistance to the flow through the filter and heater generates a pressure differential that, in turn, causes flow through the bypass line.

Procedure to set is to

1. Turn the ball-valve fully on with the inlet open
2. Regulate the flow with the ball-valve.

This configuration may require more frequent cleaning and/or replacement of sensors.

1.1.2 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 for the Power Board of the controller are as follows:

		RELAYS	**POWER IN**
GREEN	GROUND	GND	GND
BLACK	HOT	NO1	L1
WHITE	NEUTRAL	NO2	L2

Table 1 Internal Wiring

1.1.3 Grounding (GFI)

A grounding lug is provided on the right side of the cabinet. Connect to an earth ground to reduce shock hazard and eliminate leakage current leakage. Ground Fault Interruption (GFI) protection is strongly recommended for all installations.

1.1.4 Electrical Interference

The *CHEMTROL*® PC controllers feature differential amplification of the sensor signals to reduce electrical interference from stray currents in the water.

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. Different readings generally indicate current leakage interference. Its source must be identified and eliminated with proper grounding by a qualified electrician.

1.1.5 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. Note that the power input should never be used as the primary chemical disable switch.

1.1.6 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. The interlock may be defeated for maintenance purposes by pulling on the plunger.

1.2 SAFETY NOTICE

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

1.3 Power Connection

1.3.1 Line Voltage

The controller operates from a line voltage in the range of 110V to 240V at a frequency of 50 or 60Hz. Line voltage selection is accomplished by setting jumpers.

CAUTION: Operating the unit on an incorrect line voltage will cause damage and void the warranty.

1.3.2 Line Power Connection

Perform the following steps to connect the controller to line power:

1. Connect the female end of the supplied power cord to a grounded AC receptacle on the rear panel.

2. Connect the other end of the supplied power cord to a grounded AC outlet.

WARNING: The power cord supplied with the controller contains a separate ground for use with grounded outlets. Failure to use a grounded outlet may result in personal injury or death due to electric shock.

1.3.3 Line Fuse Replacement

A rear panel fuse protects the power line input of the controller. If the line fuse needs replacement, perform the steps below:

WARNING: Disconnect the line cord from the unit before changing the line fuse.

1. The fuse is located in a holder in the power module unit above the AC receptacle (figure 3-1).
2. Slide the fuse holder out to gain access to the fuse carrier and fuse.
3. Remove the carrier with the blown fuse, and replace with the correct type listed in Table 3-1.
4. CAUTION: For continued protection against fire or unit damage, replace the fuse only with the type and rating listed.
5. Install the fuse carrier in the fuse holder, then insert the fuse holder back in the power entry module.

1.4 Installation Report

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

- 1. White copy: to mail back to factory.
- 2. 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.

1.5 Principles of Operation

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

This manual covers the installation of the PC 2100, PC 3000,PC 4000, PC 5100, PC 6000, PC 7000 and PC 7100 controllers.

PC controller is contained in a rain proof and splash proof NEMA Type 4 cabinet. The cabinet also includes mounting ears for easy installation. Internally, each controller consists of a main processor board, display, keypad and various add-on modules specific to the installation that may be required.

The circuit 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 F9. If the fuse has to be replaced, make sure to use a 1 A fuse only. The use of a larger fuse may result in irreparable damage to the electronic boards.

1.6 PC 2100 CPU Boards

The key electronic components are the microprocessor and the programmable chips for Program, Display and Memory. All the electronic and electrical components are mounted inside the cabinet on two separate PC Boards: the Main CPU Board**Error! Reference source not found.** and the Power Board.

The Main Board, or mother board, is mounted directly behind the face panel of the controller and contains all the low voltage circuitry including the microprocessor and SD Card, the LCD display and the keyboard pad. It is also used to connect all the sensor inputs.

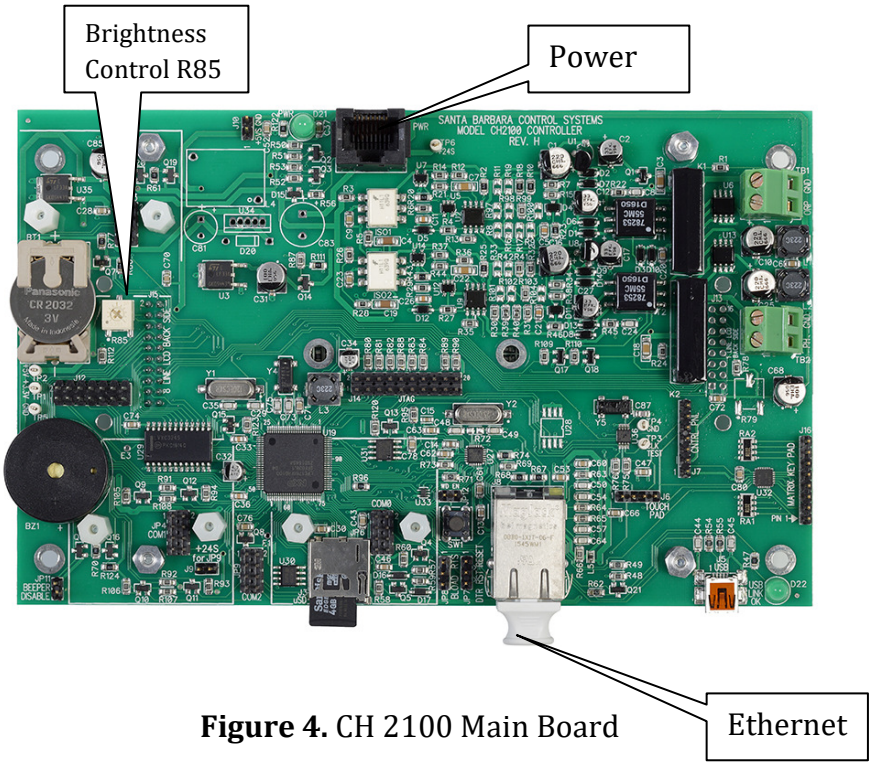


Figure 4. CH 2100 Main Board

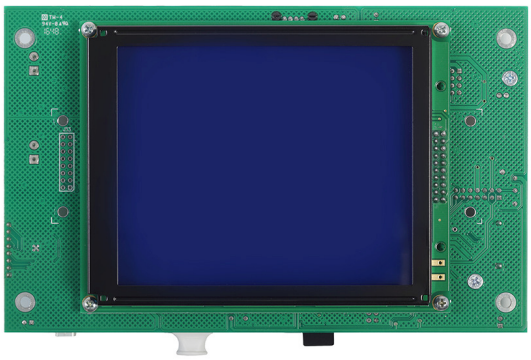


Figure 5. CH 2100 Main Board with Display (back)

1.6.1 Display Brightness

The contrast of the display can be adjusted with the potentiometer marked R85 on the PC2100c that is located on the upper left of the Main Board adjacent to the battery (Figure 5).

1.6.2 Backup Battery

The 3V Backup Battery is located on the left side of the Main Board. It is used to maintain the memory settings in case of loss of AC power. This battery is designed to last for several years in normal operation.

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.

1.7 PC 604 Series Controllers (3000, 4000, 5000, 5100, 6000, 7100)

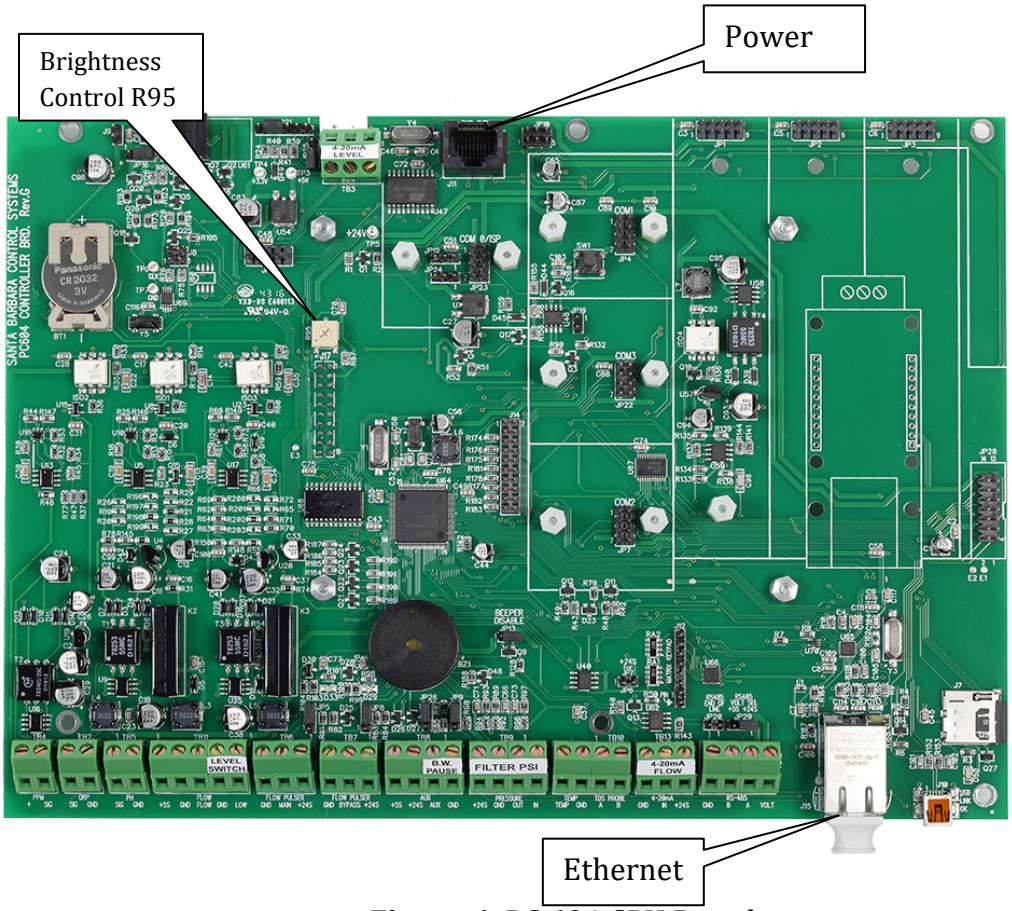


Figure 6. PC 604 CPU Board

Similar to the PC2100, the key electronic components are mounted on the Main Board (mother board). All the electronic and electrical components are mounted inside the cabinet on two separate PC Boards: the Main CPU Board and the Power Board.

The Main Board, or mother board, 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.

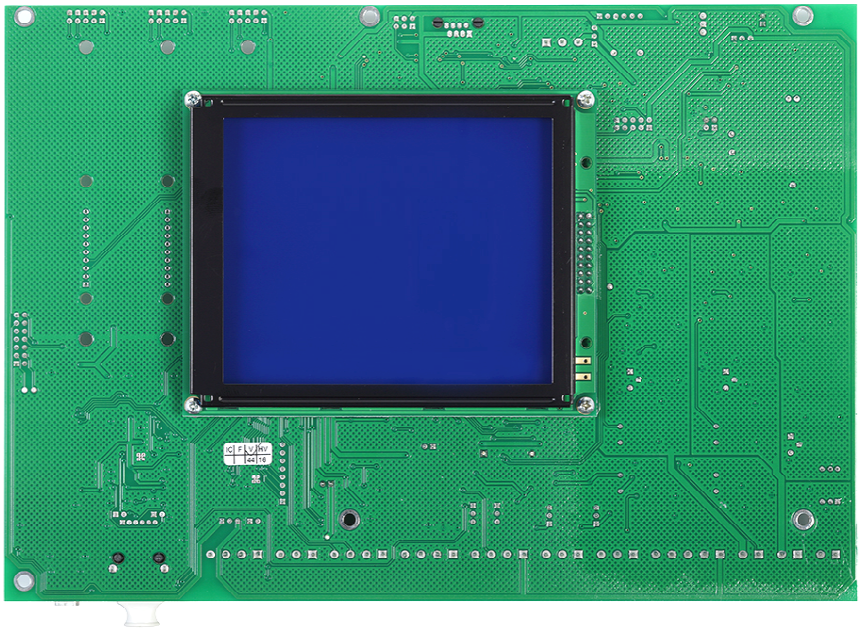


Figure 7. PC 604 CPU Board with Display (back)

1.7.1 Display Brightness

The contrast of the display can be adjusted with the potentiometer marked R95 on the PC604 Board that is located in the mid section of the Main Board.(**Figure 6.** PC 604 CPU Board)

1.7.2 Backup Battery

The 3V Backup Battery is located on the left side of the Main Board. It is used to maintain the memory settings in case of loss of AC power. This battery is designed to last for several years in normal operation.

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.

1.8 CH 2100 Power Supply Board

The CH2100 power supply is supplied with one of several options. On each option, the relays are clearly marked for each function. Not all relays may be included on the Power Board, depending on specified options.

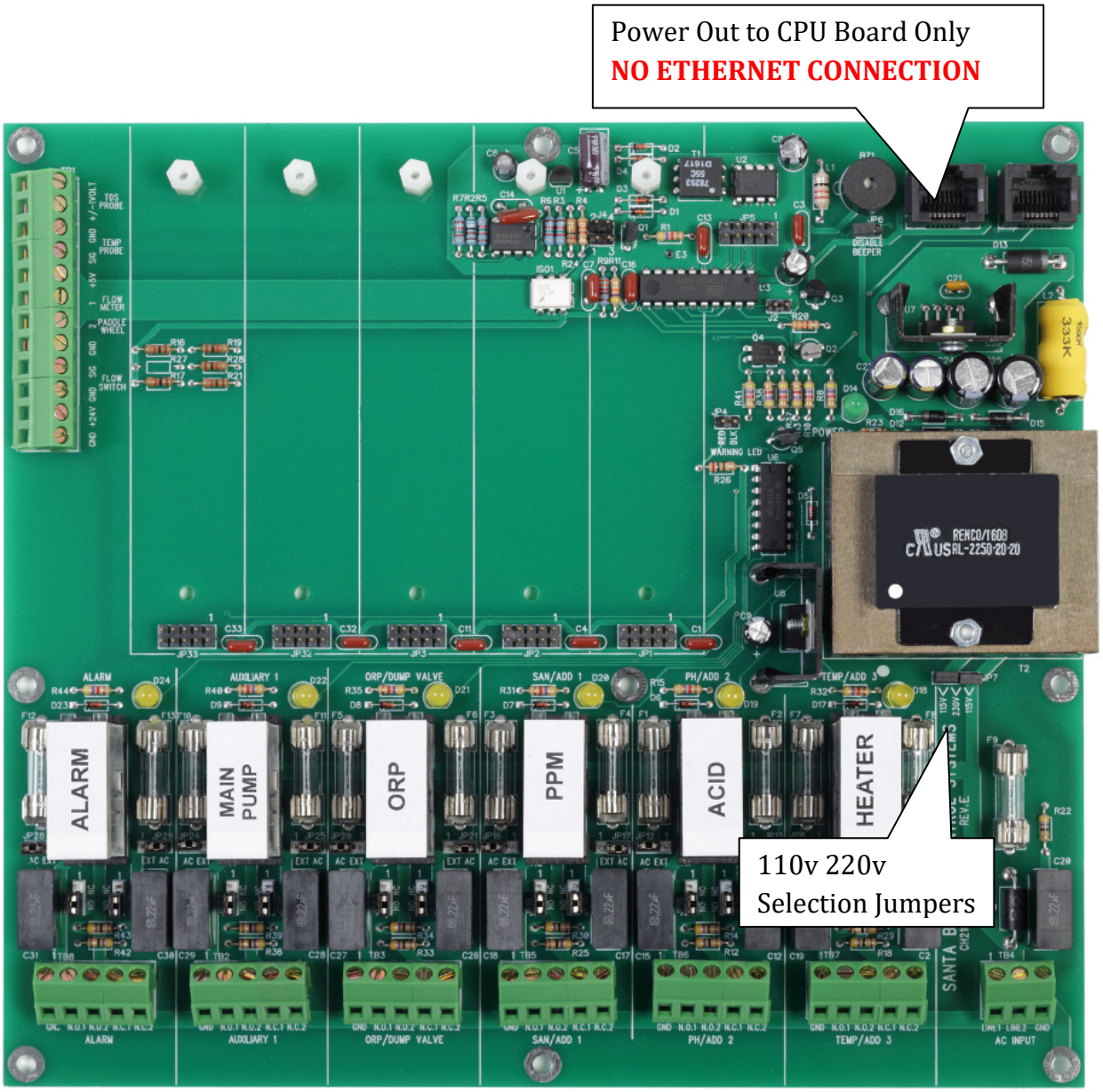


Figure 8. CH2100 Power Supply

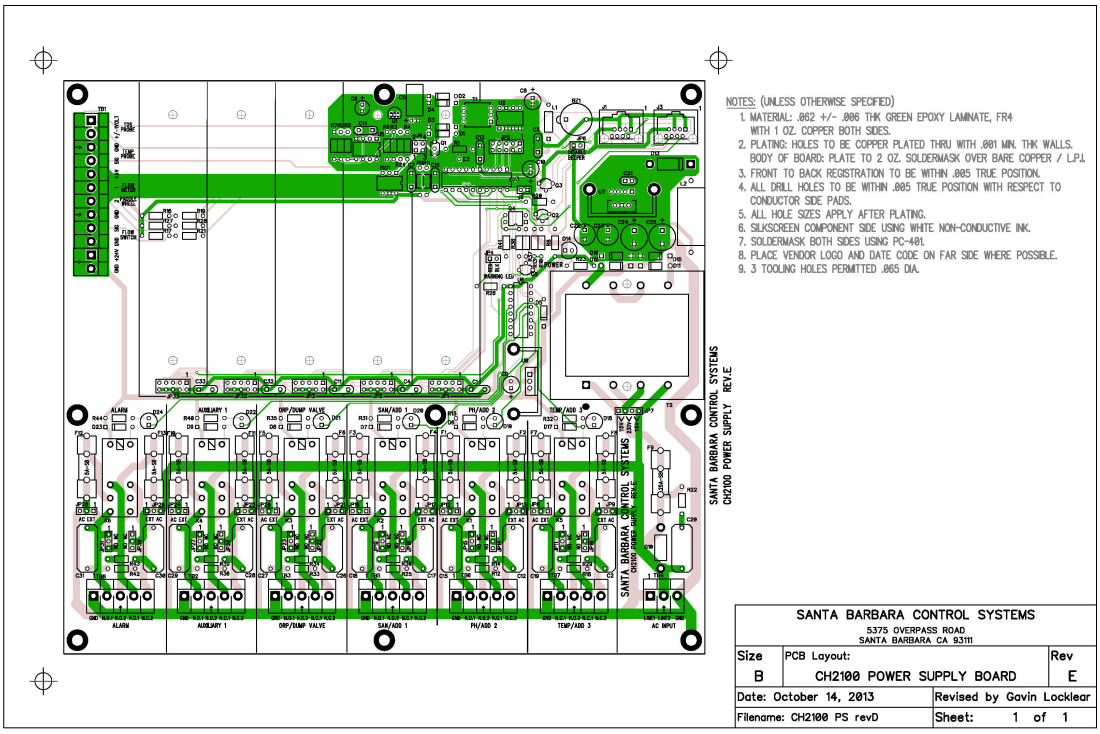


Figure 9. CH2100 Power Board

1.8.1 115V/230V Power Transformer

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

The voltage selector jumpers are located on the right side of the board next to the power transformer. For 115V two jumpers are used as shown below. For 230V one jumper is used in the center as shown in Verify that the jumpers are 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 warranty.

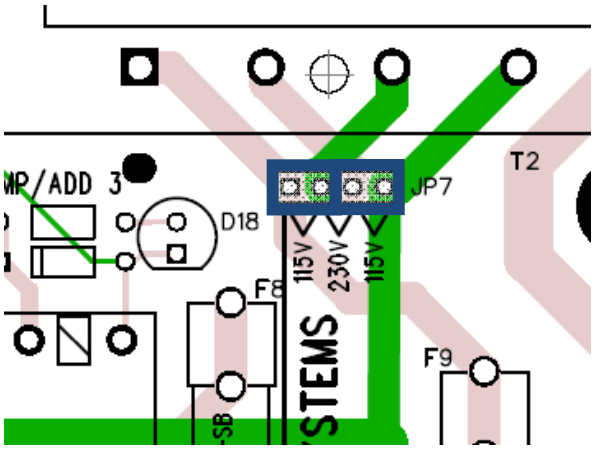


Figure 10. Voltage Selector Jumpers
set to 115 volts (2 jumpers)

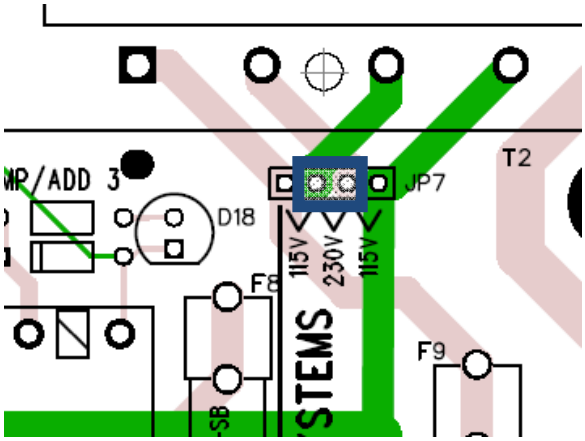


Figure 11. Voltage Selector Jumper
set to 230 volts (1 jumper in center) 110v both (2) jumpers cover 4-pins

1.8.2 Relays and Fuses

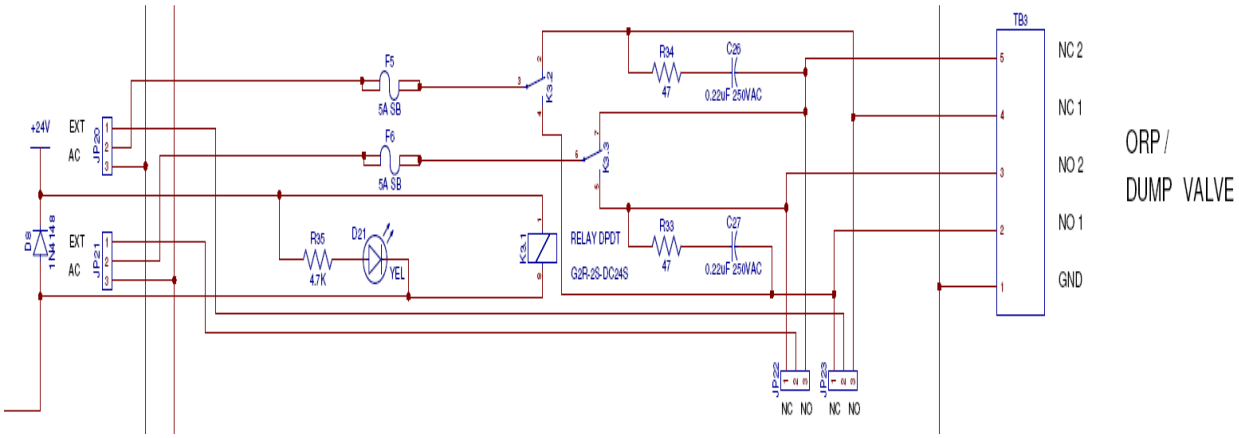
NOTE: *The fuses for the Power Supply to each PC board are AGC-1 Slo- Blow.*

All other fuses for relay outputs are 5A Fast-Blow. All output relays are fused on the Normally Open (NO) and Normally Closed (NC) sides. Both the Hot and the Neutral sides are fused.

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.

The PC2100 uses jumpers on the Power Board to determine the connections for the output relays. These jumpers are normally set at the factory and should only be changed by a Qualified *CHEMTROL*® dealer.

The power board consists of several relays that are configurable. Each of the relays has a similar layout for the configuration. As an example, consider the ORP/DUMP VALVE relay with jumpers JP20, JP21, JP22, and JP 23.



The jumpers are similarly placed on each of the relay positions. Two jumpers, labeled AC EXT control whether or not the AC power is routed through the relays. Below that are two more jumper blocks that control whether or not each relay is normally open or normally closed. Note that when the relays are used to switch AC, the normally open/normally closed terminals are directly available.

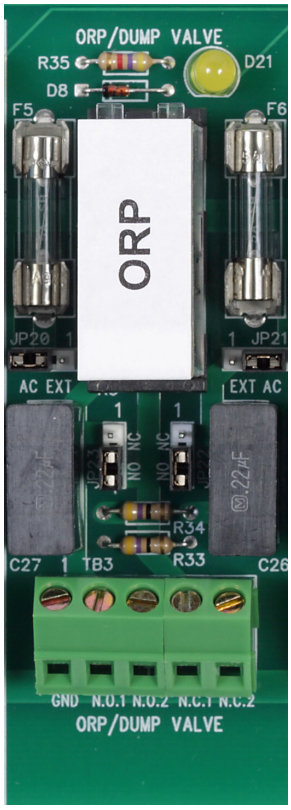


Figure 12. Typical Relay

Configuration	JP20	JP21	JP22	JP 23	Output Contacts
AC NO	2-3	2-3	Open	Open	NO1, NO2 (supplies AC)
AC NC	2-3	2-3	Open	Open	NC1, NC2 (supplies AC)
Relay 1 NO	1-2	1-2	Open	2-3	NO1, NC1
Relay 1 NC	1-2	1-2	Open	1-2	NO1, NC1
Relay 2 NO	1-2	1-2	2-3	Open	NO2, NC2
Relay 2 NC	1-2	1-2	1-2	Open	NO2, NC2

Table 2. Jumper Configuration

1.8.3 Remote Alarm

The remote alarm is a 5A DPDT relay located on the lower left of the Power Board labeled "ALARM". 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 115V 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 F8. 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.

1.8.4 Sensor Connections

All sensor connections are on the Terminal Barrier strips on the Power Board, as shown below. The pH and ORP sensors are then connected externally to the bulkhead BNC connectors on the left side of the cabinet. New configuration has them on Mother Board.

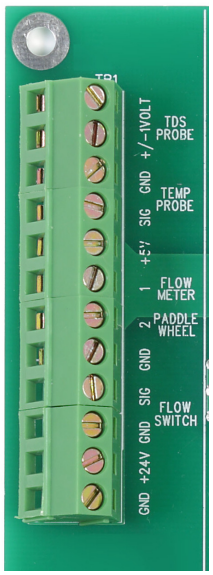
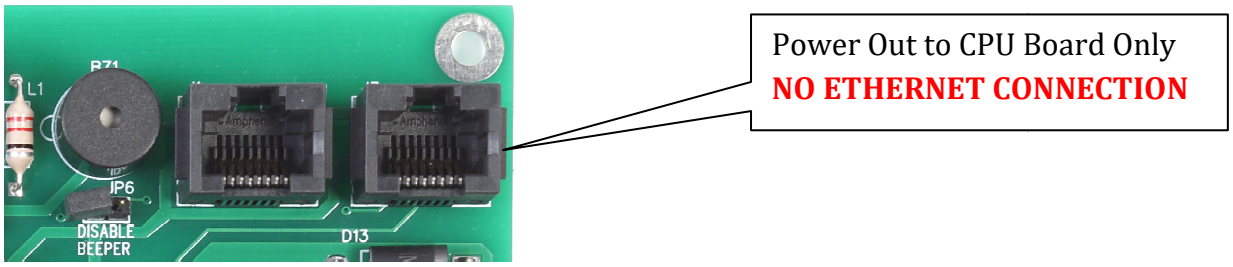


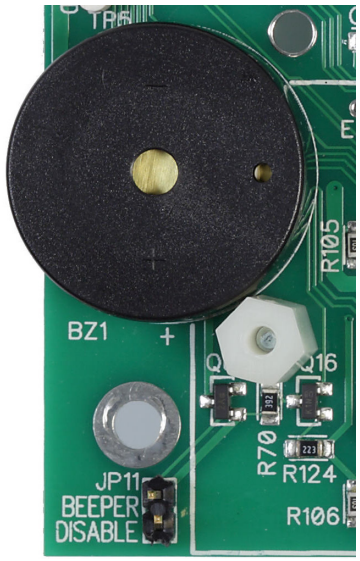
Figure 13. Sensor Connections on Power Board

1.8.5 Beepers

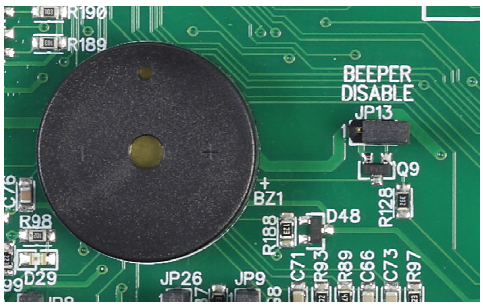
Each system contains two beepers. A beeper is located at the upper right of the Power Supply Board can be turned on for specific alarm conditions through the software program or for all alarms using the Audio Alarm Submenu. Jumper JP6 will disable the buzzer. Carefully note that the 8-pin connectors are power connectors. Do not connect Ethernet here.



The PC 2100 beeper is located on the right hand side of the main board and may be disabled with JP11



The PC3000, PC5000, 5100, PC6000, PC7000 and PC7100 series beeper is locate in the lower central area of the board. It may be disabled with JP13.



1.9 Piggy Back Boards

Piggy back boards are used to extend the functionality of a controller. Piggy back boards are used to add additional 4-20 mA signal I/O, additional ppm inputs, and additional backwash and general relay outputs.

Field Installation

For field installation, turn off all power to the controller. Position the converter board on top of the motherboard. Press the socket of the piggyback board onto the electrical header on the power supply board. Piggy back boards may be installed in one of five positions on the power supply board. Refer to your specific instructions for field installation.

1.9.1.1 4-in 4 out Stack

The 4-20 mA 4-in 4-out board (**Figure 14**) provides four additional inputs for pump influent and pump effluent pressures, and pH and sanitizer tank levels. In addition, four 4-20 outputs are also provided.

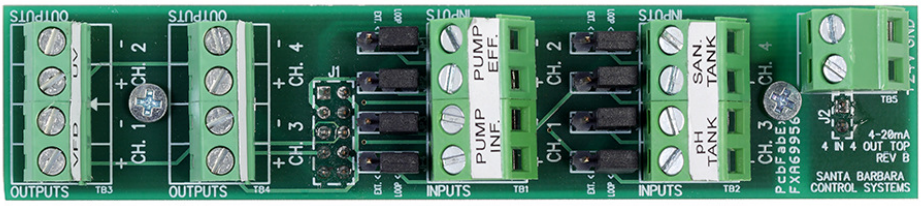


Figure 14. 4-20 mA 4-in 4-out

1.9.1.2 Four to twenty (4-20) mA 8-in 8 out Stack

The 4-20 mA 8-in 8-out stack consists of two boards: a base board (**Figure 15**) and a top board (**Figure 16**) board. The board set provides 8 additional channels of 4-20 I/O

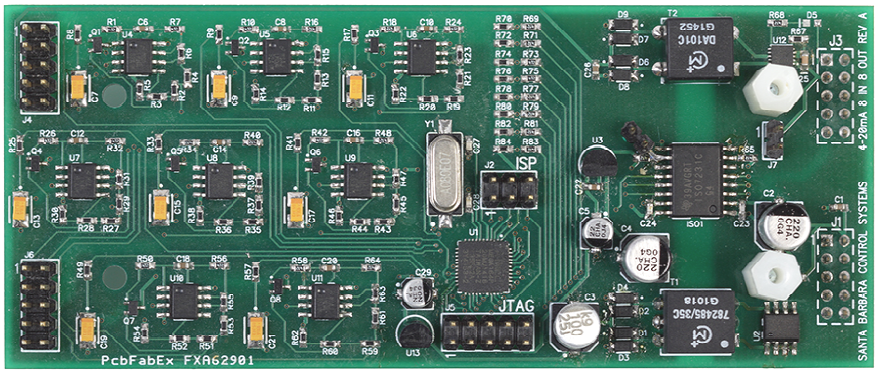


Figure 15. 4-20 mA 8-in 8 out Base

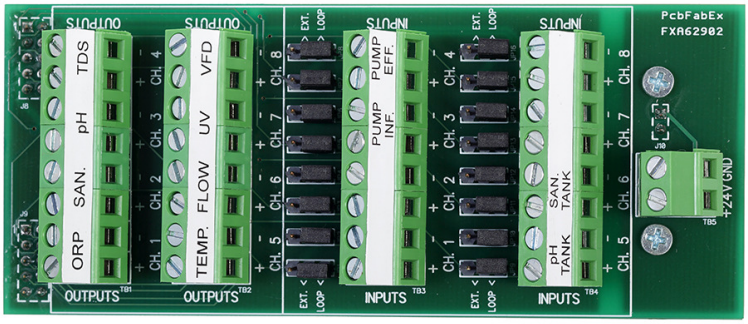


Figure 16. 4-20 mA 8-in 8 out Top

1.9.1.3 Four to twenty (4-20) ppm Module

The 4-20 mA ppm module provides an additional input for a ppm sensor.

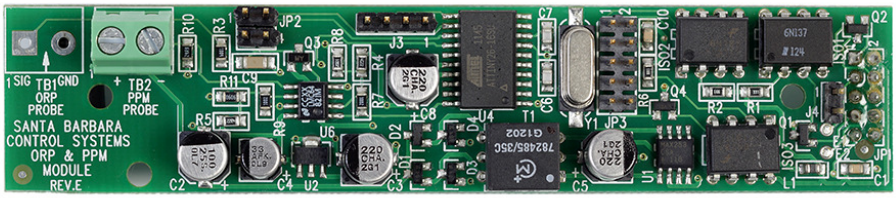


Figure 17. 4-20 mA ppm Module

1.9.1.4 Backwash Relay Expander

The Backwash expanded provides an additional relay outputs for complex backwash requirements.

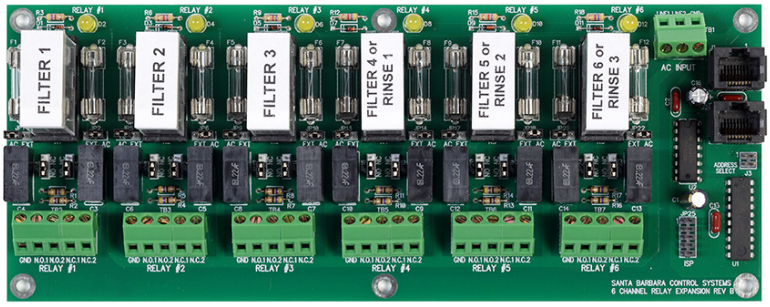


Figure 18. Backwash Relay Expander

1.9.1.5 Backwash Relay Expander for PC 6000

The Backwash expander for the PC 6000 provides an additional relay outputs for complex backwash requirements. The board is specialized to be used with the PC-6000 series controllers.

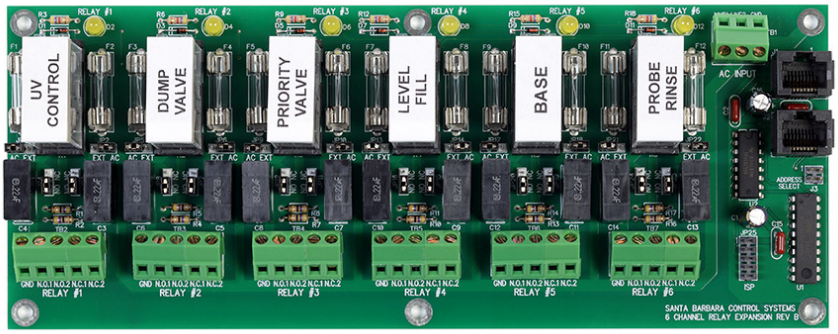


Figure 19. Backwash Relay Expander for PC 6000

1.10 Communications Adapters

1.10.1 RS-232 Adapter

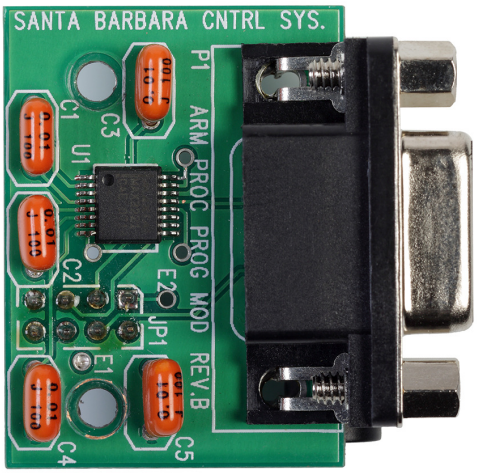


Figure 20. RS-232 Adapter

The RS-232 adapter is used to connect the ChemComm program

1.10.2 RS-485 Adapter

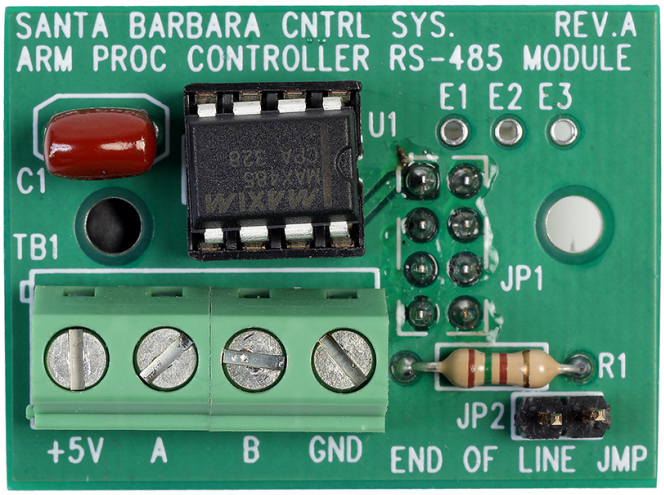


Figure 21. RS 485 Adapter

The RS-485 adapter is used to connect the Lantronix modules when required.

1.10.3 WiFi Adapter

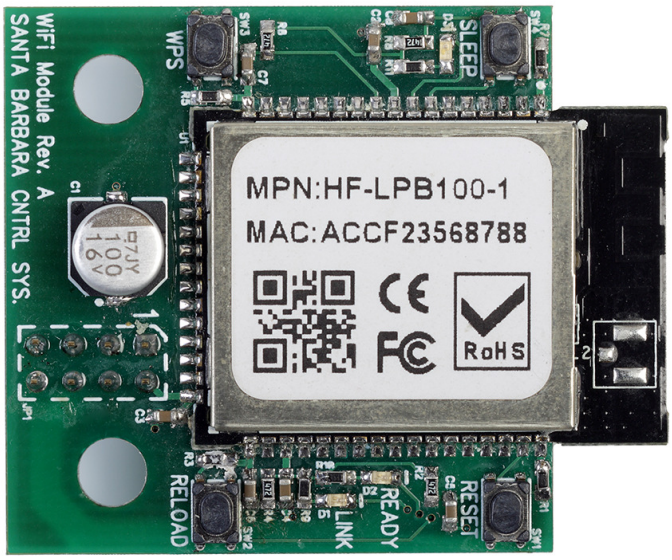


Figure 22. WiFi Adapter

1.10.4 Protocessor Adapter

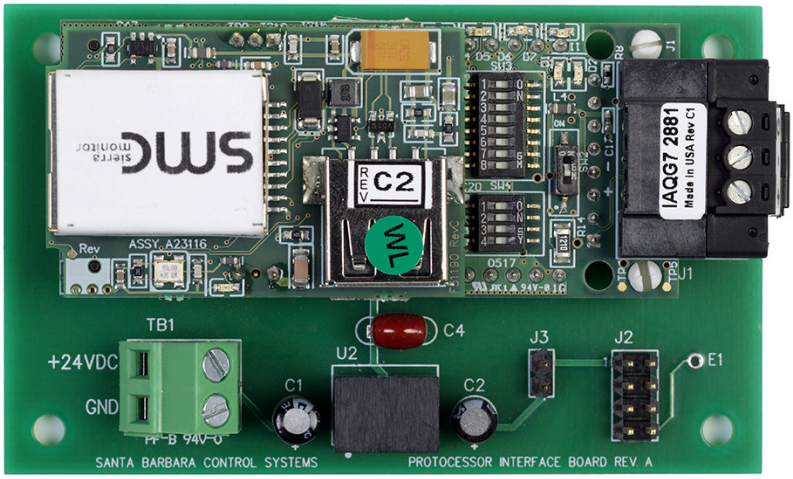


Figure 23. Protocessor Adapter

1.11 Sensor Installation

1.11.1 Plumbing

This section covers the installation of the sensors and the connection of the chemical feeders or control valves.

All chemical injection should be done on the return line, i.e. downstream of the sensors and pool equipment, as explained in the Chemical Feeders section.

1.11.2 Installation of Sensors

The *CHEMTROL*® PC controllers use ten or more sensors for measurement of water chemistry, temperature, flow rate, pressure and water level:

1. amperometric sensor for Free Chlorine
2. total Chlorine
3. Bromine ppm
4. potentiometric sensors for pH and ORP
5. thermistor for temperature
6. conductivity sensor for Total Dissolved Solids
7. Hall effect pulse generator for flow rate or 4-20 mA
8. piezoelectric sensors for influent and effluent pressures 4-20 mA
9. electro-optical water level sensor
10. Tank level sensors
11. Flow line sensors (sonic)

The first five sensors measure water chemistry (Free Chlorine, ORP, pH, conductivity and temperature). Except for the Free Chlorine Sensor (must be on bypass line), these can be mounted directly on a 2-inch main recirculation line using PVC reducing tees. On larger diameter lines, they must be mounted on a ½-inch bypass line by using a Sensor Cell Cabinet

1.11.3 In-line Installation (2" Pipe)

On smaller installations (2” pipe diameter), the sensors can be mounted directly on the main recirculation line between the strainer and the pump. Sensors may also be mounted after the pump.

Use only 2x2x½ in. SST reducing tees without reducers. Do not install the sensors near an elbow or a constriction where there might be excessive turbulence.

Install the tees on after the filter and make sure that the tip of the sensor is oriented downward - to avoid formation of air pockets near the tip. Never mount the sensors horizontally. They should be mounted vertically or at a 45 degree angle. The sensors should be readily accessible for servicing but not exposed to physical damage.

After inserting the sensor, be careful not to over-tighten the compression fitting as it can crush the small glass tube inside the sensor. Make it finger tight (no wrench). Note that paddle-wheel flow switches cannot be used with this type of installation.

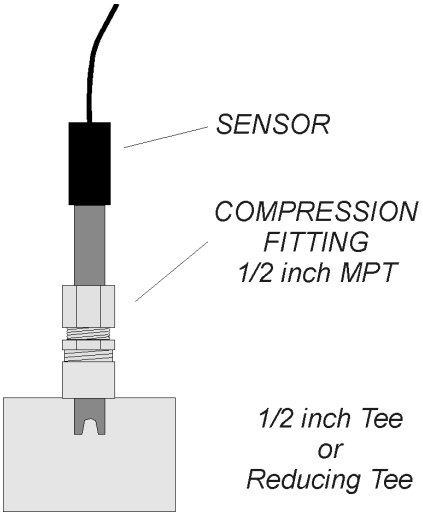


Figure 24. Sensor Installation

1.11.4 Flow Cell Assembly

For ease of installation and maintenance, the sensors should be mounted on the Flow Cell Assembly. It includes a sensor cell with an air vent and a 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.

Figure 25. Flow cell Assembly

1.11.5 Sensor Cell Cabinet (Option)

For even greater 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 paddle wheel safety flow switch. Install on a ½" bypass line, as shown.

Figure 26. Sensor Cell Cabinet (Option**)**

Make sure that the Sensor Cell Cabinet is located within 2 ft(60 cm) of the controller cabinet or orther sensor extension cables. See wiring instructions in the ELECTRICAL section and operational instructions under WATER FLOW below.

1.12 PPM Sensors

The following PPM Sensors (Model 2010) are available with PC controllers:

- PPM002 for 0-2 PPM (mg/l) of Free Chlorine ppm FC010S
- PPM010 for 0-10 PPM (mg/l) of Free Chlorine ppm FC002

Both use the same membrane Part Number PPMMEM1B

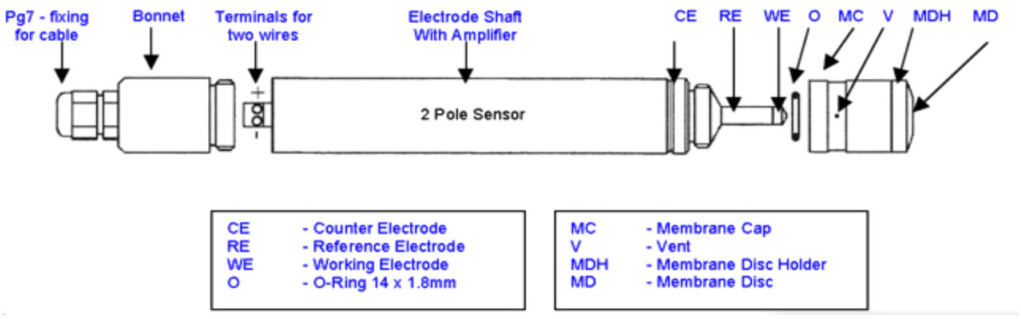
- PPM200 for 0-200 PPM (mg/l) of Free Chlorine with membrane part number PPMM02
- PPMFC010S Sensor for electrolytic chlorine generators. (salt systems).

Figure 27. PPM Sensor

NOTES

1. These sensors are not affected by cyanuric acid.
2. All sensors use the same flow cell PPMCLL and do not require the plastic spacer ring.

Note that the sensor and mount components must be assembled completely and in the proper order as shown in the following diagrams.



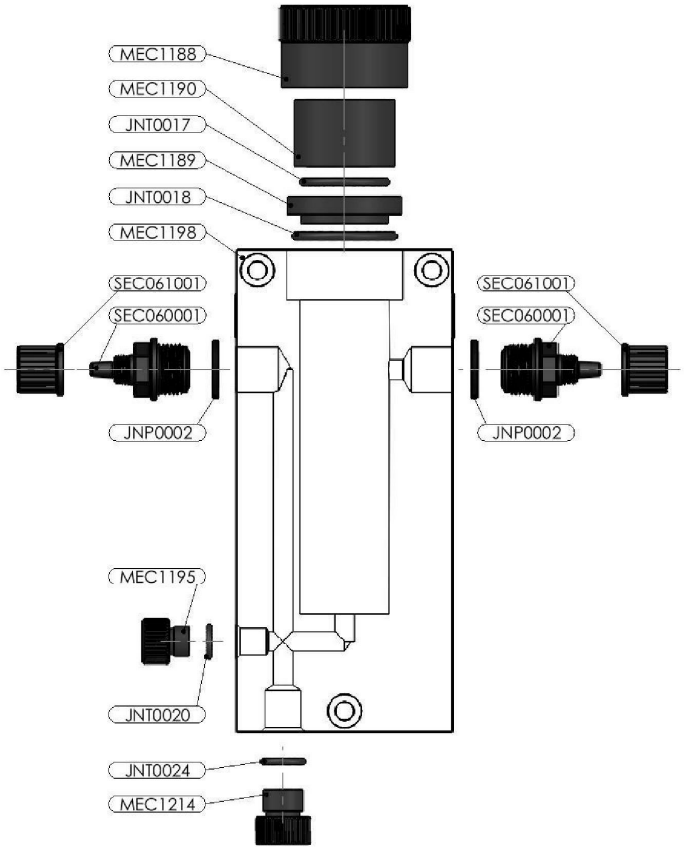


Figure 28. PPM Sensor and Mount

1.12.1 PPM Sensor Flow Cell

The PPM Sensor must be installed in the specially designed flow cell for better water flow control. Install the flow cell on a bypass line with 1/4" tubing as shown above.

Make sure that the bypass line is located after the filter and that there is a sufficient but not excessive flow of water. The ideal flow rate is between 40 to 60 liters/h (11 to 15 gal/hr.).

For a spa, it is recommended to increase the flow rate sufficiently to avoid the formation of air bubbles and to install the cell horizontally with the inflow coming in from the bottom.

Figure 29. PPM Sensor Flow Cell

1.12.2 PPM Sensor Installation

The new PPM Sensors are shipped in a molded foam package containing:

- One (1) chlorine sensor with warranty serial number,
- One (1) compression fitting with O-ring,
- One (1) electrolyte cap with membrane,
- One (1) electrolyte bottle and screw-on filling tip,
- One (1) screwdriver (not needed if pre-wired).

Figure 30. PPM Sensor Package

In order to prevent serious damage to the sensor, be careful not to touch the membrane or the electrodes. To facilitate shipment and storage of the sensor, it is not fitted with the electrolyte cap until ready for installation. The sensor cap must be filled with the electrolyte solution immediately before usage and emptied during storage.

Fill the sensor cap with the electrolyte taking care to prevent air bubbles. Fill the cap to the bottom of the threaded section. Thread the sensor into the cap as far as it will go while making sure not to touch the membrane film at the bottom with your fingers. Excess air and electrolyte may escape through the hole below the rubber seal. Wipe any excess

electrolyte with a soft tissue. Contact your CHEMTROL® dealer if you need additional electrolyte.

Slide the O-ring over the sensor tip up to the compression ring. Finally, insert the sensor with O-ring in the flow cell and make it finger tight.

For best performance, it is recommended to change the membrane cap and electrolyte at least once a year. The code date is printed on the cable with three digits. The first digit is the year and the following two digits are the month.

1.13 ORP and pH Sensors

The ORP and pH sensors are non-corroding sealed combination electrodes. 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 ORP and pH probes are shown in .

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

There is no electrical current flowing from the controller to the ORP and pH sensors. They are optically isolated from the high voltage circuit inside the electronic module.

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.

Figure 31. ORP Sensor

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

Figure 32. pH Sensor

1.13.1 Packaging

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.

1.13.2 Sensor cables

The sensors are supplied with a standard 10' (3 m)-long cables 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.

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

If a longer cable is needed, custom-made extension cables with BNC connectors can be ordered from the factory in lengths of up to 1000 feet. For longer distances, a pre-amplifier may be required. Consult your dealer or the factory for details.

1.13.3 Electrical Interference

The *CHEMTROL*® PC controllers feature differential amplification of the sensor signals to reduce electrical interference from stray currents in the water.

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.

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

Extended exposure to atmospheric conditions will cause the ORP and pH sensor tips to dry out. In contrast, the PPM sensor should be stored dry and electrically disconnected.

Always remove and properly store the sensors if the pool or spa is to be winterized or inactive. Store the sensors with the original cap provided, making sure that each cap is filled with the original storage solution or salt water.

If the storage containers have been misplaced, store the sensors individually in small glass or plastic containers with clean water covering the sensor tips.

1.13.5 Sensor Warranties

The PPM sensors are covered by a two-year manufacturer warranty. The pH and ORP 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.

1.14 Temperature Sensor

If the CONDUCTIVITY option is not included, a separate Temperature Sensor is supplied as a thermistor embedded inside a ¼" MPT fitting with a 10-ft (3 m) connecting cable

Figure 33. Temperature Sensor

A 1/4" reducer epoxyed 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 (flow cell) or sensor cell cabinet

Connect the red and black leads to the Terminal Barrier strip TB1 as indicated in **Figure 13.** Sensor Connections on Power Board

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

1.15 Conductivity Sensor

The Conductivity or TDS (Total Dissolved Solids) Sensor consists of a dual 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.

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° elbow on the bypass line (flow cell) or sensor cell cabinet

Make sure that the sensor is oriented so that the water flows smoothly through the measuring cell.

The four leads from the conductivity/temperature sensor must be connected to the Terminal block strip TB1 on the Main Board or plugged into the side of the cabinet depending upon the installation. See **Figure 39.** Connections to PC2100 (Power supply board)

Figure 34. Combination Conductivity-Temperature Sensor

1.16 Water Flow Sensors

1.16.1 Magnetic Flow Sensor

Depending on pipe diameter, three different models of sensors are used for flow monitoring:

- Model 2536-P0 for diameters from 2 to 4 in (50 to 100 mm) (**Figure 35**),
- Model 2536-P1 for diameters from 5 to 8 in (100 to 200 mm) (**Figure 35**),
- Model 2536-P2 for lines over 10 in. (250 mm) in diameter)(**Figure 35.** Sensor Model P, P1, and P2).
- Magnetic Flow Sensor (**Figure 36.** Magnetic Flow Sensor)

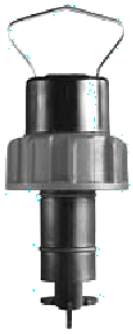


Figure 35. Sensor Model P, P1, and P2

Connect the three leads from the sensor to the Terminal Barrier strip on the power supply board. **Figure 39.** Connections to PC2100 (Power supply board) or plug into flow socket on side of enclosure.

Figure 36. Magnetic Flow Sensor

The rotor shaft should be inserted at least 10% of the pipe diameter into the water. The sensors are paddle wheel-type rated at 200 psi (14 bar) at 68°F (20°C). The signal can be transmitted up to 1000 feet (300 m) without distortion.

Follow manufacturer instructions carefully and do not install while the line is under pressure.

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 flow meter. 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 in **Figure 3**.

> 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 or balancing tank.

1.16.2 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. 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. An adapter is available for low flow systems if required.*).

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

The black, red and white leads should be connected to the contacts marked on the Mother Board, or into PWFS socket

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

Figure 37. Flow Sensor

The clear window should be facing out for visual verification of the flow.

1.16.3 Flow Sensor Location

Always install the flow sensor as far away as possible from obstructions that can affect the flow profile past the sensor. Flow sensor manufacturers specify the length of unobstructed piping required before and after the sensor. This piping is required in order to obtain a non-turbulent flow past the sensor element. Straight piping is required both before and after the flow sensor.

Figure43 show requirements for a representative flow sensor. For example, given a typical 5 inch diameter pipe, the flow sensor should be mounted at least 50 inches past a flange

joint, at least 75 inches past a reducer, atleast 100 inches past a 90^0 elbow and so on. It should also be mounted with at least 25 inches of pipe down-stream of the sensor.

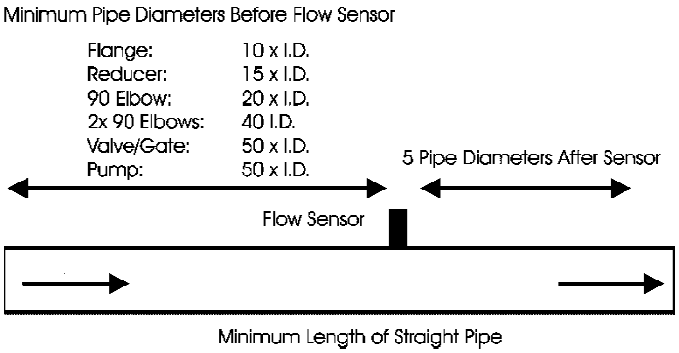


Figure 38. Flow Sensor Location

Saddle assemblies for flow sensors are available in 2, 4, 6 and 8 in. diameters and for larger sizes, call the factory for special order.

1.16.4 Flow Sensor Connections

Connect the three leads from the sensor to the Terminal Barrier strip on the power supply board

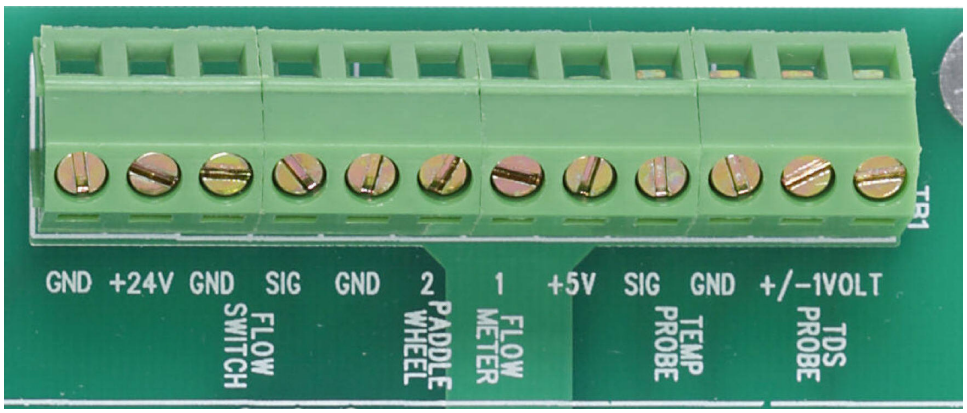


Figure 39. Connections to PC2100 (Power supply board)

- 5 V power and ground are available at the marked terminals.
- Frequency type flow meters are connected to the 1 Flow Meter terminal.
- Paddle-wheel flow meters are connected to the 2 Paddlewheel terminals

In addition, the PC 3000, PC 5000, and PC 7000 controllers have provisoin for 4-20 mA flow meters. (604 Board)

These are connected to TB13 The terminal block group has provision for 24v and ground connections.

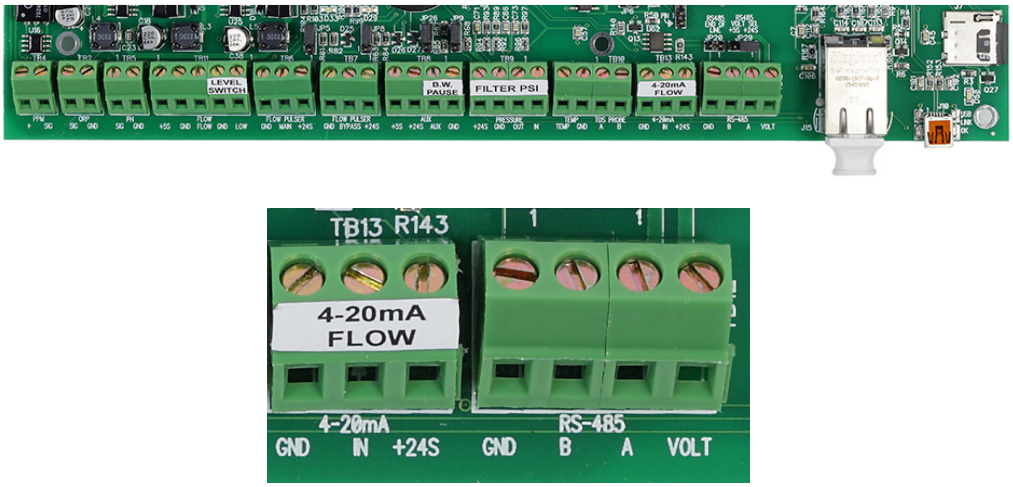


Figure 40. 4-20 mA Flow Meter Connections to PC 3000, PC 5000, pc 5100, PC6000, pc7000and PC 7100

CAUTION: A 4-20 mA signal is used . Older models use a 24 V DC signal. Reversing the wires will cause damage to the sensor and to the microprocessor.

Enter the **calibration K-factor** in pulses per unit of volume flow (gpm or l/m) for the specific pipe diameter and thickness, as discussed in Operations menu tree.

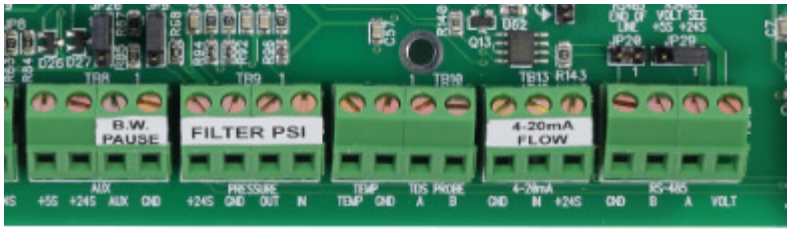
1.17 Pressure Transducers

The pressure sensors are *CHEMTROL*® Series 1200 transducers with a 1/4-18 NPT thread connection rated at -15 to 45 psi (-1 to 3 bar).

For differential pressure monitoring, a transducer should be installed on the intake (influent) side of the filter or bank of filters and another one on the return (effluent) side.

Figure 41. Pressure Transducer

Connect the leads from the sensors to the Terminal Barrier strip at TB9 (604 board). For calibration.



1.18 Level Sensors

1.18.1 Ultrasonic Level Sensors

Chemtrol Systems typically utilize the FlowLine, EchoPod DL10 or DL24 Ultrasonic Liquid Level Sensors. Ultrasonic level transmitters have no moving parts, and measure levels without physical contact with the liquid.

Figure 42. Ultrasonic Level Sensor

1.18.1.1 Ultrasonic Level Sensor Installation

Wiring

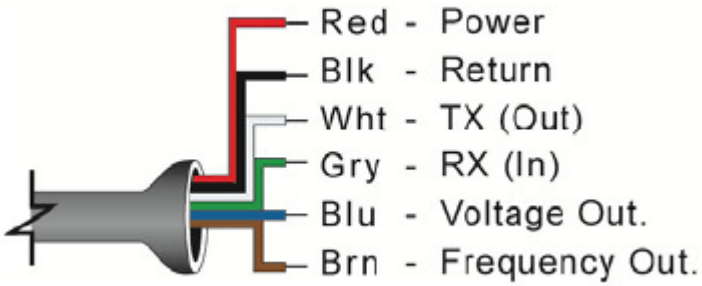


Figure 43. DL-10 Wiring

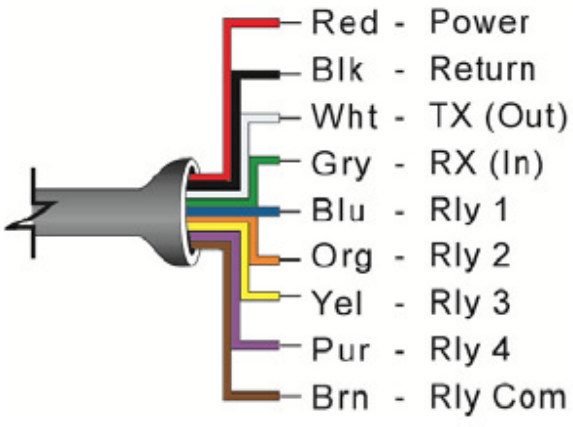


Figure 44. DL24 Wiring

Installation

The EchoPod® should always be mounted perpendicular to the liquid surface and installed using the provided Viton® mounting gasket. Make sure that the fitting and transmitter threads are not damaged or worn. Always hand-tighten the transmitter within the fitting. Perform an installed leak test under normal process conditions prior to system start up.

Note: The preferred mounting fitting for the DL10, DL14, DL24, DS14 & DX10 series is the LM52-1400 (2" thread x 1" thread) reducer bushing.

MOUNTING GUIDE

1. Do not mount at an angle.
2. Liquid should never enter the dead band.
3. Side Wall:
    a. Mount at least 2" from the side wall.
    b. For DL34 Series - mount at least 3" from the side wall.
4. Do not mount where obstacles will intrude into sensor's beam width.
5. Beam Width: 2" (5cm) diameter [3" (7.6cm) for DL34].
6. Do not mount in a vacuum
7. Avoid mounting in the center of a dome top tank.
8. In cone bottom tank, position the sensor over the deepest part of the tank.

INSTALLATION IN EXISTING FITTINGS

If the existing fitting is larger than the threads of the EchoPod®, select a reducer bushing such as the LM52-1400 (2" thread x 1" thread) or LM52-2400 (3" thread x 2" thread).

LM52-1400

LM52-2400

METAL TANKS (DL10, DL14, DL24, DS14 & DX10 SERIES)
Flowline ultrasonic transmitters have been optimized for use in non-metallic fittings.

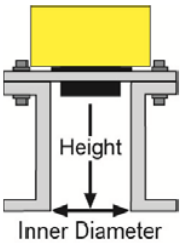
1. For best performance, avoid the use of metallic fittings.
2. Use a plastic 2" x 1" reducer bushing, such as the LM52-1400 or a plastic 1" flange, such as the LM52-1850 for metallic tanks.
3. While installations directly into a 1" metal fitting are not recommended, acceptable results may be obtained if the 1" fitting is a half coupling in form and the outer diameter of the coupling is tightly wrapped in vinyl tape to dampen vibration.

FITTING SELECTION
Check the part number to determine the required fitting mount size and thread type. EchoPod® is commonly installed in tank adapters, flanges, brackets or standpipes. Note: Always include the gasket when installing the EchoPod®.

1. Tank Adapter: Select a tank adapter fitting, such as the LM52-1890 for the DL10, DL14, DL24, DS14 & DX10 series or the LM52-2890 for the DL34 series.
    a. For best results, select a 2" tank adapter and add a reducer bushing such as the LM52-1400, thread x thread, reducer bushing.
    b. Avoid tank adapter (thread x thread) styles and/or pipe stops forward of the installed transducer.
    c. Always mount the tank adapter so the majority of the fitting is outside the tank.
    d. Note: Never mount the tank adapter upside down or where the bulk of the material is inside the tank.

Do not use thread x thread

2. Riser: Installations with tall, narrow risers can impede the acoustic signal.
    a. Core Out Concrete: Applications where a concrete tank ceiling has been cored out can also be considered as a riser type application. In these applications follow a 2:1 ratio (Inner Diameter to Core Height) for the diameter of the core.
    b. DL34 Series: 2” (5 cm) diameter risers should be no taller than 4” (10cm). Larger diameter risers should be no taller than 12” (30.5 cm).
    c. c. DL10, DL14, DL24, DS14 & DX10 Series:



Riser Specifications	
Inner Diameter	**Maximum Height**
2” (5cm)	3” (7.6cm)
4” (10cm)	8” (20cm)
6” (15cm)	12” (30cm)

Note: Do not exceed the dimensions listed above.

Note: If attempting to raise the sensor above the top of the tank to allow for a higher fill capacity, avoid the use of tall and narrow risers. The example to the left exceeds the dimensions listed in the **Riser Specifications** chart. Use a larger tank adapter which takes into account the **Riser Specifications**.

3. Flange (DL10, DL14, DL24, DS14 & DX10 Series): If installing on a flange, select a flange with a thread that is above the plane of the flange, such as the LM52-1850.
    a. The DL34 series works well with flange installations.
    b. Avoid the use of blind flanges with tapped threads or flanges where the threads are even with the plane of the flange, such as the Banjo 1" Poly ANSI Flange (series AF100).
    c. Use a flange with a 2” thread and add a 2” to 1” reducer bushing to complete the installation.

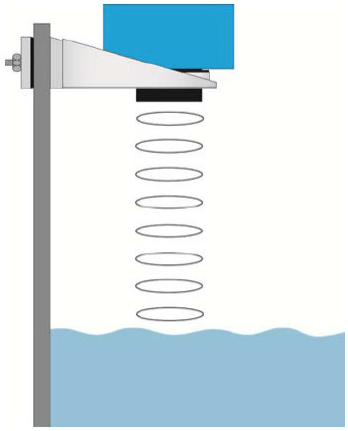
2” Flange w/ thread out of plane (LM52-1850)

1” Flange w/ thread in plane

Do not use thread in plane

2” Flange w/ Reducer Bushing (w/LM52-1800)

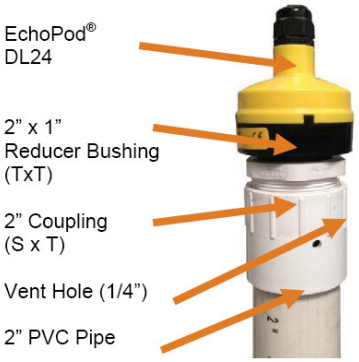
4. Side Mount Bracket: For installations in open tanks and sumps, use the LM50 series side mount bracket.
    a. For the DL10, DL14, DL24, DS14 & DX10 series, order the LM50-1001-1, which includes a 2”x 1” reducer bushing.
    b. For the DL34 series, order the LM50-1001 side mount bracket.



LM50-1001 Shown

Note: The Side Mount Bracket (LM50 series) is not designed for use with stand pipes or as a method to secure stand pipes. There are too few threads to properly hold the sensor and the stand pipe.

5. Stand Pipe: A standpipe maybe used to dampen turbulence or separate surface foam from the point of measurement in the application.
    a. Pipe can be made of any material.
    b. Select a 3” ID pipe for the stand pipe.
        i. A 2” pipe (minimum pipe size) is usable with the DL10, DL14, DL24, DS14 & DX10 series. Minimum pipe size for DL34 series is 3” ID.
        ii. Pipe series larger than 3” can also be used.
    c. Use a coupling and reducer bushing to attach the EchoPod® to the pipe.
        i. Use a plastic reducing bushing such as LM52-1400 (2”T x 1”T) fitting or the LM52-1410 (2”S x 1”T) fitting.
        ii. For the DL34 series, use a plastic reducer bushing such as LM52-2400 (3”T x 2”T) fitting or the LM52-2410 (3”S x 2”T) fitting.
    d. The pipe length should run the measurement span and the bottom of the pipe should remain submerged at all times to prevent foam from entering the pipe.
    e. Cut a 45°notch at the bottom of the pipe and drill a 1/4”pressure equalization hole within the dead band of the sensor.
    f. The pumps should not drive liquid past the open end of the stand pipe which causes the liquid in the pipe to oscillate.



DL24 attached to a LM52-1400 (2"x1" reducer bushing) and 2" Coupling (S x T).

Avoid the use of a tee within the stand pipe. A tee can create false signals that will negatively effect the sensor's performance.

1.18.2 Optical Level Sensor

The water level in the pool can be automatically maintained with a fill valve controlled by the water level sensor. The sensor is an ELS-1100 Series electro-optical sensor with a 1/4" NPT thread. The sensor is may be located in the pool or in the surge pit

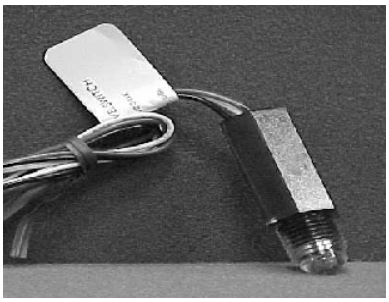


Figure 45. Optical Level Sensor

The optical sensor uses the reflection of an LED light beam inside a prism to determine the position of the water level (

Figure 46). With no liquid present, the light beam from the LED is reflected within the prism to the receiver. When the liquid level reaches the prism, the index of refraction is changed and the beam is cannot be detected by the receiver.

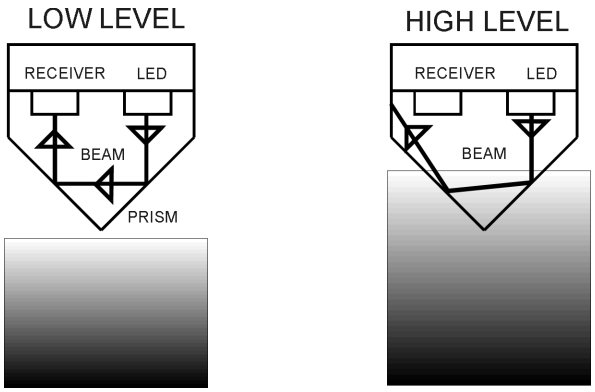


Figure 46. Optical Beam Path

For best results, the surface of the prism must remain clean.

1.18.2.1 Optical Level Sensor Installation

Locate the sensor in a convenient location in the pool, surge pit or water tank as shown on

. Wire the fill valve to the Level Fill relay.

Connect the leads from the sensor to the Terminal Barrier strip TB1 as indicated.

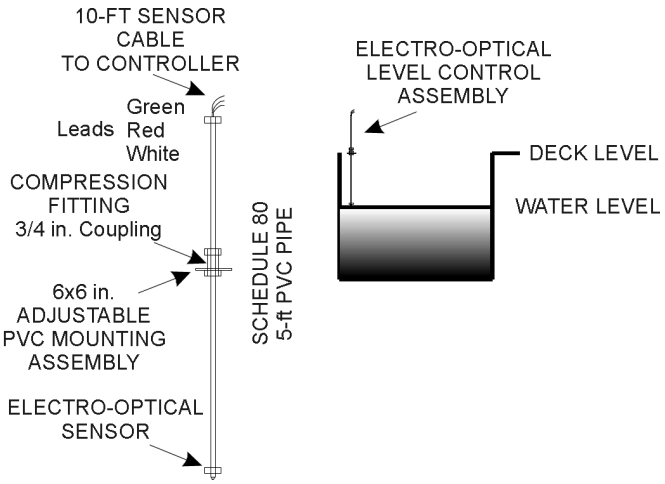


Figure 47. Water Level Assembly

1.18.2.2 Level Sensor Wiring

The level sensor switch is wired to the LEVEL SWITCH inputs on the PC 3000 and above.

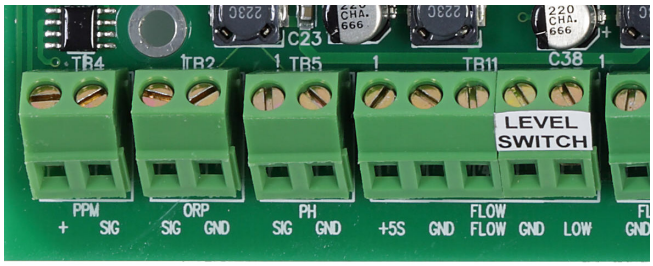


Figure 48. Level Switch inputs (PC 3000 and above)

1.18.2.3 Optical Level Sensor Maintenance

The surface of the prism should always be kept clean and should be positioned at least 2" (cm) away from reflective surfaces.

2 Chemical Feeders

2.1 WARNING: Tank Sizing

The *CHEMTROL*® PC controller includes 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.

2.2 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.

2.2.1 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. In large pools, it is typically used in conjunction with muriatic acid (HCl) to control pH and total alkalinity.

2.2.2 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.

2.2.3 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 49). 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 49**.

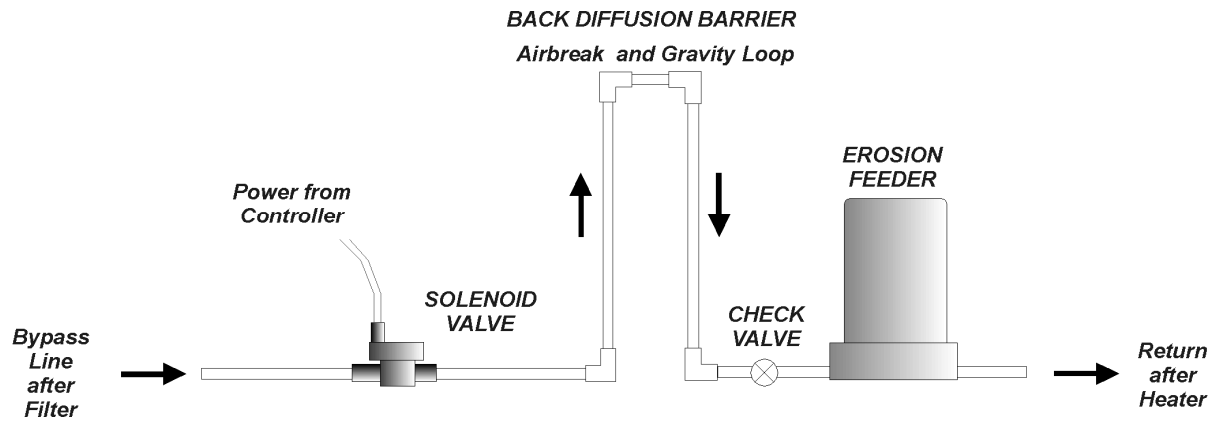


Figure 49. Erosion Feeder Control

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.

2.3 Filter Backwash

The Power Board of the *CHEMTROL* PC4000 – PC6000 series includes six (6) double-pole, double-throw (DPDT) 5A relays for automated filter backwash. They can be used to control solenoid valves, motorized valves, hydraulic valves or pneumatic valves.

2.3.1 Main Pump Shutoff

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

Use Filter Submenu in the *CHEMTROL* PC4000 – PC6000 series to specify if the main recirculation pump is to be shutoff during cycling of the valves. The standard shutoff value is 5 seconds but it can be changed.

2.3.2 Single Filter Backwash

As shown in **Figure 50**, backwashing of a single filter is controlled with four valves that are connected to the Normally Open (NO) and Normally Closed (NC) poles of Filter Relay 1.

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

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

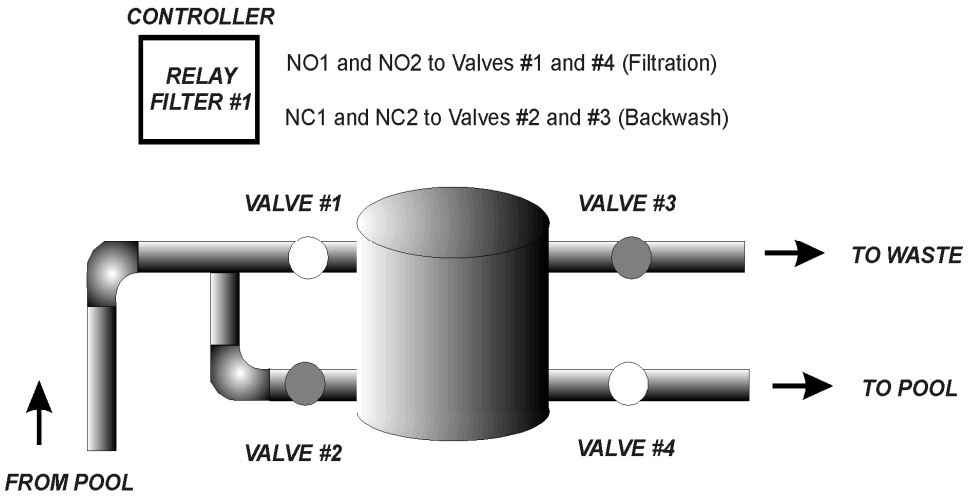


Figure 50. Single Filter Backwash

2.3.3 Multiple Filter Backwash

The connections for sequential backwashing of multiple filters with three-way valves connected to Filter Relays 1 to 6 are shown below. If more than six filters are used, several filters can be banked together.

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

A partial closure valve (priority valve or flow control valve) can be connected to the relay marked Deoxidizer. Specify in Submenu 7.8.1 if it is to be activated during backwash.

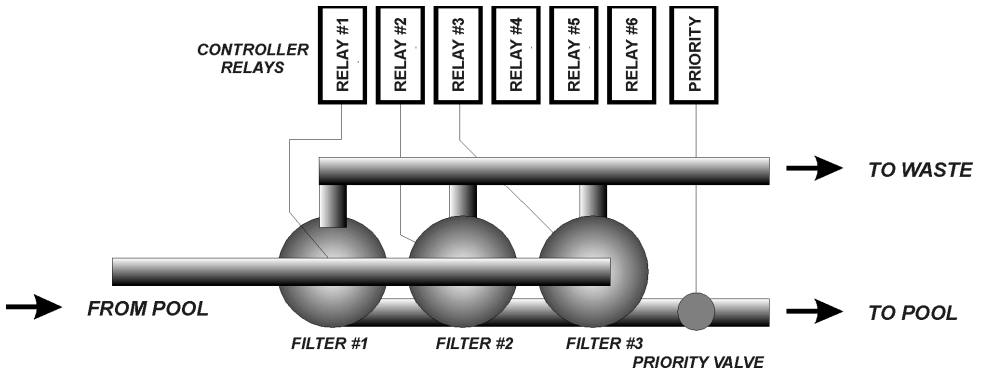


Figure 51.Multiple Filter Backwash

2.3.4 Backwash Stager

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

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

3 Electrical Valves

3.1 Solenoid Valves

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

3.2 Hydraulic Valves

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

3.3 Pneumatic Valves

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

3.4 CALIBRATION

3.4.1 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

3.4.2 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

3.4.3 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

Glossary

The **Shock Treatment** program is used to destroy harmful elements, such as chloramines, germs and algae, by raising the oxidizer or sanitizer level on a specified schedule. This can be done either with the ORP function menu (Shock Treatment) or with the Sanitizer function menu (SUPERCHLORINATION), depending on which activation outlet is used.

The **Deshock** program can be used after the Shocking program to return the concentration levels back to normal values.

The **Chemical Savings** program is used to save chemicals by reducing the treatment level when the facility is not in use, such as at nighttime or on weekends.

4 STARTUP

4.1 Controller Startup

4.1.1 Configuration Menu

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

4.1.2 Alarm Buzzer

The Audible Alarm option is normally turned off until the sensors are installed. Use to turn it on for normal operation.

4.1.3 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.

4.1.4 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 seen through the CONFIGURATION / BATTERY

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

4.1.5 PPM Board Initialization

The PC board for the PPM sensor on the PC2100 must be initialized prior to calibration of the PPM sensor itself.

Turn the controller on and wait at least 30 minutes to allow the sensor to charge. Read the **PPM SANITIZER** display on the controller.

4.2 Chemical Control

4.2.1 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 controller, 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.

4.2.2 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).

4.2.3 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.

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.

4.2.4 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 be a ball valve.

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

4.2.5 pH Calibration

NOTE:

Always calibrate the pH sensor first, i.e. 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, CO_2, 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 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.

4.2.5.1 pH Feed (Acid or Base)

The *CHEMTROL*® PC has two pH control relays, one for Acid feed and one for 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

4.2.5.2 pH Setpoint

The default value for the pH setpoint is 7.5. It can be modified at any time through the pH Menu.

4.2.5.3 ORP Calibration

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

4.2.6 ORP Setpoint

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

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

4.2.7 Sanitizer Calibration

> 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 8.0 ppm for bromine:
  - wait until the level is reduced to below these values,
  - add a reducing agent (Sodium Thiosulfate), or
  - replace part or all of the water.

Select the Sanitizer Calibration and enter the value indicated by the test kit.

4.2.8 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 limit 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*® PC Qualified Dealer for assistance.

4.2.9 Shock Treatment

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

4.2.10 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 over-chlorination.

4.2.11 Water Saturation

The *CHEMTROL*® PC features automatic calculation of the Langelier Saturation Index.

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.

5 CHAPTER VI - MAINTENANCE

5.1 CONTROLLER MAINTENANCE

5.1.1 Regular Maintenance

The *CHEMTROL*® PC 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.

5.2 The Acid Test

The Acid Test can be used to check the ORP, pH sensors and the bypass 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.

5.2.1 Sensor Cleaning

5.2.1.1 PPM Sensor Cleaning

DO NOT CLEAN the PPM sensor or the membrane. May cause irreparable damage.

5.2.1.2 ORP and pH Sensor Cleaning

The sensors stop reading when they become coated with oil, calcium or dirt. To clean the ORP or pH sensors, 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.

5.2.1.3 Conductivity Sensor Cleaning

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

5.2.1.4 PPM Sensor Storage

Store the PPM sensor dry and protected.

5.2.1.5 ORP and pH Sensor Storage

- 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.

5.2.2 Sensor Winterizing

During cold weather, all sensors must be protected from freezing.

5.2.3 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 .

If the battery shows a voltage below 2.5 V, it should be replaced with a 3V lithium 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.

5.2.4 Software Upgrade

Software is updated on an as required basis. Updates may be needed, for example, if additional sensors are added or if there are special or unusual requirements. Updates are provided on a micro SD card. Place the micro SD card in the control and turn on the power. The update occurs automatically.

5.3 Final Review and Recommendations

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.

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.

5.3.1 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 set point is between 7.4 and 7.8. 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.

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.

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 set point, 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.

5.3.2 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 than 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*® 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:

Make sure to shut off the Bypass Line when adding sequestering agents as they will coat the platinum ring of the ORP sensor, resulting in false readings

5.3.3 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

5.3.4 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*® 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

5.4 PERIODIC MAINTENANCE

5.4.1 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.

5.4.2 Shock Treatment

Even when maintaining the proper chlorine residual level with Chemical Automation, it is recommended to shock or super-chlorinate 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 super-chlorination.

WARNING:

If the chloramine concentration exceeds 0.2 PPM (mg/l), it is recommended to superchlorinate at 10 times the combined chlorine level.

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

5.4.3 Precautions

1. During super-chlorination, the Limit Safety Timer is disabled.
2. A SHOCK treatment warning is displayed on the Display Screen when activated.
3. During backwash the controller stays on if setup for automatic backwash. The chemistry checks go into standby.
4. The out-of-range alarms stay on as long as the oxidizer or sanitizer levels are above the high limits or below the low limits.

ALWAYS MAKE SURE TO TURN OFF THE CONTROLLER AND SHUT OFF THE BYPASS LINE WHEN DOING GENERAL POOL MAINTENANCE.

6 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. 1c. Verify proper input voltage 110V or 230V. 1d. Check Fuse F2 on Power Board. If blown, replace with AGC1 fast blow fuse..
2. FAINT OR DARK DISPLAY	2a. Adjust contrast with Display a. R85 on the CH 2100 board b. R 85 on the 604 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. Check the SD card for proper seating..

4. NO CHEMICAL FEED NO HEATER ACTIVATION NO VALVE ACTIVATION	4a. 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. 4b. If LOW or HIGH ALARM is flashing: Adjust water chemistry manually. Press RIGHT arrow to change alarm limits. Set Feed Lockout to Off (CAUTION !!!). 4c. If TIME LIMIT line is flashing: Increase chemical feeder rate. Increase Limit Timer setting. Reset Time Limit with AUTO setting. 4d. 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 !!!). 4e. Set Feed Mode to MANUAL. Feed Indicator on Main Display should turn on. 4f. Check Relay Fuses on Power Board. ORP: Fuses F4 and F5 Sanitizer:Fuses F10and F11 pH: Fuses F8 and F9 Heater: Fuses F4 and F5 TDS: Fuses F4 and F5 Filters: Fuses F4 and F5
5. CANNOT CALIBRATE	NOTE: The ORP needs to be above 650 mV for Sanitizer calibration. 5a. Check water balance and adjust if needed. 5b. Clean faulty sensor as indicated. 5c. Check sensor connections. 5d. Check sensor with the PORTAPROBE™. 5e. Test electronics with the PORTAPROBE™.

6. CHLORINE OR pH OVERFEED	6a. Clean and test the faulty sensor. 6b. Check and adjust the calibration. 6c. Check and adjust the setpoint. 6d. Check the relay. 6e. Check the chemical feeder for leaks. 6f. Reduce feed rate or dilute the solution. 6g. Check the Superchlorination Program. 6h. Adjust proportional, increase progressive zone.
7. IMPROPER READINGS	7a. Clean the faulty sensor. 7b. Recalibrate 7c. Test the sensor with the PORTAPROBE™. 7d. Test the electronics with the PORTAPROBE™.

7.1 PARTS, ACCESSORIES AND UPGRADES

PPMGEL1B	Free Cl Gel
PPMGEL1C	Electrolyte for Active chlorine (PPMAC010) Thin in clear bottle
PPMGEL2C	Electrolyte for Chlorine Dioxide (PPMCD010)
PPMGEL1H	Electrolyte for Free chlorine high temp (PPMFC00H)
PPMGELPA	Electrolyte for peracetic acid (PPMPA200)
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.
PPM002	0-2 PPM Chlorine Sensor with connector
PPMAC010	10 PPM Active Chlorine Sensor
PPMTC010	10 PPM Total Chlorine Sensor
PPMFC002S	0-2 PPM Free Chlorine Salt Sensor
PPMFC010S	0-10 PPM Free Chlorine Salt Sensor
PPMBM010	10 PPM Free Br Sensor
PPMCD0100	10 PPM Cl Dioxide Sensor
PPMCEL1C	Clear Flow Cell
PPMM01	Membrane for PPM002/PPM010 Sensors
PPMM02	Membrane for PPM200
PPMMEM1O	Total Cl Orange Membrane
PPMMEM1C	Active Cl Clear Membrane
PPMMEM1B	Free Cl Blue Membrane
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.
MB2100	MOTHERBOARD, electronic PC board for PC2100, 3000 with microprocessor.
MB604	MOTHERBOARD, electronic PC board for PC 5000, 5100, 6000, 7000 with microprocessor.
PB2100	POWER BOARD, electronic PC board for PC2100 with relays (specify).
4-20 mA Board	COMMUNICATIONS BOARD for 4-20 mA input or output (specify), 5 channels.
PPM Board	PC Board for Free Chlorine sensor.
BPL	BYPASS LINE ASSEMBLY, ½-in, flow meter, safety flow switch, three (3) ball valves ...
SC	SENSOR 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.
SCC	SENSOR CELL CABINET with Flow Cell Assembly.
205T	PVC SOLENOID VALVE for erosion feeder, 1" or 3/4" FPT (specify 24 V or 110VAC).
REM3:	UPGRADE for remote operation with true duplex CHEMCOMM™ Remote Operation
RS485	for direct computer operation with communication converter and true duplex CHEMCOMM™ *Windows* software
S45M3-V	MULTIPORT SOLENOID VALVE, 3-way, 3-position motorized ball valve, PVC body, 2” FPT, 110 VAC, 150 psi for electrically operated filter backwash.
8221G2	SOLENOID VALVE, 3-way, brass body, 3/8” FPT, Normally Closed (NC), for hydraulically operated filter backwash.

8262G208	SOLENOID VALVE, brass body, 1/4” FPT, Normally Open (NO), for pneumatically operated filter backwash..