



WG-602
Water Quality Analyzer



Version 5.13
March 2011

1 Preface

1.1 Intended Use

This manual is for qualified and trained service technicians who will install and service the WaterGuard WG-602 Water Quality Analyzer. It provides instructions on how to install the WaterGuard system, how to integrate it with external chemical dosing systems, as well as how to calibrate, operate, and maintain the system.

Safety Precautions

Warning: Only properly trained and licensed electricians should attempt to wire or service the electronic components of the analyzer. There is an Electrical Shock Hazard when servicing this system. Always verify that all electrical power source(s) are off before opening the analyzer unit or attempting to service electronic components or wiring.

Caution: Extreme caution should be used when installing, operating, and maintaining the WaterGuard WG-602 Water Quality Analyzer and Controller. Only properly trained technicians are authorized to install and maintain the analyzer. Only properly trained and licensed electricians should attempt any change to the system's electrical components. Only properly trained and licensed operators should attempt to make any changes to chemical dosing levels.

Always follow local health and safety regulations when performing any service on the WaterGuard unit or changing chemical dosing settings.

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1.2 Overview of Chapters

This document is divided into functional sections according to the various steps involved in installing and operating the WaterGuard system.

Section 1:	Short Overview of manual layout and general precaution information.
Manual Overview	
Section 2:	General description of how WaterGuard automatically monitors water quality.
Analyzer Overview	
Section 3:	Instructions on WaterGuard installation and how to integrate WG analyzers with water quality systems.
Installation	
Section 4:	Instructions to configure, calibrate, and operate the WaterGuard system immediately after installation.
First Time Set up and Operation	
Section 5:	Instructions on responding to alarms and troubleshooting issues.
Routine Operation and Maintenance	
Section 6:	Additional components that may be preinstalled or upgraded in the field.
Measurement Options	
Appendix A:	Description of WaterGuard's direct control components and operation.
Relays and Closed Loop Control	
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Technical Information	

2 Overview

The WaterGuard WG-602 Water Quality Analyzer continuously monitors chemical levels in a process water application. WaterGuard automates free chlorine, total chlorine, pH, ORP (Redox), temperature, turbidity, conductivity and/or flow rate, administering chemicals as required, according to the results of these tests (closed loop).

2.1 Measurements and Features

The WaterGuard unit can be configured to measures any combination of the following water quality parameters:

- Free Chlorine – Amperometric
- Turbidity
- Conductivity
- pH and Temperature
- Flow Rate

Several communication options are also available:

- Internal 4 to 20 mA Outputs (up to 4 channels)
- External 4 to 20 mA Outputs (up to 8 channels + dry contact alarms)
- HydroSoft - Direct Connection
- Wireless Communication Package*

Optional Module – See supplemental manual for more information

2.1.1 Wireless Management Package

An advanced and unique WaterGuard option is the cellular communication package which provides web-based monitoring of up to 5 analyzers. The cellular communicator accepts WaterGuard's alarms and readings and transmits them to a web-based application server. The information is easily accessible remotely through the Internet or mobile telephone.

Caution: Remote control of water chemistry is potentially dangerous; therefore, the WaterGuard remote monitoring and control service is set by default to monitoring and reporting only.

2.2 System Components

WaterGuard has two primary units: the analyzing unit and the control unit. The analyzing unit performs the actual measurements and the control unit includes all electronics, the user interface and the software that controls the measurements performed in the analyzing unit. Together, they contain the following components:

Flow Cell - contains the sensors, including the pH, Redox (ORP), and temperature sensors.

I/O Module (Input/Output) – Power Supply to the analyzer and contains the dry-contact relays for direct control of external dosing systems.

Control Panel Module – Calculates the measurement results and determines the required chemical dosing to maintain an appropriate chemical balance in closed-loop systems, and provides data to external communication devices such as 4 to 20mA Outputs or the wireless communication package.

Keyboard Panel - mounted on the cover of the control module, it functions as WaterGuard's user interface. The control panel displays current measurements and indicates alarms. All settings and adjustments are performed through the control panel.

pH, Redox, Temp Module* – receives the signal from the pH, Redox, and temperature probes.

Internal 4-20 Input Module* - Contains Connections for Turbidity, Conductivity meter, and 4-20 Flow Meter.

Internal 4 to 20 Output Module* – Provides up to 4, 4 to 20mA outputs for any measured variable.

External 4 to 20 Module* – Provides up to 8, 4 to 20mA outputs for any measured variable. Contains dry contacts for alarms not related to measured values including: low reagents, no reagents, no flow, etc.

*Optional Module

3 Installation

3.1 Selecting a Location

Take extra time in selecting a location since the installation location will determine the ease of the installation and future operation and maintenance. The location where WaterGuard is installed is dependent on various considerations:

Convenient Access - WaterGuard should be installed where it can easily be viewed and operated.

Dry Area – WaterGuard handles electricity and includes electronic circuitry that is susceptible to short-circuiting and/or corrosion when exposed to water or high ambient moisture levels.

Away from Chemicals - Many water treatment chemicals can be corrosive to WaterGuard's electronic circuitry. It is highly recommended that WaterGuard is not installed adjacent to the chemicals storage area or the dosing systems themselves.

Minimum Distance from Supply Pipe - The water sampling line that is connected to the main pipe, feeding the WaterGuard should be as short as possible. A long sample line from the main pipe to WaterGuard creates an unnecessary delay between supply, measurement, analysis, and chemical dosing.

Freezing Temperatures – The analyzer should be installed in a location that is not susceptible to freezing temperatures. The reagents will freeze, preventing accurate readings (even when thawed) and parts may be damaged due to expansion when ice forms.

3.2 Site Requirements and Installation

The WaterGuard assembly is wall mounted. It should be located on a wall where operators and service technicians can easily access it for normal operation and maintenance. It is also advisable to install it where the operators can easily view the readings and alarms. Finally, the unit weighs approximately 6 lbs. (3 kg), so, it must be mounted securely onto a stable wall. The WaterGuard unit measures 26.3" x 13.1" (66.8 cm x 33.2 cm). The base of the complete WaterGuard assembly should be mounted at least 24" (60 cm) above the floor (preferably at eye level).

The WaterGuard unit and its mounting panel are not shipped with mounting screws or anchors. The installer must provide screws and anchors that can hold the weight of the WaterGuard unit, mounting panel, intake filter, and electrical outlets and junction boxes. The screws and anchors must be compatible with the wall where it will be installed.

3.2.1 Mechanical Installation

- 1) WaterGuard is shipped pre-mounted on a mounting panel, along with a water filter. The mounting panel includes four screw holes, one in each corner.
- 2) Determine the location of one hole on the WaterGuard unit or on the mounting panel.
- 3) Secure one corner of the WaterGuard unit or mounting panel to the wall.
- 4) Level the WaterGuard unit or mounting panel and mark the remaining three (3) screw holes.
- 5) Secure the remaining corners to the wall using 5/16" (8 mm) screws.

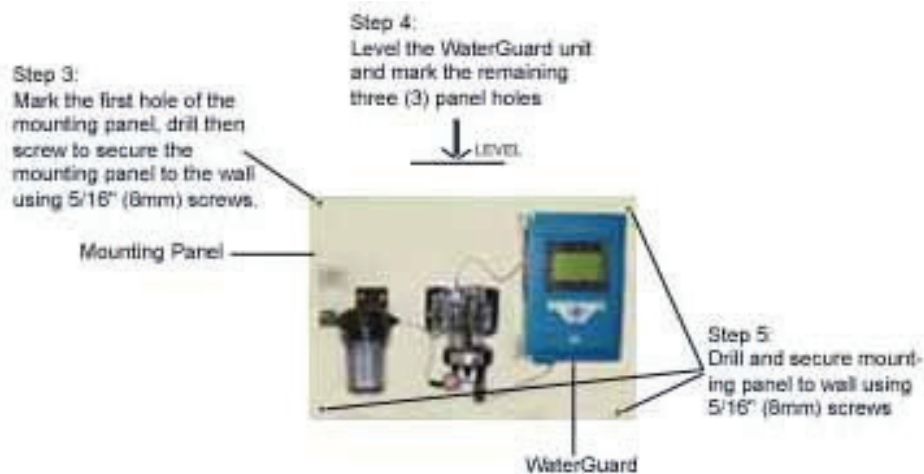


Figure 1: WaterGuard 602 Mounting Panel

3.3 Plumbing Requirements and Installation

3.3.1 Water Supply

WaterGuard requires a pressurized water supply to the flow cell, a zero pressure (gravity) water return from the colorimeter and a pressurized (or gravity) return from the flow cell. An isolating valve must be installed in the main line and the pipe (or tube) from the main pipe should be as short as possible, in order to minimize the delay time between the water being sampled and WaterGuard testing the water and adjusting dosing levels (see section 3.1). The inlet pressure should not exceed 36 psi (2.5 bar) and should be adjusted to 7 psi (0.5 bar) using a pressure regulator attached to the outlet of the pre-filter.

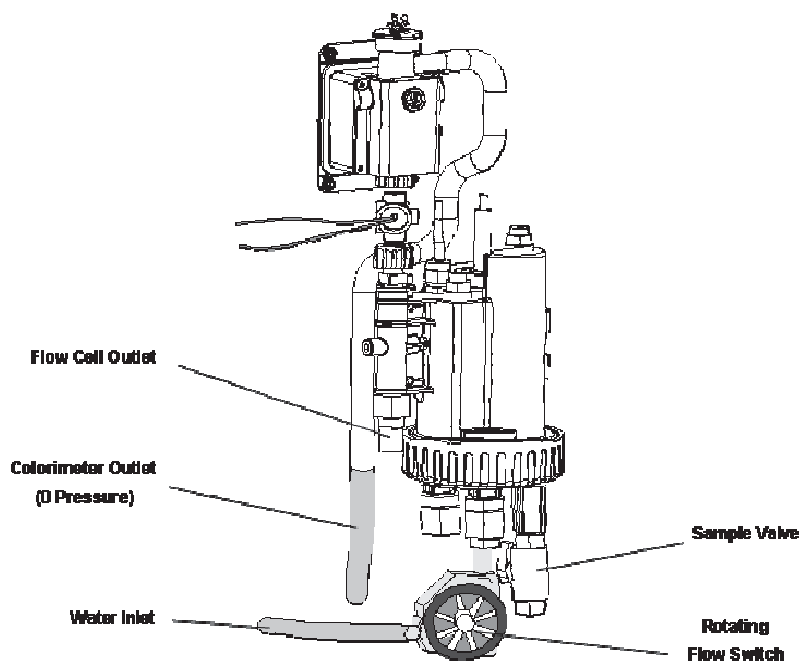


Figure 2: Flow cell and Colorimeter Inlet and Outlet

3.3.2 Drainage

A pressurized, vacuum, or gravity connection is required from the outlet of the flow cell. The flow cell may be pressurized up to 7 psi (0.5 bar) and a ¼" FNPT fitting is supplied for the flow cell drain connection.

3.4 Electrical Requirements and Installation

WaterGuard requires a 90-120 or 180-240 VAC, 50/60 Hz electrical power source on a separate 16A circuit in the plant room's electrical board. The main WaterGuard power supply should be connected to a non-dependent power supply, so that the unit remains powered constantly. The active relays should be connected to a (pump) dependent power supply (interlocked power supply) to provide an additional layer of prevention against chemical addition and equipment operation when the main water supply is not operating.

3.4.1 Connecting the Main Electrical Power Source

The Main Power Supply may be connected to either 90-120 or 180-240VAC 50/60Hz. Switching between voltages is accomplished by changing two (2) jumpers located above the main power connection, to the left of the transformer. For 90-120VAC, a 1amp fuse should be used; for 180-240VAC, a 0.5amp fuse should be used. These changes must be completed prior to wiring.

Caution: Before making a connection to a power source, confirm that both jumpers are located on the correct voltage and that the appropriate fuse is in place.

- 6) Verify that the power switch or circuit breaker to the non-dependent power source is off.
- 7) Connect the line (live) wire to the I/O board connector marked Line.
- 8) Connect the neutral wire to the I/O board connector marked Neutral.
- 9) Connect the earth wire to the I/O Module connector marked Ground.
- 10) Continue with the other electrical connections.
- 11) Turn on electrical power only after all electrical connections have been completed.

For information on wiring and using the relays as dry contact or for control, see Appendix A.

3.4.2 Input Switches

Flow input switch terminal blocks on the I/O module allow for three input switches to be connected to the system as additional layers of security against accidental chemical additions when there is no flow. If a connection is expected but not detected at each input, the analyzer/controller will indicate an alarm and will close all relays (and open the alarm relay). Therefore, if a safety switch (flow, level, etc.) will not be installed, a fixed connection (jumper wire) is required to allow the controller to operate.

Two flow switches and one flow meter may be connected:

- Flow Switch (internal): Flow switch connected to flow cell of analyzer. Supports both 2 and 3 wire flow switches.
 - If a 2 wire switch is used, it should be connected to the "In" and "Gnd" connections. If a 3 wire switch is used, the "VCC" connection will also be used.
 - If a rotating flow switch is used, the J25 jumper should be in place; if a float-type or other on/off flow switch is used, the J25 jumper should be removed (to be used with the open cell analyzer models).
- External Flow Switch: Connection for external 2-wire flow switch. If an external switch is not connected, a jumper must be installed for the analyzer to operate properly.

- Flow Meter: Connection for 2 or 3 wire flow Meter. The analyzer will not look for the flow meter connection unless the option is turned ON in technician menu; therefore, no jumper is required if a meter is not installed.

Caution: Electrical connections in this section are ONLY recommendations. All electrical connections should comply with National Electrical code (NEC) and all local regulations.

First Time Operation and Calibration

3.5 Installing additional Sensors and Meters

Install all additional sensors and meters and connect to the WG-602 main system, following the supplemental manuals for each sensor or meter.

3.6 First Time Menu Setup

This section describes how to configure the settings (set points, alarms, and calibrations) through the WaterGuard control panel.

Caution: WaterGuard's control board unit should not be opened except for initial installation and troubleshooting and should only be opened by a trained and approved technician.

3.6.1 WaterGuard Control Panel

The WaterGuard control panel is a simple, intuitive interface for monitoring and controlling water quality with the following components:

LCD Display	At the top of the control panel is an LCD display which shows all measured variables at top and all Alarms and Menus at bottom
Menu Button	Enters and scrolls through the menus
Esc	Moves one level back in the menu without making changes
OK	Enters setting change mode and accepts setting change
Up/Down Arrows	Changes value up or down

When an alarm is issued, the bottom row of the LCD displays the alarm.

Pressing the up and down arrows together will display the Langelier index for approximately five (5) seconds, and then returns to the previous display mode.

3.6.2 Menus

WaterGuard has two menu levels: Operator and Technician. The Operator menu includes settings that may be controlled by on-site operators. The Technician menu includes settings and calibrations that should be restricted to specially trained WaterGuard maintenance technicians. Each menu has a separate password. The technician level password may be used whenever a password is required, however the operator password will only be accepted in the operator menu.

Table 1 displays the operator menu functions and their description and Table 2 displays the menu functions with the minimum and maximum values for each.

Table 1: Operator Menu Functions and Descriptions

MENU #	NAME	DESCRIPTION
1	Shock Cl ₂	Turn Cl ₂ Shock On/Off
2	Menu Relays	Manual activation of Relays
3	Cl ₂ Setpoint 1	Controls Cl ₂ Relay 1 - (On/Off or Proportional)
4	Cl ₂ Shock Setpoint	Setpoint for Cl ₂ Shock
5	Cl ₂ Setpoint 2	Controls Cl ₂ Relay 2 - (On/Off Only)
6	Cl ₂ Calibrated To	Shows most recent calibration and sensor value at calibration to aid in troubleshooting
	Cl ₂ Sensor Was	
7	Cl ₂ Low Alarm	Alarm when Cl ₂ below this value
8	Cl ₂ High Alarm	Alarm when Cl ₂ above this value
9	pH Setpoint	Controls pH Relay 3 = (On/Off or Proportional)
10	pH Calibrated To	Shows most recent calibration to aid in troubleshooting
11	pH Sensor Was	Shows sensor value at calibration to aid in troubleshooting
12	pH Low Alarm	Alarm when pH below this value
13	pH High Alarm	Alarm when pH above this value
14	Temp Setpoint	Controls Temperature Relay 6
15	Temp Calibrated To	Shows most recent calibration and sensor value at calibration to aid in troubleshooting
	Temp Sensor Was	
16	Temp Low Alarm	Alarm when temp below this value
17	Temp High Alarm	Alarm when Temp above this value
18	Turbidity Setpoint	Controls Turbidity Relay 4 (optional module)
19	NTUL Calibrated To	Shows most recent NTU low calibration and sensor value at calibration to aid in troubleshooting
	Sensor Value Was	
20	NTUH Calibrated To	Shows most recent NTU high calibration and sensor value at calibration to aid in troubleshooting
	Sensor Value Was	
21	Turb. High Alarm	Alarm when Turbidity above this value (optional module)
22	Conductivity Calibrated To	Shows most recent Conductivity calibration and sensor value at calibration
	Sensor Value Was	
23	Alarm Delay	Time delay before Alarm Relay 5 closes
24	Flow Low Limit	Low flow limit for external flow meter
25	Flow K-Factor	K-Factor for external flow meter
26	Total Alkalinity	Manually entered for Langelier Index
27	Total Hardness	Manually entered for Langelier Index
28	TDS	Manually entered for Langelier Index
29	Language	Allows choice of language
30	System Reset	Restarts controller - safer than turning off and on

Table 2: Operator Menu and Variable Limits

MENU #	NAME	MINIMUM VALUE	MAXIMUM VALUE	DEFAULT	UNITS
1	Shock Cl ₂	OFF	ON	OFF	—
2	Menu Relays	OFF	ON	OFF	—
3	Cl ₂ Set Point 1	0	9.99	1.5	PPM
4	Cl ₂ Shock Set Point	0	9.99	3	PPM
5	Cl ₂ Set Point 2	0	9.99	0.5	PPM
6	Cl ₂ Calibrated To	0.1	9.99	N/A	PPM
	Cl ₂ Sensor Was	0.1	9.99	N/A	PPM
7	Cl ₂ Low Alarm	0	9.99	0.5	PPM
8	Cl ₂ High Alarm	0	10.0	2.00	PPM
9	pH Set Point	4.0	10.0	7.40	—
10	pH Calibrated To	4.0	10.0	N/A	—
11	pH Sensor Was	4.0	10.0	N/A	—
12	pH Low Alarm	4.0	10.0	6.9	—
13	pH High Alarm	7.0	14.0	7.8	—
14	Temp Set Point	1/34	49.9/121.9	22°C	°C or °F
15	Temp Calibrated To	1/34	49.9/121.9	N/A	°C or °F
	Temp Sensor Was	1/34	49.9/121.9	N/A	°C or °F
16	Temp Low Alarm	1/34	49.9/121.9	18°C	°C or °F
17	Temp High Alarm	1/34	49.9/121.9	50°C	°C or °F
18	Turbidity Setpoint	0	40	0.60	NTU
19	NTUL Calibrated To	0	1	N/A	NTU
	Sensor Value Was	0	1	N/A	NTU
20	NTUH Calibrated To	1.1	40	N/A	NTU
	Sensor Value Was	1.1	40	N/A	NTU
21	Turb. High Alarm	0	99.99	99.99	NTU
22	Conductivity Calibrated To	0	2000	N/A	US
	Sensor Value Was	0	2000	N/A	m ³ /hr or GPM
23	Alarm Delay	0	10	0:30	Minutes
24	Flow Low Limit	0	200 or 999	0=OFF	m ³ /hr or GPM
25	Flow K-Factor	0.01	655	0.01	—
26	Total Alkalinity	0	600	0	PPM
27	Total Hardness	0	600	0	PPM
28	TDS	0	5000	0	PPM
29	Language	Language Selection		English	—
30	System Reset	N/A	N/A	N/A	—

3.6.3 Configuring Settings in the Operator Menu

Each of the parameters in the operator menu is configured in the same way. The following procedure describes how to configure a typical setting:

- 12) Locate the desired parameter in the menu:
 - a) Press Menu until the desired parameter name appears in the LCD display.
- 13) Press OK. Enter Password 100 appears in the LCD display.
- 14) Enter the Operator password (or technician password; both are accepted)
- 15) Press the up arrow or down arrow until the password number is reached.

Note: Holding Menu while pressing up or down will advance the first digit. Holding up or down for an extended period of time will proceed through the numbers more quickly.

The factory-set operator password is 123. The operator password can only be changed by entering the current operator or technician password (see Technician Menu Setup).

- 16) Press Enter to accept the password. The parameter name and current setting appear in the LCD display.
- 17) Press Enter, again. The LCD display shows the parameter and the current setting.
- 18) Enter the new parameter setting:
 - a) Press the up arrow or down arrow until the desired value is reached.
 - b) The second row of the menu display, below the value that is being changed, shows the current value.
- 19) Press Enter to save the new setting or Esc to abort without saving the new setting.

To change the settings of additional parameters, press Menu until the desired parameter appears in the LCD display and repeat steps 6-8 above to set the new parameter.

Note: The Menu button displays the next parameter in the list, so that the operator can check every parameter in the menu. There is no scroll-back option. To view or change a previous parameter in the menu, you must exit the menu by pressing Esc, and start the above procedure from the beginning.

3.7 Calibration

Parameters must be calibrated with measurements taken with external testing devices. Always use digital calibration devices, not the less accurate visual test kits. Alternatively, standard solutions may be used. Make sure the standard solution is not expired or contaminated prior to using. Follow the procedures below EXACTLY as instructed.

ALWAYS take water for calibration from the sampling valve, NOT from the process line directly. The analyzer should always be calibrated with water from the same source.

Following calibration directions for each sensor as indicated in the sensor manual; however chlorine is listed below as an example.

3.7.1 Example Calibration - Chlorine

- 20) Open the water sampling valve.
- 21) Fill the sampling container.
- 22) Test the water sample for chlorine using a digital photometer.
- 23) Press Menu until "Cl Calibrated to" appears in the LCD display.

The top line will display "Cl Calibrated to" and a number. The number displayed is the last value someone entered for the calibration. The bottom line will display "Cl Sensor was" and a number. This number is the sensor reading without any calibration at the time of the last calibration. If there is a large discrepancy between these two numbers, the sensor was calibrated improperly or there is a problem with the analyzer. The value displayed normally on the main screen and the value the analyzer uses to determine dosing rates is the calibrated value.

- 24) Press OK.
- 25) Enter the password. Press the up arrow or down arrow until the password is reached.
- 26) Press OK.
- 27) Press OK again.

The display will now show "Calibrate Cl to" on the top line and "Sensor Reading" on the bottom line. The "Sensor Reading" is the current reading of the sensor with no calibration. The "Calibrate Cl to" value is the new value which you want to set.

- 28) Press the up arrow or down arrow until the value is the same as the value given by the digital photometer.
- 29) Press OK to save the new calibration or Esc to abort without saving.
- 30) Press Esc to return to the main display.

3.7.2 Calibrating other Sensors and Meters

Calibration of other sensors and meters is similar to the chlorine calibration and requires the use of a reliable external testing device or standard solution. See the supplemental manuals for each sensor or meter for specific information on calibration.

3.8 Technician Menu Setup

The Technician menu includes advanced parameter settings that are accessible separately from the Operator menu. Anyone can view the settings, but only someone with technician password can change. This has been done to allow only those who are qualified to change the advanced analyzer settings. These are also settings that should not require frequent changes after the initial installation and set-up.

Table 3: Technician Menu Functions and Descriptions

MENU #	NAME	DESCRIPTION
51	Cl ₂ P Factor	Proportional Factor for Cl ₂ Relay 1
52	Cl ₂ Pump Period	1 Pump cycle (On + Off time) for Cl ₂ Relay 1
53	Cl ₂ Pump Frequency	Cl ₂ pump max pulses/min, 0 for On/Off
54	Cl ₂ Averaging	Displays an average of the last 4 Cl ₂ readings
55	Cl ₂ Sensor Type	Select which Cl ₂ Sensor is connected
56	pH p Factor	Proportional Factor for pH Relay 3
57	pH Pump Period	1 Pump cycle (On + Off time) for pH Relay 3
58	pH Pump Freq	pH pump maximum pulses/min, 0 for On/Off
59	ph Balance Type	To select if acid or base is being added to
60	Flow Sensor	Will turn display of Flow rate on/off (Only use
61	Flow Rate	Choose between metric and English units
62	Celsius/Farh	Choose between metric and English
63	Temp Hysteresis	Value, in degrees, below setpoint which will
64	Turbidity	Turns Turbidity module ON/OFF (optional
65	NTU Wiper Interval	Interval for Turbidity module Wiper to clean
66	Minutes	Current time for data logger
67	Hour	Current time for data logger
68	Day	Current time for data logger
69	Month	Current time for data logger
70	Year	Current time for data logger
71	Recording Interval	Time interval between readings stored on the
72	View Free Cl ₂	Displays measurement value on LCD
73	View pH	Displays measurement value on LCD
74	View Conductivity	Displays measurement value on LCD
75	Address	Controller ID - used with external
76	Software Version	Current software version
77	Max Flow Range	Maximum Flow Rate (flow at 20μA) of 4-
78	4-20μA Output Settings	Configures outputs for internal 4-20μA
79	On Alarm Go To	4-20μA output during an alarm condition
80	Operator Password	Change operator password
81	Technical Password	Change technical password

Table 4: Technician Menu and Variable Limits

MENU #	NAME	MINIMUM VALUE	MAXIMUM VALUE	DEFAULT	UNITS
51	Cl ₂ P Factor	0.1	50	0.1	—
52	Cl ₂ Pump Period	0.5	4	0:30	Minutes
53	Cl ₂ Pump Frequency	0 (0= ON/OFF pump)	120	0	Maximum pulses/min
54	Cl ₂ Averaging	OFF	ON	ON	—
55	Cl ₂ Sensor Type	1	2	1	—
56	pH p Factor	0.1	100	1.0	—
57	pH Pump Period	0.5	4	0:30	Minutes
58	pH Pump Freq	0 (0= ON/OFF	120	0	Maximum
59	ph Balance Type	Acid	Base	Acid	—
60	Flow Sensor	OFF	ON	OFF	—
61	Flow Rate	m ³ /hr	GPM	m ³ /hr	—
62	Celsius/Farh	°C	°F	°C	—
63	Temp Hysteresis	0.1	1	0.1	°C or °F
64	Turbidity	OFF	ON	OFF	—
65	NTU Wiper Interval	1	60	2	Minutes
66	Minutes	1	59	N/A	Minutes
67	Hour	0	23	N/A	Hours
68	Day	1	31	N/A	Days
69	Month	1	12	N/A	Months
70	Year	1	99	N/A	Years
71	Recording Interval	1	240	0:03	Minutes
72	View Free Cl ₂	OFF	ON	ON	—
73	View pH	OFF	ON	ON	—
74	View Conductivity	OFF	ON	ON	—
75	Address	1	32	1	—
76	Software Version	N/A	N/A	N/A	—
77	Max Flow Range	0	200/999	200	m ³ /hr or GPM
78	4-20µA Output Settings	N/A	N/A	N/A	—
79	On Alarm Go To	2	20	2	N/A
80	Operator Password	1	999	123	—
81	Technical Password	1	999	456	—

3.8.1 Configuring Settings in the Technician Menu

Navigation within in the Technician Menu is identical to the operator menu.

- 1) To enter the Technician menu, press Menu to enter the operator menu and then the up arrow and down arrow together simultaneously until the menu display changes.
- 2) Locate the desired parameter in the menu:
 - a) Press Menu until the desired parameter name appears in the LCD display.
 - b) Press OK. Enter Password 100 appears in the LCD display.
- 3) Enter the Technician menu password:
 - a) Press the up arrow or down arrow until the password number is reached.
 - b) Press OK. The parameter name and current setting appear in the LCD display.

Note: Technician menu password is different from the Operator menu password. The default Technician menu password is 456 and if lost, can only be reset by replacing the chipset.

- 4) Continue changing the parameter setting, as described in the Operator menu.

3.9 Calibration and Initial Operation Checklist

Before leaving the site, perform the procedure in this section and record the requested values.

Calibrate the following WaterGuard parameters and enter the information into the table below. If pH is reading slightly low, do not calibrate as it will continue to increase for the first 24-48 hours.

Date	Site	Technician's Name
Parameter	Analyzer Reading	External Device or Standard Value
Free Cl		
pH		
Temperature		
Turbidity		
Conductivity		
Flow Rate		

4 Routine Operation and Maintenance

Once installed by a qualified technician, WaterGuard can begin monitoring and controlling water quality. WaterGuard is specifically designed for easy operation; however some periodic maintenance is still required.

- **Basic Operation:** involves setting the desired parameters and monitoring the system for alarms. When operating normally, WaterGuard demands very little operator involvement.
- **Calibration:** Sensor sensitivity and accuracy can degrade or drift over time. For this reason, WaterGuard settings must be periodically recalibrated and compared with measurements from other measuring devices, such as electronic photometers, pH sensors, and thermometers or compared to standard solutions like pH buffers.

- **Shut-down and Winterizing:** If the analyzer will not be operating for an extended period of time or in areas where temperatures drop below freezing, all water must be removed from the analyzer to prevent components from breaking and the probes must be removed and stored in a warm area and kept wet at all times.
- **Troubleshooting:** Occasionally problems will occur with the analyzer readings or chemical dosing. These problems are most often simple to correct. The troubleshooting section provides an outline to follow to help correct the problems easily.

4.1 Monitoring WaterGuard Alarms

WaterGuard issues alarms when it detects chemical levels that are above or below the allowed range. Every alarm is automatically displayed in the LCD status display and logged in the data logger. Most deviations in chemical levels, however, are automatically corrected. Thus, the internal alarms do not immediately activate an external alarm. A delay mechanism prevents false alarms from minor deviations that were automatically corrected. The external alarm is only activated after an internal alarm has been continuously active for a certain period of time, as defined by the operator.

The Alarm Delay command in the Operator menu sets the number of seconds WaterGuard waits before closing Relay 5, the relay that operates the external alarm. Only one alarm is shown on the screen at a time based on importance and the order in which it should be fixed. For example, if the pH is high and the ORP is low, only the pH alarm will be indicated since lowering the pH will likely also correct the low ORP. All of the alarms are presented in Table 5 along with a description and resulting action of the analyzer/controller.

Table 5: Alarm Description and Result

Alarm #	Alarm	Description	Result
A1	No flow	Flow switch in flow cell is off	No chemical dosing
A2	Low flow	external flow meter below minimum flow	No chemical dosing
A11	Low chlorine	Cl below low limit	--
A12	High chlorine	Cl above high limit	--
A13	Low pH	pH below low limit	--
A14	High pH	pH above high limit	--
A16	High NTU	Turbidity above high limit	--
A17	EXTERNAL OFF	external flow switch is off	No chemical dosing
A21	Temp. low alarm	Temperature below low limit	--
A22	Temp. high alarm	Temperature above high limit	--
A23	Cl overfeed time	Cl dosing on for longer than max time	Cl dosing stops until reset
A24	pH overfeed time	pH dosing on for longer than max time	pH dosing stops until reset

* No dosing only affects the relay operation. Alarm relay will close and all other relays will open.

4.2 Shut-Down and Winterizing

The WaterGuard analyzer is designed to keep the probes submerged even if there is no flow to the analyzer. However, if the analyzer is going to be offline for an extended period of time and/or exposed to freezing temperatures, it must be winterized to prevent damage to the analyzer and the probes.

- 1) Store all probes following directions in the supplemental manuals for each sensor.
- 2) Drain the flow cell completely by opening the sampling valve on the bottom. Leave the valve in the open position to allow air to completely dry the cell.
- 3) Check the security of the analyzer doors to ensure a weatherproof seal.

4.3 Troubleshooting

The following procedures instruct how to locate, evaluate, and fix a problem when WaterGuard issues an alarm or indicates suspect chemical levels.

Alarm	#	Description	Symptom	Solution / Suggestion
No Flow	A1	Not enough water reach the controller. Stop all chemical dosing (all relays are open)	No chlorine measurements. No dosing	Increase flow and check flow switch wire connection on board. Check that the switch is not stuck.
Low Flow	A2	Water flow rate in main circulation pipe is lower than the flow limit. Stop all chemical dosing (all relays are open)	No dosing	Check the circulation pipes, not controller problem.
Low Chlorine	A11	Free Chlorine level is below alarm level.	Message Only	Compare to manual reading! Check reagent flow from bottle to colorimeter. Check/clean solenoid valve (including spring). Check correct water flow. Verify if necessary. Check unstable reading, due to poor grounding. Increase high/low pH level if operation is normal. Replace probe
High Chlorine	A12	Free Chlorine level is above alarm level.	Message Only	
Low pH	A13	Acid/base level is below alarm level.	Message Only	
High pH	A14	Acid/base level is above alarm level.	Message Only	
High NTU	A16	NTU level is above alarm level.	Message Only	Check constant reading. Compare to manual reading. Check wiper movement. Clean sensor window. Change if necessary.
External Off alarm	A17	Connections External flow Switch indicating no flow. Stop all chemical dosing (all relays are open)	Message Only	Make connection on I/O board with flow sensor on connections 5 + 6 or with jumper wire to complete circuit. Not recommended to operate with jumper only.
Temp Low	A21	Temp level is below alarm level.	Message Only	--
Temp High	A22	Temp level is above alarm level.	Message Only	
Cl pump Overfeed time	A23	Chlorine relay has been active for more than a pre-determined time limit and has shut off for safety reasons.	No Chlorine Dosing.	Confirm proper operation of dosing systems and perform a system reset
pH pump Overtime		pH relay has been active for more than a pre-determined time limit and has shut off for safety reasons.	No pH Dosing	Confirm proper operation of dosing systems and perform a system reset

4.4 Replacing Components

The following procedures describe how to replace certain WaterGuard components.

Caution: The following procedures should only be performed by properly qualified and trained WaterGuard analyzer technicians.

Warning: Disconnect all power supplies to the WaterGuard analyzer before opening the control unit door. Replacing any parts of WaterGuard without the expressed written authorization of Chemical Injection Technologies, Inc., or the qualified representative who supplied the product may void the warranty.

Chemical Injection Technologies, Inc., takes no responsibility, written or implied, for installation or maintenance of WaterGuard that is not performed by a properly trained and certified WaterGuard technician.

4.4.1 Replacing Flow Switch

- 1) Turn off the inlet and outlet water to the flow cell and the power to the analyzer.
- 2) Open the doors of both the analyzing module and the control module.
- 3) Locate the flow switch attached to the flow cell.
- 4) Disconnect the flow switch wires from the I/O module.
- 5) Remove the inlet connection to the old flow switch.
- 6) Remove the flow switch from the flow cell.
- 7) Pull the flow switch wires gently to completely remove from the analyzer
- 8) Insert the new flow switch on the flow cell
- 9) Insert the inlet connection on the flow switch
- 10) Route the flow switch wires back to the connection on the I/O module and connect the wires to the input switch terminal block.
- 11) Close the analyzer doors and turn on the water and power and ensure proper operation.

4.4.2 Replacing Control Panel Module (electronics card)

Disconnect the power supply to the unit before opening the control unit.

- 1) Disconnect the flat cable plug from the card.
- 2) Unscrew the four (4) mounting screws.
- 3) Put in the new card and tighten the 4 mounting screws.
- 4) Connect the flat cable plug to the card.

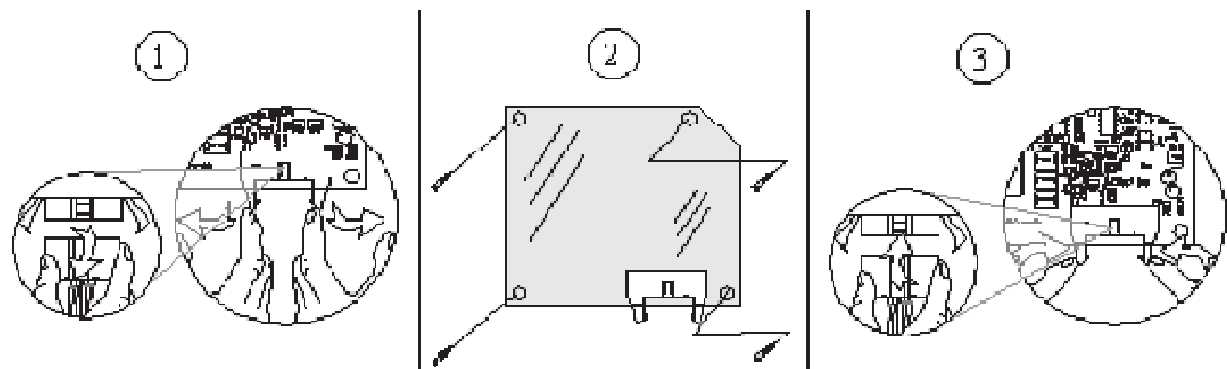


Figure 3: Replacing all types of electronic modules (cards)

4.4.3 Replacing I/O Module

Disconnect the power supply to the unit before opening the control unit.

- 1) Disconnect the flat cable plug from the card.
- 2) Unscrew the four (4) mounting screws.
- 3) Put in the new card and tighten the 4 mounting screws.
- 4) Connect the flat cable plug to the card.

4.4.4 Module Software Update

Each electronic module (card) has a microcontroller chip (IC) with its own unique software. Whenever a module's software is updated, its chip must be replaced by a new version with the new software.

- 1) Turn OFF the power to WaterGuard.
- 2) Locate the chip that needs to be replaced
- 3) Remove the chip carefully by prying up each end a little at a time with a thin screwdriver.
- 4) Install the new chip in the same location. Please note in the figure that the chip and the board each have a directional mark. The chip must be positioned so that these directional marks are aligned.

* The control panel has no IC, it is necessary to replace the module (electronics card).

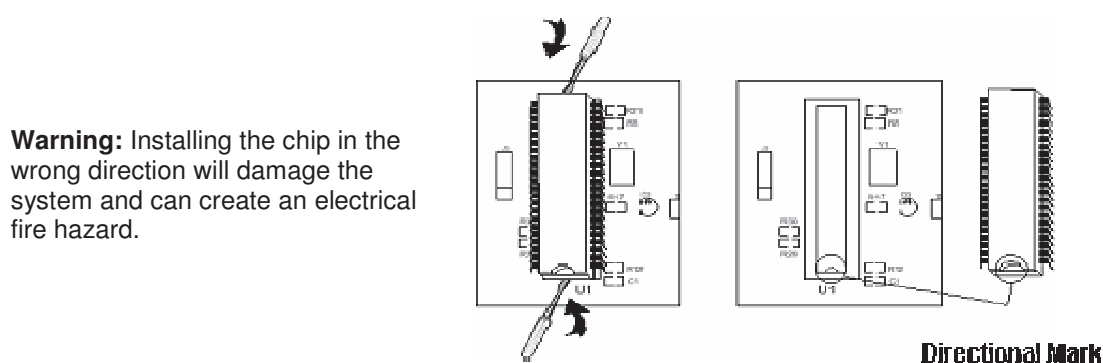


Figure 4: Installing New Chipset

5 Additional Features

5.1 *Cl, pH and Temperature Measurements*

5.1.1 Installation

If the WaterGuard system was ordered with these components some steps in this process will have been completed in the factory and may be skipped.

Required Components

- Amperometric, pH, Temp Module (electronics card)
- 150 mm flat cable
- Amperometric probe
- pH probe
- Temperature probe

Note: the system may be operated with only pH or only Amperometric but must always have the temperature probe as this provides additional grounding to ensure reliable measurements. Likewise, the integrated pH compensation for the Amperometric measurement will only operate if the pH probe is installed.

The following procedure describes how to install the Amperometric and pH sensors in the WaterGuard unit. The installation of all the sensors in the flow cell is similar, expect for the connecting wires.

Caution: Make sure the amperometric and pH sensors have plastic or rubber plugs covering their ends. Use another sensor if the plug of any sensor is missing or has fallen off.

Make sure to connect the appropriate wire to the appropriate sensors. Labels are located on the wires near the probe connection and on the connection on the amperometric, pH, Temp Module.

Hardware Installation

- 1) Turn off all power and water supplies to the analyzer
- 2) Install the amp, pH, Temp module (electronics card) in the control module on the top left using the 4 supplied screws.
- 3) Connect the flat cable to the amp, pH, Temp module to an open connector on the I/O module
- 4) Install the temperature probe
 - a) Thread the 3/8" compression connector into the back of the flow cell.
 - b) Place the probe into the connector until and hand tighten the connector.
 - c) Route the temperature probe wires into the electronics box and connect to the bottom of the amp, pH, Temp module following the color codes listed on the module.
- 5) Install the amperometric probe
 - a) Remove the sensor from its packing box and remove the plastic cover or plug from the end of the sensor and drain the solution from the tube. Keep the plastic cover in a safe place for winterizing or storage of probes.
 - b) Hold the sensor by its connector, with the tube pointing down.
 - c) If not already installed, install the threaded adaptor on the probe.
 - d) Insert the sensor into the largest opening on the top of the transparent flow cell and thread in securely. DO NOT OVERTIGHTEN.
 - e) Route the cable to the electronics box and connect to the middle of the amp, pH, Temp module following the color codes listed on the module.
 - f) Connect the one remaining wire to the grounding connector on the module.
- 6) Install the pH probe
 - a) Remove the sensor from its packing box and remove the plastic cover or plug from the end of the sensor and drain the solution from the tube. Keep the plastic cover in a safe place for winterizing or storage of probes.
 - b) Hold the sensor by its connector, with the glass tube pointing down.
 - c) Insert the sensor into 1/2" connector on the top of the transparent flow cell and thread in securely. DO NOT OVERTIGHTEN.
 - d) Route the pH cables to the electronics box and connect to top of the amp, pH, Temp module.
 - e) Connect the cable to the pH sensor.
- 7) If the pH sensor is not installed:
 - a) install a jumper between the inputs for pH
 - b) In the menu, set the low and high alarm limits at the minimum and maximum values respectively to prevent a false alarm for pH.
- 8) Turn the flow on to the analyzer and confirm that no connections are leaking. If the flow is not turned on immediately, at least add water to the flow cell to keep the probes wet.

5.1.2 Software Set-up

- 1) Turn the analyzer ON
- 2) Enter the operator menu and set the alarms and set-points (if using relays) levels as appropriate.
- 3) Enter the technician menu and turn on the display for Free Cl and ph (temperature is automatically displayed)
- 4) Perform a system reset and verify that Cl, pH and temperature appear on the display.
- 5) Observe the Cl and pH levels and wait several minutes until both readings stabilize.
- 6) If either one or both indicators do not display a proper reading or are not stable confirm proper installation and then see Troubleshooting.

Note: the Cl readings should fully stabilize within 1 hour and the pH within 24 hours; however the readings should not be erratic.

5.1.3 Routine Maintenance

Calibration

pH Calibration

pH is calibrated using an Phenol Red or Buffer 7 solution.

- 1) Shut off the water inlet and outlet from the flow cell
- 2) Remove the pH sensor and temperature probe from the flow cell.
- 3) Wipe sensor probe with a dry cloth and submerge it and the (PT-100) temperature probe into a cup with the Phenol Red or Buffer 7 solution and wait for the reading to stabilize.

Note: The reading will not stabilize if the temperature probe is not also in the buffer solution

- 4) Press Menu until pH Calibrated to appears in the LCD display.
- 5) Press OK.
- 6) Enter the password. Press the up arrow or down arrow until the password is reached.
- 7) Press OK.
- 8) Press OK again.
- 9) Press the up arrow or down arrow until the value is the same as the value printed on the label of the Phenol Red or Buffer 7 Solution.
- 10) Press OK to save the new calibration or Esc to abort without saving.
- 11) Press Esc to return to the main display.

Cl Calibration

- 1) Open the water sampling valve.
- 2) Fill the sampling container.
- 3) Test the water sample for chlorine using a digital photometer.
- 4) Press Menu until "Cl Calibrated to" appears in the LCD display.

The top line will display "Cl Calibrated to" and a number. The number displayed is the last value someone entered for the calibration. The bottom line will display "Cl Sensor was" and a number. This number is the sensor reading without any calibration at the time of the last calibration. If there is a large discrepancy between these two numbers, the sensor was calibrated improperly or there is a problem with the analyzer. The value displayed normally on the main screen and the value the analyzer uses to determine dosing rates is the calibrated value.

- 5) Press OK.
- 6) Enter the password. Press the up arrow or down arrow until the password is reached.
- 7) Press OK.
- 8) Press OK again.

The display will now show "Calibrate Cl to" on the top line and "Sensor Reading" on the bottom line. The "Sensor Reading" is the current reading of the sensor with no calibration. The "Calibrate Cl to" value is the new value which you want to set.

- 9) Press the up arrow or down arrow until the value is the same as the value given by the digital photometer.
- 10) Press OK to save the new calibration or Esc to abort without saving.
- 11) Press Esc to return to the main display.

Note: When the WaterGuard is initially turned on, the pH readings will continue to rise for the first 24-48 hours. If calibration is required, it is best to wait until the readings have stabilized or recalibrate when the readings have stabilized.

Temperature Calibration

Take a sample of water from the flow cell

- 1) Insert a digital thermometer into the sample
- 2) Wait for the thermometer reading to stabilize
- 3) Press Menu until Temperature Calibrated to appears in the LCD display.
- 4) Press OK.
- 5) Enter the password. Press the up arrow or down arrow until the password is reached.
- 6) Press OK.
- 7) The value that appears is the last calibrated value.
- 8) Press OK again.
- 9) Press the up arrow or down arrow until the value is the same as the independent digital thermometer.
- 10) Press OK to save the new calibration or Esc to abort without saving.
- 11) Press Esc to return to the main display.

5.1.4 Shut-down and Winterizing

- 1) Remove the probe from the flow cell
- 2) Fill the rubber caps (that were on the new probes) with tap water or preferably KCl (potassium chloride) solution and insert over the end of each probe (DO NOT use DI water).
- 3) Screw the plastic cap over the top of each probe to protect the connector.
- 4) Store in a safe location that will not drop below freezing, preferably in the original probe box for additional protection.

5.1.5 Replacing Sensors

Replacing the Amperometric sensor

- 1) Turn off the inlet and outlet water to the flow cell and the power to the analyzer.
- 2) Open the doors of both the analyzing module and the control module.
- 3) Remove old sensor from flow cell
 - a) Disconnect the wires from the amperometric, pH, temp module.
 - b) Unscrew the sensor from the flow cell
 - c) Pull the sensor up until its tube clears the hole.
- 4) Install new Sensor
 - a) Open the replacement sensor's box, and remove the sensor cable connector.
 - b) Remove the plastic cap on the end of the probe
 - c) Hold the sensor by its connector, with the tube pointing down, and insert into the flow cell.
 - d) Thread the probe into place. DO NOT OVERTIGHTEN
 - e) Attach the sensor's wire on the amp, pH, temp module following the color coding on the module.

Replacing the pH sensor

- 1) Turn off the inlet and outlet water to the flow cell and the power to the analyzer.

- 2) Open the doors of both the analyzing module and the control module.
- 3) Remove old sensor from flow cell
 - a) Unplug the sensor's wires from the sensor, by grabbing the connector at the top end of the sensor and unscrewing the connector.
 - b) Unscrew the sensor from the flow cell
 - c) Pull the sensor up until its glass tube clears the hole.
- 4) Install new Sensor
 - a) Open the replacement sensor's box, and remove the sensor by the metal connector.
 - b) Remove the plastic cap on the glass end of the probe
 - c) Hold the sensor by its metal connector, with the glass tube pointing down, and insert the glass tube into the flow cell.
 - d) Screw the probe into place. **DO NOT OVERTIGHTEN**
 - e) Attach the sensor wire onto the probe.

Replacing the Temperature Probe

- 1) Turn off the inlet and outlet water to the flow cell and the power to the analyzer.
- 2) Open the doors of both the analyzing module and the control module.
- 3) Remove the four (4) wires from the temperature probe in the control module.
- 4) Remove old sensor from reading cell:
 - a) Unscrew the compression fitting from the temperature probe
 - b) Pull the probe up until it clears the fitting.
- 5) Install new sensor:
 - a) Insert the temperature probe into the fitting
 - b) Screw the compression fitting around the probe.
 - c) Connect wires to amp, pH, Temp module following color coding

5.1.6 Troubleshooting

Problem / Symptoms	Potential Cause	Solution / Suggestion
pH or amperometric readings unstable	pH probe not installed	install probe or install jumper between probe connection
	Probe has not stabilized	allow at least 1 hour for amp probe and 24 for pH probe
	poor grounding	Check all probe connections. Confirm that temperature probe is contacting the same water supply as the pH/amp probes. Check for continuity between temperature probe black wire and outside metal of probe. Replace temperature probe. Check earth ground on I/O module. .
	Bad probe	Replace pH/amp probe. Probes may be damaged if stored in air.

5.2 Turbidity Measurements

5.2.1 Installation

If the WaterGuard system was ordered with the Turbidity pre-installed some of these steps may have been completed in the factory.

Supplied Components

- Turbidity Input Module (electronics card)
- 250 mm flat cable
- Turbidity Sensor (wiper optional)
- Turbidity Flow Cell (bubble remover optional)
- Flow Cell Mounting Bracket

Caution: Prior to opening the analyzer or installing any electrical components, turn off all power supplies to the analyzer

There are five (5) wires, contained in a single cord, from the sensor that must be connected to the analyzer. The standard wire length is 22 ft (7m), and may be cut or extended up to 650 ft (200m) as needed. The turbidity flow cell and sensor must be securely mounted using appropriate hardware for the mounting location. Unfiltered water will need to be supplied to the turbidity flow cell at a flow between 0.25 to 1 GPM and less than 30 psi (2 bar).

Hardware and Plumbing Installation

- 1) Mount the Turbidity Flow Cell, using the supplied bracket (or other mounting hardware as appropriate) such that the inlet and outlet ports are horizontal and the flow tube extends down.
- 2) Insert the sensor into the opening of the flow tube, ensuring that the notch in the top of the opening matches the rod on the sensor.
- 3) Hand-tighten the connector to secure the sensor and seal the turbidity flow cell.
- 4) Connect the water supply to the turbidity flow cell. Follow the flow indicated by the arrow on the flow cell.



A



B

Figure 5: A. Turbidity Sensor and Flow Cell without bubble remover
B. Flow Cell with bubble remover

The flow rate should be between 0.25 and 1 GPM (15-60 gal/hr or 50-225 L/hr) and the pressure should not exceed 30psi (2 bar). The inlet and outlet connections are 1/4" FNPT.

Electrical Installation

- 1) Install the Turbidity Module (electronics card) on the inside, bottom of the control panel door using the supplied screws.
- 2) Connect the turbidity module to the I/O module using the supplied ribbon cable and any open connector (the connectors on both boards operate in parallel).
- 3) Pass the sensor cable through an open glad on the bottom of the analyzer.
- 4) Connect the wires from the sensor cable to the terminal block on the lower left corner of the Turbidity Module, following the color order indicated on the module.

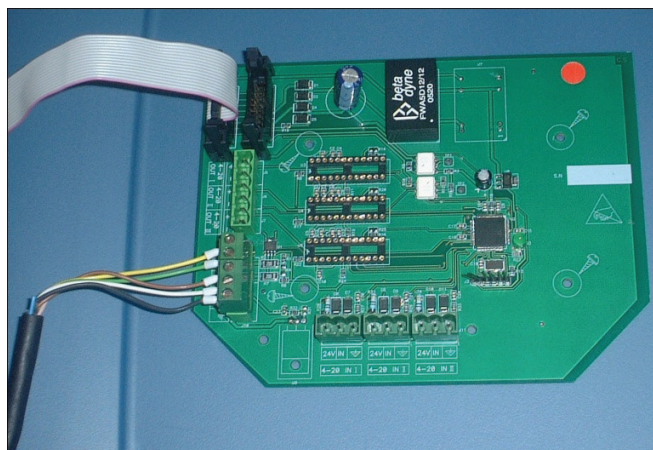


Figure 6: Connecting Turbidity Sensor to Turbidity Module

The sensor cable may be cut or extended up to a maximum distance of 650 feet (200m) as needed.

If the turbidity relay is not going to be connected to any external equipment, the installation is complete. If the relay will be used to operate equipment based on the turbidity set point, the following steps will need to be followed:

5.2.2 Relay Wiring and Use

Wiring of the Turbidity Relay (NTU relay) is identical to wiring of all other relays and should be connected to a dependent (interlocked) power supply to prevent operation of equipment when the water supply is not active. Likewise, it operates based on closed-loop control.

The line (live) wire of the pump-dependent power source connects to the connection labeled Common (C) on the NTU relay. The line wire of the controlled external turbidity equipment is connected to the normally open (NO) or normally closed (NC) connection of each relay as appropriate. Normally Open means that the relay will be open (i.e. no power from the relay) until the analyzer calls for power; Normally Closed means that the relay will be closed (i.e. power from the relay) until the analyzer calls to stop power.

- 1) Turn OFF all power sources to the analyzer.
- 2) Connect the earth ground wire of the power supply to the ground return wire from the controlled external turbidity equipment.
- 3) Connect the neutral wire of the power supply to the neutral wire from the controlled external turbidity equipment.
- 4) Connect the line (live) wire of the power supply to the connector marked 'C' (common) on the NTU terminal block.

- 5) Connect the line (live) wire of the controlled external turbidity equipment to the normally open (NO) or normally closed (NC) connection on the NTU terminal block.

Caution: Each relay connection is limited to 4 amps, to prevent overheating. The relays may show a higher rating but do not connect equipment exceeding 4 amps.

Relay and External Equipment Operation

The relay will operate in an ON/OFF mode. Whenever the measured turbidity is below the set point, the relay will remain open (no power to normally open connection). Whenever the measured turbidity is above the turbidity set point, the relay will close (power will be supplied to the normally open connection).

If the measured turbidity is above the turbidity high alarm, the alarm on the analyzer will be activated. The NTU relay will remain closed (power to the normally open connection) even during alarm.

5.2.3 First Time Set-up and General Operation

Although the turbidity unit is connected, it will not operate until it is set-up in the analyzer menu.

Operator Menu

If the NTU relay is connected to external equipment:

- 1) Press Menu until "Turbidity Set Point" appears on the display and press OK
- 2) Enter the operator or technician password and press OK
- 3) Enter the turbidity set point value and press OK

With or without the NTU relay connected to external equipment:

- 4) Press Menu until "Turbidity High Alarm" appears on the display and press OK
- 5) Enter the operator or technician password and press OK
- 6) Enter the turbidity high alarm value and press OK

Technical Menu

- 1) Press Menu to enter the Operator Menu and then Press up and down together to enter the technical menu
- 2) Press Menu until "Turbidity ON/OFF" appears in the display and press OK
- 3) Enter the technician password and press OK
- 4) Press up to turn the turbidity sensor ON and press OK
- 5) Press Menu until "Turbidity Wiper Interval" appears in the display and press OK
- 6) Enter the technician password and press OK
- 7) Enter the wiper interval (2 minutes is recommended) and press OK

The turbidity unit should now be active. Confirm that the turbidity value appears on the LCD display. If it is not active, perform a system reset.

5.2.4 Routine Maintenance

Turbidity Calibration

- 1) Take a sample of water from the flow cell
- 2) Test the sample using an accurate digital turbidity meter
- 3) Press Menu until NTUI Calibrated to or NTUh Calibrated to appears in the LCD display.

If calibrating below 1.0 NTU use NTUI (low) if calibrating above 1.0 NTU use NTUh (high).

- 4) Press OK.
- 5) Enter the password. Press the up arrow or down arrow until the password is reached.
- 6) Press OK.
- 7) The value that appears is the last calibrated value.
- 8) Press OK again.
- 9) Press the up arrow or down arrow until the value is the same as the independent digital turbidity meter.
- 10) Press OK to save the new calibration or Esc to abort without saving.
- 11) Press Esc to return to the main display.

Note: Only 1 Turbidity calibration will be active. If the measured Turbidity is less than 1.0, only the NTUI calibration will be active; if the turbidity is greater than 1.0, only the NTUh calibration will be active.

5.2.5 Cleaning the Turbidity Sensor

The turbidity meter will need to be periodically cleaned to ensure proper operation and reliability. The cleaning frequency will depend on the water source being tested. The meter should be cleaned whenever the measurement accuracy is questionable and before calibration.

- 1) Turn off power to the analyzer.
- 2) Shut off the flow to the turbidity flow cell and remove the turbidity meter.
- 3) Rinse out the flow assembly with clean water to remove any sediment that may have been trapped in the flow cell.
- 4) Wash the turbidity meter under clean water and a cloth to remove any debris and oil. Be careful not to scratch the sensor covers.
- 5) If installed, inspect the wiper for signs of wear and replace if necessary.
- 6) Reinstall the meter and turn the flow back to the meter.
- 7) Confirm that the meter is operating properly and that the flow cell is sealed.

5.2.6 Shut-down and Winterizing

- 1) Disable the Turbidity measurement in the technician menu
- 2) Shut off the flow of water to the turbidity flow cell
- 3) Open the drain at the bottom of the flow cell to drain all water
- 4) If temperatures will drop below freezing, remove the turbidity sensor and store in a safe location where temperatures will not drop below freezing.

5.2.7 Replacing Components

Replacing the Turbidity Meter

- 1) Turn off the inlet and outlet water to the flow cell and the power to the analyzer.
- 2) Open the door of the control module.
- 3) Remove the 5 wires from the bottom of the Turbidity input module
- 4) Remove the meter from the flow cell by unscrewing the cap and pulling gently
- 5) Install the new meter in the flow cell
- 6) Route the wires back to the turbidity module and reconnect the 5 wires following the color coding on the module.
- 7) Restart the flow and turn the power on
- 8) Confirm that proper operation has been restored

Replacing Turbidity Input Module

Disconnect the power supply to the unit before opening the control unit.

- 1) Disconnect the flat cable plug from the card.
- 2) Disconnect all terminal blocks
- 3) Unscrew the four (4) mounting screws.
- 4) Put in the new card and tighten the 4 mounting screws.
- 5) Connect the flat cable plug to the card
- 6) Reconnect the terminal blocks

5.3 Conductivity Measurements

5.3.1 Installation

If the WaterGuard system was ordered with the Conductivity pre-installed some of these steps will have been completed in the factory.

Supplied Components

- Conductivity 4-20 input Module (electronics card)
- 150mm Flat Cable (ribbon cable)
- Conductivity meter
- Conductivity flow cell

Caution: Prior to opening the analyzer or installing any electrical components, turn off all power supplies to the analyzer

- 1) Attach the module to the inside of the control panel door below the control panel module using the 4 supplied screws.
- 2) Attach the ribbon cable from the conductivity module to any open connector on the I/O module.
- 3) Mount the conductivity flow cell and meter on a solid wall or surface using appropriate hardware (not supplied). Make sure that the distance is less than 15m (45 feet) from the WaterGuard analyzer.
- 4) Connect a water supply of no greater than 2 bar (30 psi) to the inlet fitting using 6mm tubing. It may be a new separate water supply or a line tapped from the main analyzer water supply before the pre-filter. Larger tubing may be used if the fitting is replaced to accept the new tubing.
- 5) Connect a 6mm water outline line to the outlet fitting and connect to:
 - a. The main water system at least 5 psi (0.3 bar) lower than the inlet water supply or
 - b. The pre-filter of the WaterGuard analyzer.

- 6) Route the conductivity meter wire through an open gland on the bottom of the analyzer
- 7) Connect the wires to an open 4-20mA input on the bottom of the 4-20 module
- 8) Connect 24V from the meter to 24V on the module
- 9) Connect mS from the meter to IN on the module
- 10) Connect GND from the meter to ground (symbol) on the module

5.3.2 First Time Set-up and General Operation

For Output of the conductivity measurement, see internal or external 4-20mA module sections to configure the output in your specific WaterGuard analyzer.

5.3.3 Routine Maintenance

Conductivity Calibration

Must be conducted when process is stable, specifically temperature should be within normal operating range.

- 1) Test a sample of water with an accurate external conductivity meter
- 2) Use the calibration adjustment screw to increase or decrease the conductivity, making very small changes
- 3) Wait for the adjustment to take effect before making additional changes

5.3.4 Cleaning the Conductivity Meter

Routine cleaning of the conductivity meter will ensure long-term reliability. The frequency of cleaning will depend on the water source being tested and should be conducted whenever there is significant visible dirt, the measurement accuracy is affected, or before the meter is calibrated.

- 1) Shut off the flow of water to the conductivity flow cell and remove the meter.
- 2) Wash the meter under a jet of water to remove the debris.
- 3) Use a soft cloth to remove any additional debris and oil.
- 4) Replace the meter and restore flow to the flow cell.

5.3.5 Shut-down and Winterizing

- 1) Shut off the flow of water to the conductivity flow cell
- 2) Drain the water from the flow cell
- 3) If temperatures will drop below freezing, remove the conductivity sensor and store in a safe location where temperatures will not drop below freezing.

5.3.6 Replacing Components

5.3.7 Replacing the Conductivity Meter

- 1) Turn off the inlet and outlet water to the flow cell and the power to the analyzer.
- 2) Open the door of the control module.
- 3) Remove the wires from the bottom of the Conductivity input module
- 4) Remove the meter from the flow cell by unscrewing the cap and pulling gently
- 5) Install the new meter in the flow cell
- 6) Route the wires back to the conductivity module and reconnect the wires to the 4-20 input module.
- 7) Restart the flow and turn the power on
- 8) Confirm that proper operation has been restored

Replacing Conductivity Input Module

Disconnect the power supply to the unit before opening the control unit.

- 1) Disconnect the flat cable plug from the card.
- 2) Disconnect all terminal blocks
- 3) Unscrew the four (4) mounting screws.
- 4) Put in the new card and tighten the 4 mounting screws.
- 5) Connect the flat cable plug to the card.
- 6) Reconnect the terminal blocks

5.4 Flow Meter

Chemical Injection Technologies, Inc., can supply flow meters; but WaterGuard WG-602, itself, provides only input connections and display.

5.4.1 Installation

Required Components

- Flow meter – frequency or 4-20
- 4-20 input module if using 4-20 flow meter
- 150 mm flat cable if using 4-20 input module

Prior to opening the analyzer or installing any electrical components, turn off all power supplies to the analyzer

Frequency Output Flow Meter

A flow meter with either two (2) or three (3) wires for a frequency output can be connected to the input switch section on the I/O module.

Installation

- 1) Install the flow meter following the manufacturer directions. Be sure to install close enough to WaterGuard that the wires will reach.
- 2) Pass the flow sensor cable through an open glad on the bottom of the analyzer.
- 3) Connect the two or three wires from the sensor cable to the input switch terminal block on the lower right corner of the I/O Module.

Although the flow meter is connected, it will not operate until it is set-up in the analyzer menu.

- 4) Press Menu until "Flow Low Limit" appears and enter the low flow value (the flow value which will cause an alarm and will disable any direct chemical dosing).
- 5) Press Menu again and "K-factor" appears. Enter the k-factor for the flow meter being used (should be on paperwork with flow meter).
- 6) Press Up + Down arrows together and then press Menu until "Flow Rate m3/hr" appears and select the flow units of m3/hr or GPM.

4-20 Output Flow Meter

Any flow meter with a 4-20mA output can be connected to the analyzer's internal 4-20 input module

- 1) Install the flow meter as per the manufacturer directions.
- 2) Pass the flow sensor cable through an open gland on the bottom of the analyzer.
- 3) Connect the 4-20mA output wires from the flow meter to the middle 4-20mA Input connection on the input module.

Although the flow meter is connected, it will not operate until it is set-up in the analyzer menu.

- 4) Press Menu until "Flow Low Limit" appears and enter the low flow value (the flow value which will cause an alarm and will disable any direct chemical dosing).
- 5) Press Up + Down arrows together and then press Menu until "Flow Rate m3/hr" appears and select the flow units of m3/hr or GPM.
- 6) Press Menu until "Max flow Range" appears and enter the maximum flow rate (flow rate at 20mA output). The minimum flow rate (flow rate at 4mA output) is assumed to be zero.

The flow meter should now be active. Confirm that the flow rate appears on the LCD display. If it is not active, perform a system reset.

5.4.2 Routine Maintenance and Troubleshooting

Follow manufacture's recommendations for maintenance procedures and any troubleshooting issues.

5.5 Communication Options

5.5.1 External 4 to 20mA Outputs

Overview

The 4 to 20 mA output provides a connection of the WaterGuard water quality analyzer to any external monitoring or control system. For each parameter, an output signal is transmitted and the strength of the signal (in mA) can be simply correlated to the actual parameter value. Likewise, specific alarm information may also be transmitted to alert personnel of a problem not related to the output parameters.

Installation

Required Parts

The 4 to 20mA module upgrade includes two (2) main components that are supplied with the upgrade:

- External 4 to 20 module case
- 4 to 20 module (electronics card)

To complete the installation a few additional components, not supplied with the upgrade will be needed:

- Hardware to attach the external module case to a wall or other secure structure.
- 110-115 or 220-230V AC power supply with 3 wires
- A 2-wire cable for connection between the module and analyzer
- A 2-wire cable for each output channel/parameter

Hardware Installation

- 1) The external case has 4 mounting brackets on the back. All 4 should be used to securely attach to the wall.
- 2) Mark the location of each screw hole and drill a hole for a screw anchor.
- 3) Thread the screws almost completely into the anchor leaving about 1/4" (6 mm) of thread exposed.
- 4) Attach the external case to the screws
- 5) Adjust the screw depth to securely fasten to the wall

Electrical Installation

The 4 to 20 mA module requires a separate power supply in order to operate. The 2-wire connection to the analyzer is for communication only and does not supply any power.

The Module Power Supply may be connected to either 110-120 or 220-240VAC 50/60Hz. Switching between voltages is accomplished by changing two (2) jumpers located above the main power connection, to the left of the transformer. For 110-120VAC, a 1amp fuse should be used; for 220-240VAC, a 0.5amp fuse should be used. These changes must be completed prior to wiring.

Caution: Before making a connection to a power source, confirm that both jumpers are located on the correct voltage and that the appropriate fuse is in place.

Connecting Main Power and Analyzer Communication

- 1) Verify that the power switch or circuit breaker to the non-dependent power source is off.
- 2) Locate the power supply connection.
- 3) Connect the line (live) wire to the electronic board connector marked Line.
- 4) Connect the neutral wire to the electronic board connector marked Neutral.
- 5) Connect the earth wire to the electronic board connector marked Ground.
- 6) Locate the RS485 connections on the analyzer control panel (electronics card on the analyzer door) and the 4 to 20 mA module.
- 7) Connect the 2-wire cable from the RS485 connection on the analyzer to the RS485 connection on the 4 to 20 mA module.
 - a) Connect the '+' wire from the analyzer to the 'A' connection on the module
 - b) Connect the '-' wire from the analyzer to the 'B' connection on the module
- 8) Turn on electrical power only after all electrical connections have been completed.

Confirming Operation and Communication

Prior to connecting to the external monitoring or control system, it is best to confirm that all desired outputs are working properly using a digital multi-meter. This must be done without output wires connected to an external system.

- 1) Set the multi-meter to measure current and connect the multi-meter to an active output (an output is inactive if it does not have a chipset installed next to the terminal block).
- 2) Record the current in mA.
- 3) Confirm that the value is accurate using, Equation 1.
- 4) Repeat for each active output.

$$MeasuredValue = \frac{(mA) * (Fullscale)}{16} + MinimumValue$$

or

$$mA = \frac{(16) * (MeasuredValue)}{FullScale} + 4$$

mA = milliamp output value

Full Scale = Max Value - Min Value (in case of Min is zero, it's the max value)

Equation 1: Determining Parameter Value from mA output

Connecting to External Monitoring System

- 1) Connect two wires from the active output to the appropriate connection on the external system
- 2) Repeat for each active output
- 3) If an active output (output with a chipset installed) is not to be used, place a jumper wire between the contacts.
- 4) For alarm notification
 - a) Connect two wires to the appropriate dry contact
 - i) Connection between C and Nc will have contact unless alarm
 - ii) Connection between C and No will only have contact during alarm
 - b) Repeat for each alarm

Connections on an optional, external 4 to 20mA Module

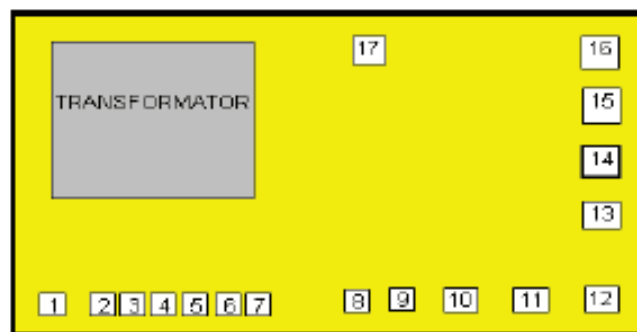


Figure 7: Optional External 4 to 20 mA Output Module Electrical connections

1. Power Input 110-115 or 220-230VAC 50/60 Hz

Alarm (Dry Contacts)

2. No Flow
3. Unclean Cell

Alarm (Dry Contacts), continued

4. No Communication with the Colorimeter
5. Reagents Close to completion
6. No Reagents
7. External Disconnected

Communication Connection

8. RS485 Communication Terminal Block
17. RS 232 Communication Terminal Block

Communication Connection

9. Free Cl	4mA = 0	20mA = 9.99
10. pH	4mA = 0	20mA = 9.99
11. ORP	4mA = 0	20mA = 999
12. Temp	4mA = 0	20mA = 50 °C or 212 °F
13. NTU	4mA = 0	20mA = 9.99
14. Flow Rate	4mA = 0	20mA = 200 m ³ /hr
15. Total Cl	4mA = 0	20mA = 9.99
16. Conductivity	4mA = 0	20mA = 2000 uS

Troubleshooting

There are a few indicator lights on the 4 to 20 mA module to aid in troubleshooting. The following conditions are possible:

Green Light

ON – 4 to 20 mA module is powered

OFF – 4 to 20 mA module is not powered

Red Light

ON – One or more of the outputs is not connected (use jumper wire on unused outputs)

Flashing – No communication between 4 to 20 mA module and analyzer

OFF – Communication and Outputs are working properly

5.5.2 Internal 4 to 20mA Output

Installation

Required Parts

- Internal 4-20mA Module (electronics card)
- 250mm Flat Cable (ribbon cable)

To complete the installation a 2-wire cable for each output channel/parameter will also be required.

Hardware Installation

- 1) Attach the 4 to 20 module to the inside of the control panel door below the control panel module using the 4 supplied screws.
- 2) Attach the ribbon cable from the 4 to 20 module to any open connector on the I/O module.

Electrical Installation

The 4 to 20 mA module is powered through the ribbon cable and does not require a separate electrical supply as the external module.

Software Set-up

- 1) Go to "4-20mA Output Settings" menu and press OK
- 2) Enter the technician password and press OK
- 3) Select the channel (1 to 4) and press
- 4) Press OK and Select the parameter for that channel (Free Cl, Total Cl, pH, etc.)
- 5) Press Menu and then OK to set the minimum range (4mA value)
- 6) Press Menu and then OK to set the maximum range (20mA value)
- 7) Optional: Press Menu and then OK to set the test value (to be used for troubleshooting purposes or initial tests)
- 8) Press Escape to return to the set-up menu and repeat above for remaining channels
- 9) Press Menu to go to "On Alarm go to" menu and then OK to set the error value (output value in case of measurement or communication error) from the following options:
 - 2 mA
 - 4 mA
 - 20 mA
 - Hold Last Value

This is the 4-20mA output value that will indicated whenever an alarm condition exists or communication between the analyzer and 4-20 module is interrupted.

Confirming Operation and Communication

Prior to connecting to the external monitoring or control system, it is best to confirm that all desired outputs are working properly using a digital multi-meter. This must be done without output wires connected to an external system.

- 1) Set the multi-meter to measure current and connect the multi-meter to an active output (an output is inactive if it does not have a chipset installed next to the terminal block).
- 2) Record the current in mA.
- 3) Confirm that the value is accurate using, Equation 1.
- 4) Repeat for each active output.

$$MeasuredValue = \frac{(mA) * (Fullscale)}{16} + MinimumValue$$

or

$$mA = \frac{(16) * (MeasuredValue)}{FullScale} + 4$$

mA = milliamp output value

Full Scale = Max Value - Min Value (in case of Min is zero, it's the max value)

Equation 1: Determining Parameter Value from mA output

Connecting to External Monitoring System

- 1) Connect two wires from the active output to the appropriate connection on the external system
- 2) Repeat for each active output
- 3) If an active output (output with a chipset installed) is not to be used, place a jumper wire between the contacts.

6 Appendix A: Relays and Closed-Loop Control

There are 6 dry-contact relays on the I/O module. Five of the relays may be used for direct control of closed loop systems. All of the relays may be used as dry-contacts, and will operate based on the settings, specifically the set-points, selected in the operator menu.

6.1 Connecting external equipment to the Relays

This is only required if the relays are being used to power and control external dosing equipment. The relays will act as dry contacts if no power is supplied. A dependent power supply should be used such that no equipment will be activated unless the process line has flow.

6.1.1 Wiring to Dosing Systems

WaterGuard controls chemical dosing systems using a series of electronic relays that start and stop the dosing pumps. Each relay opens and closes a switch that activates a separate pump or piece of equipment.

The line (live) wire of the dependent power source connects to the connection labeled Common on each relay. The line wire of each controlled system is connected to the normally open (NO) or normally closed (NC) connection of each relay as appropriate. Normally Open means that the relay will be open (i.e. no power from the relay) until the controller calls for power; Normally Closed means that the relay will be closed (i.e. power from the relay) until the controller calls to stop power.

- 1) Verify that the power switch or circuit breaker to the dependent power source is off.
- 2) Connect the earth wire to the ground return wire from each of the external dosing systems.
- 3) Connect the neutral wire to the return wire from each of the external dosing systems.
- 4) Connect the line (live) wire to the connector marked Common of each active relay.

Caution: Each relay connection is limited to 4 amps, to prevent overheating. The relays may show a higher rating but do not connect equipment exceeding 4 amps.

The following table lists the relays and the dosing systems they control:

Relay	Control
Cl 1	Main chlorine system. On/Off or proportional. Proportional controls pulse length or pulse frequency (PL/PF).
Cl 2	Secondary chlorine system (On/Off only – no proportional control)
pH	Acid or base dosing. On/Off or proportional. Proportional controls pulse length or pulse frequency (PL/PF).
NTU	Nephelometric Turbidity Units – Controls the injection of flocculants or coagulants. Used only with the optional turbidity module.
Alarm	Activates an external alarm when certain alarm types are registered and after the alarm delay time has expired.
Temperature	Controls water temperature by activating the water heating system.

6.1.2 Proportional Control Overview

WaterGuard controls dosing proportionally. This method sets dosing rates in relation to how far current chemical levels are from the set point. The dosing rates gradually decrease as chemical levels get closer to the set point.

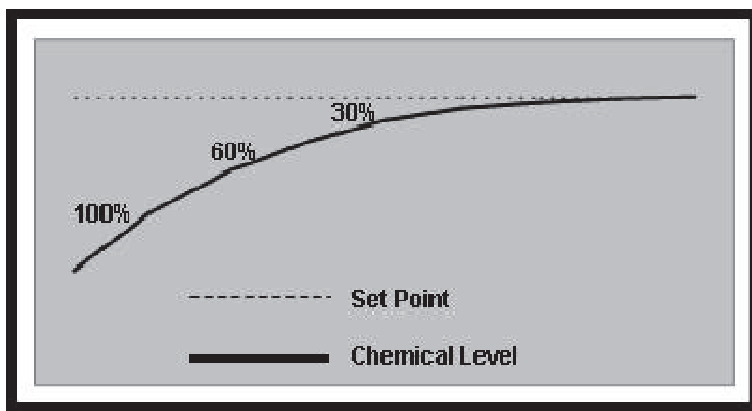


Figure 8: Proportional Control of Chemical Dosing

If water chemical levels are far below the set point, WaterGuard will operate the dosing systems to operate at full speed (100%). As the controller senses chemical levels rising and getting closer to the set point, it will control the dosing systems to slow down to a lower speed (i.e. 60%). As chemical levels get even closer to the set point, the dosing system will slow down even more (i.e. 30%), and so on, until the chemical level gets to the set point.

The % of the time on is explained by the following equation with chlorine as an example:

$$\%time_{on} = \left[\frac{(\text{setpoint} - \text{measured})}{\text{setpoint}} \right] \bullet P_{factor}$$

In this example, the Cl set-point and measured values are:

Cl Set Point	Cl Measured
2.0	1.8

If the P-factor is changed, the percentage of the pump cycle that will be on (% time on) changes as follows:

P factor	% Time ON
0.1	1%
0.5	5%
1	10%
5	50%
10	100%

The range for P-factor for Cl and pH are presented in the table below.

Cl p Factor	50	On/Off control
	0.1	Very proportional and slow dosing
pH p Factor	100	On/Off control
	0.1	Very proportional and slow dosing

6.1.3 Setting Proportional Factor

Proportional control of chemical dosing requires configuration according to various factors. The primary factors are the ratio between the system size and the rate the chemical dosing systems can feed chemicals, and the delay time between when the chemical level changes and when it is sensed by the controller.

In large systems, changes in chemical levels occur slowly. The dosing systems must feed large amounts of chemicals for a long period of time in order for a change to be noticed. The chemicals also disperse slowly in larger systems. Smaller systems, on the other hand, react much more quickly.

The length of time between the change and when the controller identifies the change also affects proportional control. The controller can only identify water chemical levels after they have been distributed throughout the system and have returned to the analyzer. This may be a long time after the chemicals were released into the water. The controller, therefore, recognizes the chemical levels from dosing settings in the past. The dosing systems continue feeding chemicals during this delay, causing chemical levels to pass the set point, resulting in fluctuations.

To prevent these fluctuations, the controller must reduce chemical dosing rates as it senses that chemical levels are approaching the set point, taking the delay into account. The controller should also not overcompensate for the delay, which would cause chemical levels.

In short, the larger the water system, the higher the p-factor.

6.1.4 Setting Pump Period

Pump period is a single cycle during which the dosing pump operates and then rests. Proportional control divides the pump period into two distinct phases: active and at rest.

In general it is recommended to operate in a short cycle, i.e., 00:30 Sec. For large systems, or if you activate solenoid valves, you may consider longer pump periods.

6.1.5 Step By Step Proportional Settings

- 1) Finish the installation of all controllers (electrical, water, feeding systems, and electrodes).
- 2) Calibrate the controller to the water chemical values at the sample point.
- 3) Set the proportional factor and the pump period of the chlorine and the pH at an initial setting.
- 4) Let the controller operate the chlorinator and the pH correction devices and make sure that chemicals are injected into the water.
- 5) Watch the chlorine and pH as they change. We recommend that you record the values frequently so that the process is closely monitored.
 - a) If the values greatly exceed the set point, you need to decrease the proportional factor.
 - b) If it takes too long to get to the set point, you need to increase the proportional factor.

Note: In large systems the delay time between injection of the chemicals and receiving the change in the controller can be very long (30 minutes or more).

7 Appendix B: Technical Specifications

pH measurement	Display range	4 to 10
	Sensor	Ceramic diaphragm and gel filling
	Input impedance	$0.5 \times 10^{12} \Omega$
Chlorine measurement	Sensor	Amperometric
	Display range	0-20ppm
Temperature measurement	Sensor	PT-100
	Measuring range	32 to 158 °F (0 to 50 °C)
pH value control	Closed Loop Control function	On/Off P or PI
	Proportional band	yes
	Characteristics	Normal / Inverted
	Set value function	Pulse Length proportional controller Pulse Frequency proportional controller
Chlorine control #1	Closed Loop Control function	On/Off or PI
	Proportional band	yes
	Set value function	Pulse Length proportional controller
		Pulse Frequency proportional controller
Chlorine control #2	Closed Loop Control function	On/Off
	Proportional band	no
	Integral action time	no
Data logger	Memory	256K
	Lines	1000
	Recording interval	1-360 min
	Event logger	yes
	Total relay on time	yes
Security	Operation Password	Yes
	Technician Password	Yes
		regulator adjusted to 0.5 bar
	Outlet Pressure	5 to 10 psi (0.3 to 0.7 bar)
	Minimum Flow Rate	0.25 GPM (60 L/hr)

APPENDIX 1

Background:

Based on feedback from the field, several changes have been made to the software for the WG 602/702. This document explains only these new features.

Changes:

Two standard on-board 4-20mA outputs:

The control panel (electronics card with the LCD display) will now come standard with two 4-20mA outputs. Up to 4 additional internal outputs may be added using the 4-20mA outputs card.

Software-based conductivity calibration:

A conductivity calibration menu has been added, allowing for calibration of conductivity from the software instead of requiring adjustment of the calibration screw on the conductivity sensor.

Optional two-point pH calibration:

pH may be calibrated using the standard single-point calibration or a two-point calibration.

Description:

On-board 4-20mA outputs:

There are two 4-20mA output channels on the control panel electronics card. These are connected the same as all of the other 4-20mA outputs using a (+) and (-) connection.

Configuring the outputs is done through the “4-20mA Settings” menu in the technical menu section. The output channels now include:

- Built-In Ch. #1
- Built-In Ch. #2
- 4-20/NTU Ch. #1
- 4-20/NTU Ch. #2
- 4-20/NTU Ch. #2
- 4-20/NTU Ch. #2

Please make sure that you are configuring the correct output.

Conductivity Calibration:

A conductivity calibration menu is now part of the software and is located in the operator menu. Conductivity may be calibrated like all other parameters and there is no need to use the adjustment screw on the conductivity meter.

pH Calibration:

There are two pH calibration menus:

- pH 7 Calibrated to #.#
 Sensor Value was #.#
- pH 4,10 calibrated to #.#
 Sensor Value was #.#

Single-Point Calibration (same as previous versions).

1. Use only the first pH calibration menu (pH 7 calibrated to), to calibrate the pH at any level using a buffer or external testing device.

Two-Point Calibration:

1. Use the pH 7 calibration menu and a pH 7 buffer to calibrate pH = 7.
2. Use the pH 4,10 calibration menu and a pH 4 or pH 10 buffer to calibrate pH = 4 or 10.

Note: for 2-point calibration, pH 7 must be calibrated first and buffers must be used to ensure accuracy.

APPENDIX 2

Maintenance

Check the measurement at regular intervals; depending on the respective conditions at least once a month.

Perform the following tasks:

- If the membrane is visibly soiled, clean the sensor (see section "Cleaning the sensor").
- Refill the sensor with electrolyte once per season or every 12 months. Depending on the chlorine content on site, this period can be reduced or extended (see section "Refilling the electrolyte").
- Calibrate the sensor when necessary (see "Calibration").

Cleaning the sensor

Caution!

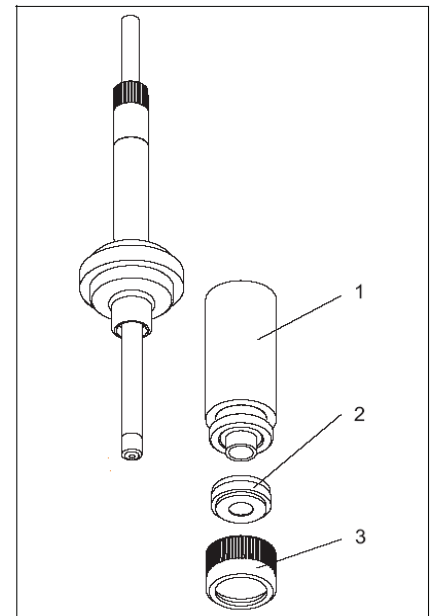
- Do not use chemicals reducing the surface tension.
- When using hydrochloric acid, observe the safety regulations.

If the membrane is visibly soiled, proceed as follows:

1. Remove the sensor from the flow assembly.
2. Clean the membrane mechanically with a gentle water jet or put it for some minutes in 1 to 5 % hydrochloric acid without chemical additives.

Replacing the membrane

1. Unscrew the measuring chamber (pos. 1) from the shaft.
2. Unscrew the front screw cap (pos. 3).
3. Remove the membrane cap (pos. 2) and replace it by a replacement cartridge.
4. Refill the measuring chamber with electrolyte (see section "Refilling the electrolyte").



Membrane replacement

- 1 Measuring chamber
- 2 Membrane cap
- 3 Screw cap

Refilling the electrolyte

Warning !

Do not swallow the electrolyte! Avoid contact of the electrolyte with skin or eyes. Otherwise wash with a lot of cold water! In case of eye inflammation, contact a doctor!

Wear gloves when refilling the electrolyte.

Caution !

- Do not touch or damage the electrodes!
- The electrolyte is sensitive to oxidation: Always keep the electrolyte bottle closed after use.

Do not transfer the electrolyte into other containers!

- The electrolyte should not be stored for more than 1 year and not yellow (use by date, see label).
- Avoid forming air bubbles when pouring the electrolyte into the measuring chamber!

Proceed as follows to fill in the electrolyte:

1. Unscrew the measuring chamber from the sensor shaft.
2. Hold the measuring chamber at an angle and fill in about 7 to 8 ml (0.24 to 0.27 fl.oz) electrolyte, up to the internal thread of the measuring chamber.
3. Tap the filled measuring chamber several times on a flat surface so that adherent air bubbles can detach and rise.
4. Insert the sensor shaft vertically from above into the measuring chamber.
5. Slowly tighten the measuring chamber to the stop. Excess electrolyte is pressed out at the sensor bottom during the tightening.

Reconditioning the sensor

Long-term operation (> 1 week) in chlorine-free media, i.e. with very low sensor currents, leads to a deactivation of the sensor.

This deactivation is a continuous process that results in a lower slope and longer response times.

After long-term operation in a chlorine-free medium, the sensor must be reconditioned.

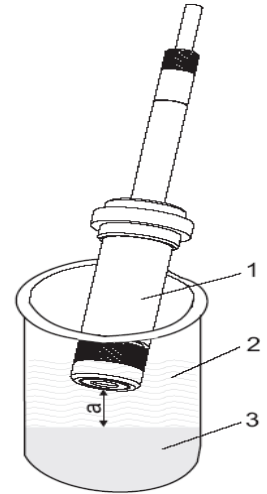
You need the following materials for reconditioning:

- Demineralized water (or electrolyte)
- Polishing sheet (see "Accessories")
- Beaker
- Approx. 100 ml (3.381 fl.oz) of chlorine bleach liquor NaOCl approx. 13 %, pharmaceutical quality (available at chemical stores or pharmacies)

Proceed as follows:

1. Close the medium inlet and outlet and make sure that no medium can squirt out of the assembly.
2. Remove the sensor from the assembly.
3. Unscrew the measuring chamber and put it aside.
4. Polish the gold cathode of the sensor using the polishing sheet:
 - Place a wetted strip of the sheet in your hand.
 - Polish the gold cathode by moving it circularly on the strip.

- Rinse the sensor with demineralized water (or electrolyte).
- 5. Top up the electrolyte if required (see chapter "Refilling the electrolyte") and screw the measuring chamber back into place.
- 6. Fill the beaker with chlorine bleach liquor to about 10 mm (0.39") and position it safely.
- 7. " Caution!
The sensor must not touch the liquid.
Place the sensor in the gaseous phase about 5 to 10 mm (0.2" to 0.39") above the chlorine bleach liquor.
- 8. The sensor current will now increase. The absolute value and the speed of increase depend on the temperature of the chlorine bleach liquor.
 - When the sensor has reached a high value CL reading, leave the sensor under these conditions over a period of 20 min.
 - If the chlorine value is not increasing, cover the beaker to avoid quick air change.
- 9. After the 20 min. have elapsed, re-install the sensor in the assembly.
- 10. Re-establish the medium flow. The sensor current will normalize.
- 11. After sufficient settling time (no noticeable drift), calibrate the measuring chain.





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