# OPERATING INSTRUCTION MANUAL

# MODEL 2200BG
# BOILER ANALYZER

**REV. 7.0**

AquaMetrix Inc.
4-30 Royal Crest Court
Markham, ON
Canada, L3R 9W8

Tel: (800) 742-1413
(905) 946-1064
Fax: (905) 946-8064
www.aquametrix.com

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# MODEL 2200BG BOILER GARD
# INSTRUCTION MANUAL

## 1.0 GENERAL INFORMATION

The AquaMetrix Model 2200BG Boiler Gard is a versatile industrial microprocessor based instrument, designed to automate the blow down of a boiler system. The unit has 2 operating modes: Continuous Sampling and Timed Sampling. The 2 operating modes enable the 2200BG to be used to control both large and small volume boilers. Setpoints and outputs are programmed through the operations menu with push buttons on the front of the unit. Calibration is accomplished through the operations menu. The 2200BG may be used in conjunction with any AquaMetrix MSBG series sensor.

To safeguard against operator error, the 2200BG will automatically return on-line if it is left in the menu mode for longer than 10 minutes, or the blow-down relay has been left in the manual override mode for longer than 5 minutes. These features can be field disabled.

The 2200BG has a non-isolated 0-5 Vdc and 0-1 mA output, and an isolated 4-20 mA output. The analog outputs may be scaled to represent any segment of the measuring range. One control relay, for operating a solenoid, or motorized valve, and one alarm relay with high and low setpoints are provided.

The integrity of the system is ensured with a watch-dog timer and system alarm. A password feature protects the stored values.

The 2200BG is housed in a NEMA 4X enclosure. The standard unit is provided with mounting hardware for surface mount applications. Both panel and pipe mount kits can be ordered separately.

## 2.0 SPECIFICATIONS

**DISPLAY:**
4 digit, 7 segment LED, 1/2" high digits

**MEASURING RANGES:**
Conductivity: 0-5000uS
Temperature: 100°C to 200°C (212°F to 292°F)

**POWER REQUIREMENTS**:
Standard: 98-132 Vac, 50/60 Hz (less than 5 VA)
Optional: 196-264 Vac, 50/60 Hz (less than 5 VA)
23-26Vdc (nominal current 150mA)

**AMBIENT CONDITIONS:**
-30 to 50°C (-22 to 122°F)
0 to 90% R.H. non-condensing

**BLOW DOWN RELAY:**
5A 115/230 Vac, 5A 30 Vdc SPDT
Fully adjustable Relay On and Relay Off Setpoints
Manual Override: Auto / Off / On. Relay automatically returns to Auto mode if left in On / Off Mode and no key is pressed for 5 minutes.
Normal or Fail Safe operation

**ALARM RELAY:**
5A 115/230 Vac, 5A 30 Vdc SPDT
Programmable to activate at high and low alarm setpoints
Deadband fixed at 2% of Full Scale
Normal or Fail Safe Operation

**RELAY INDICATORS:**
Two individual LED's indicate status of the blow-down and alarm relays.

**OPERATING MODES:**
**Continuous Sampling**: Relay will energize based on Relay On and Relay Off Setpoints. Optional cycle feature causes relay to cycle, when conductivity is between Relay On and Off Setpoints.

**Timed Sampling**: Relay will continually cycle based on Cycle On / Off time. At the end of the On time the if the conductivity is above the Relay On setpoint the relay will remain energized until the conductivity falls below the relay off setpoint. During the off cycle the display will show the time remaining until the next blow down.

**TimeOut Alarm:** User enabled feature that protects the system if continuous blow occurs for longer than Alarm time set in the Utility Menu.

**ANALOG OUTPUTS:**
Non Isolated 0-1mA, 100 ohms maximum load
Non Isolated 0-5Vdc, 1000 ohms minimum load
Isolated 4-20mA, 800 ohms maximum load
*Range Expand:* The analog outputs can be scaled to represent any segment of the measuring scale. Minimum segment is 10% of full scale.
*Output Hold*: The analog outputs are automatically placed on hold when the unit is in the Operations or Utility menus.
*Temperature Output*: The 0-5 Vdc and 0-1mA outputs can be programmed to follow the process temperature or conductivity. The temperature output can be scaled from 100°C-200°C.

**TEMPERATURE COMPENSATION:**
Automatic 100°C to 200°C (212°F to 392°F)

**SYSTEM ERROR:**
A LED indicates a system error. The alarm relay can be programmed to activate upon system memory loss.

**DIAGNOSTICS:**
Invalid entries are identified by respective flashing LEDs. When a system error is indicated, use the MENU key to display STATUS, to determine the status code.

**TEST:**
Display value and analog outputs can be set manually to any value for testing and diagnostic purposes. This feature allows the operation of the control relay, alarm relay, and analog outputs to be tested independently of the process.

**SAFETY AND SECURITY:**
Non-volatile memory (EPROM)
Password protected if enabled
Watch-dog timer monitors microprocessor
2200BG automatically returns to on line operation if accidentally left in menu mode. (This feature may be field disabled if desired.)

**SENSITIVITY:** 0.1% of span

**STABILITY:** 0.1% of span per 24 hrs. non-cumulative.

**NON-LINEARITY:** 0.1% of span

**REPEATABILITY:** 0.1% of span or better

**TEMPERATURE DRIFT:**
Zero: 0.01% of span per °C
Span: 0.01% of span per °C

**ENCLOSURE:**
NEMA 4X molded fiberglass reinforced polyester enclosure with four 1/2" conduit holes and mounting feet for surface mount. A NEMA 4 plug is provided for one hole.

**MOUNTING CONFIGURATIONS:**
Standard is surface mount
Optional panel mount hardware Part No. C35-68
Optional pipe mount hardware Part No. C35-69

**NET WEIGHT:** 3 1/2 lb. (1.6 kg)

**APPROVALS:** CSA

## 3.0 INSTALLIATION

### 3.1 Location

3.1.1 Locate the 2200BG within 3000 feet of where the AquaMetrix MSBG conductivity sensor is installed.

3.1.2 Select an installation site which is:

- free of mechanical vibrations
- reasonably clean and dry
- protected from falling corrosive fluids within the ambient temperature and humidity specifications
- remote from high voltage relay and power switches

### 3.2 Type of Mounting

3.2.1 If the 2200BG is to be pipe or panel mounted a special hardware kit will be required. For panel mount order part number C35-68. For pipe mount order part number C35-69. Instructions for both types of mounting will be included with the kits.

3.2.2 For surface mount applications, four feet brackets, together with fastening screws, are provided with the 2200BG. These should be fastened to the back of the enclosure and screwed or bolted in the selected location.

### 3.3 Conduit Connections

3.3.1 Four 1/2" conduit holes are provided in the bottom of the enclosure. One of these is fitted with an approved water-tight plug. To maintain NEMA 4 integrity, approved conduit hubs must be used to connect conduit. The hubs must be connected to the conduit before being connected to the enclosure. Any unused conduit holes must be closed with water-tight plugs or connectors.

3.3.2 For convenience of internal connections the right conduit hole (viewed from the front) should be used for power connection; the next hole to the left for relay outputs; the next hole to the left for analog outputs and finally the fourth hole for the sensor input.

### 3.4 Electrical Connections

**CAUTION: The 2200BG operates from line voltage. This constitutes a possible shock hazard. Ensure that line power is removed before attempting connections. *Note:* A separate source of line power may have been connected to the floating relay contacts.**

3.4.1 To access the terminal strips open the door of the 2200BG and then unscrew the captive retaining screw near the upper right hand corner of the panel. Now swing open the panel to reveal the terminal strip on the power supply circuit board and the smaller terminal strip on the back of the main circuit board.

3.4.2 The terminal strip on the power supply board at the back of the 2200BG is labeled for line power, relay outputs and analog outputs. Connect the wiring in accordance with this labeling. Refer to Fig.1

Note: Control Relay B is not used in the 2200BG.

Terminals 4 and 5 are wired directly to the input line voltage. These terminals can be used to supply power to the relays. Use the common ground of Terminal 1 as the ground for the auxiliary devices. A separate source of power can also be used to provide power to the relays. Ensure that the circuit breaker supplying the 2200BG is able to supply enough current to the auxiliary devices, to ensure proper operation of the 2200BG.

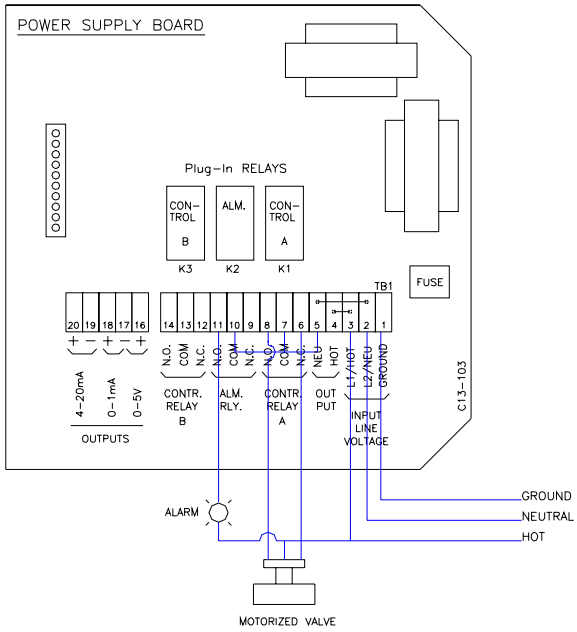



FIG. 1

***CAUTION*:** Connecting the line voltage to incorrect terminals may cause serious damage.

### 3.5 Cell Connections

3.5.1 Connect the 4 wires of the cell cable to the TB2 terminal strip on the main circuit board being sure to match the colors as printed on the TB2 terminal strip. White and black are the electrode wires; red and green are the temperature sensor wires. Place switches S41 and S42 in the down “on-line” position. Refer to Fig.2

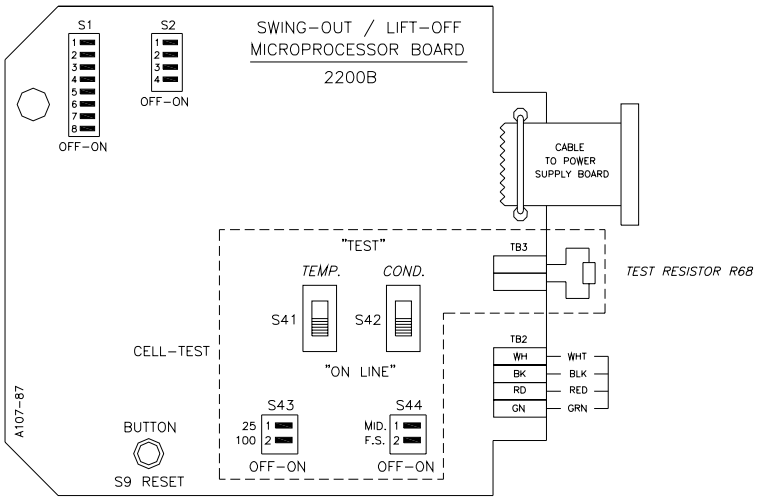
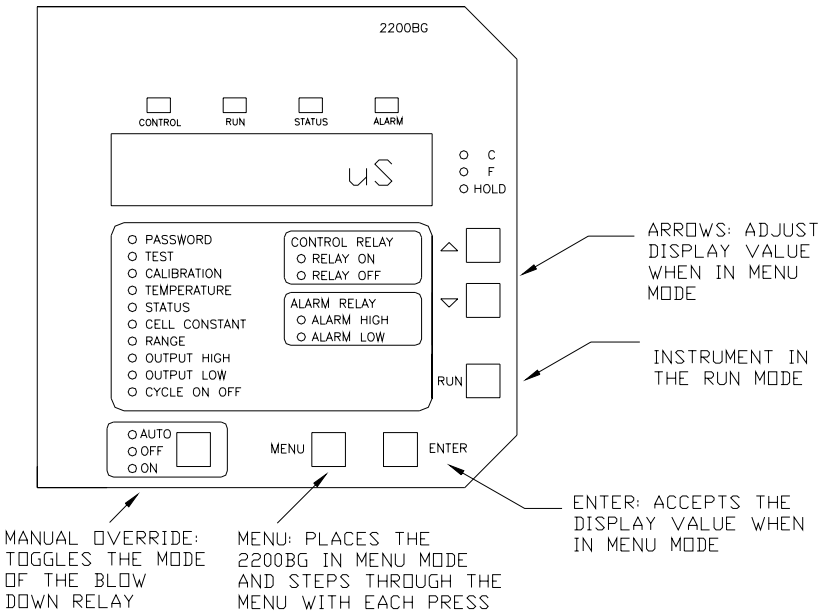



FIG. 2

3.5.2 The test resistor R68, is used for the simulation feature. It has a resistance equal to the equivalent resistance of the cell at mid scale. The resistor that is shipped with the unit is 160 ohms. This corresponds to the resistance of the cell at 2500uS and 100°C. This resistor should not be removed and is required if the unit is to be calibrated using the internal calibration feature.

## 4.0 Description of Functions




### 4.1 Overview

4.1.1 The Model 2200BG Boiler Gard is a microprocessor based conductivity controller designed for industrial applications. It is compatible with AquaMetrix's MSBG series conductivity sensors. The unit's software makes maintenance and operation easy.

4.1.2 The outputs include voltage-free relay contacts and industry standard analog transmission signals. Two programmable relays are provided for blow-down and alarm. The status of each relay is indicated on the front by a LED. The analog output signals transmit low power signals to communicate with peripherals devices such as chart recorders and PLC's.

4.1.3 The software is designed for ease of operation. It uses a simple menu with all items indicated on the front panel. The user interface consists of six buttons on the front panel. The keys are scanned continuously. In addition, an extensive system of checking all system values and parameters is performed by the software. All of the operating parameters are stored in non-volatile memory, without the need of a battery.

4.1.4 The Model 2200BG operates like a normal analog converter with a number of additional functions made possible by the microprocessor in the 2200BG.

Some of these are:

- Recall and easy adjustment of relay and output parameters
- Push button calibration
- A HOLD function for outputs, when in the menu modes
- Continuous sensor check during measurement
- Continuous self-check and watch-dog timer to ensure correct operation
- Password protection of stored values
- Temperature Output

## 4.2 Calibration

4.2.1 All conductivity systems need to be calibrated when first placed in service and thereafter from time to time. The frequency of calibration can only be found by the operator's experience with each process. Calibration must always be performed when a new sensor is placed in service. The 2200BG can be calibrated by two different methods. Refer to Sec. 5.2.

## 4.3 Temperature Compensation

4.3.1 Temperature compensation is an essential component of conductivity measuring units. Electrolytic conductivity increases with temperature even though there has been no addition of dissolved solids. It is therefore the industry standard to compensate for temperature changes, and display the conductivity as if the temperature were constant at 25°C. The 2200BG references all conductivity readings to 25°C (77°F)

## 4.4 Relay Outputs

4.4.1 Two SPDT (Single Pole Double Throw) relays are provided. The normally open contacts, NO, are open when no alarm or control is active.

The blow down relay will activate in response to rising conductivity. It is normally used to control a solenoid valve, or motorized valve, which is used to remove contaminated water from the boiler. It may be set to close at any point on the scale. The blow down relay is setup by entering the Relay on, and Relay off setpoints. Refer to Sec. 5.4.

4.4.3 The second relay functions as a high-low alarm. It has two programmable Setpoints (high and low). The deadband is fixed at 2% of full span. The alarm relay can be programmed to signal memory loss and excessive continuous blow-down. Refer to Sec. 4.7, 5.7.

4.4.4 All relays can be programmed for "fail-safe" operation which reverses the normal operation of the relay. In fail safe mode the Normally Closed contact functions as the Normally Open contact. In the event of power loss to the unit, the relay will de-energize and the device connected to the Normally closed contact will be turned on. This option is selected with the DIP switches on the swing out board. Refer to Sec. 4.7.

### 4.5 Analog Outputs

4.5.1 The analog output signals consist of a non-isolated 0-1 mA, 0-5 Vdc, and isolated 4-20 mA signals.

4.5.2 From the factory all of the analog outputs have a linear range corresponding to the full range of the 2200BG. The analog outputs can be programmed to another linear range by entering two values:

- Output High: This is the conductivity value at which you wish to have 100% output.
- Output Low: This is the conductivity value at which you wish to have 0% output.

4.5.3 When programming, you must ensure that the output range has a span of at least 10% of the full range of the 2200BG. For applications that require the output to decrease as the process value increases, i.e. an inverted output, the Output High value will be less than the Output Low. Refer to Sec. 5.3.

4.5.4 The 2200BG may be used to measure the temperature of the process either in °C or in °F. The 2200BG does not control temperature but the 0-5 Vdc and 0-1 mA analog outputs can be dedicated to follow the process temperature. See Section 5.9.

### 4.6 Operations Menu

4.6.1 The operations menu allows the user to recall and to adjust the parameters, required by the 2200BG's functions.

4.6.2 When the 2200BG is powered up, the program will display the conductivity reading. None of the LED's in the operation's menu will be illuminated.

4.6.3 Five buttons on the panel are used to operate the menu. Use the MENU key to enter the operations menu and to step through the items in the menu. The red LED beside each item makes it very easy to follow the menu. The function of the RUN button is to return to the on-line conductivity display from anywhere in the menu. The 2200BG has a built-in timer, which returns the unit to the online mode if no button has been pressed for 10 minutes. This timeout has the same effect as pressing the RUN button.

4.6.4 When in the menu mode, the display will shows the current value of the parameter, such as the Relay On Setpoint of the blow-down relay. The two arrow keys are used to adjust the display value up or down. To accept the new value press the ENTER key twice. While in the operations menu, the relay and the analog outputs remain on hold.

The items that appear in the operations menu are:

- Password
- Test
- Calibration
- Temperature
- Status
- Cell Constant
- Range
- Output High
- Output Low
- Cycle On / Off
- Control Relay, Relay On Setpoint
- Control Relay, Relay Off Setpoint
- Alarm Relay, High Alarm Setpoint
- Alarm Relay, Low Alarm Setpoint

### 4.7 DIP Switches

4.7.1 The controls which are frequently used in the normal operation of the 2200BG are all accessible through the operations menu. Some switches, which are infrequently used, are located on the back of the main circuit board.

4.7.2 The DIP switches are scanned on power-up and every time a key is pressed on the front panel. Therefore, after changes to the DIP switch settings, you must press one of the keys, in order for the 2200BG to scan the new settings.

4.7.3 The following table describes the use of the 16 DIP switches:

**Bank S1**

| ***Dip Switch*** | ***Description*** | ***ON*** | ***OFF*** |
|---|---|---|---|
| 1 | Selects temperature unit | **°C** | °F |
| 2 | Password Feature | **Disabled** | Enabled |
| 3 | Fail-Safe mode for Relay A | Enabled | **Disabled** |
| 4 | Auto return for Blow-Down Relay Manual Override | **Enabled** | Disabled |
| 5 | Alarm Relay to be activated for memory loss | Disabled | **Enabled** |
| 6 | Fail-Safe mode for Alarm Relay | Enabled | **Disabled** |
| 7 | Auto return from menu | **Enabled** | Disabled |
| 8 | 0-5V / 0-1mA Select | **Conductivity** | Temperature |

**Bank S2**

| ***Dip Switch*** | ***Description*** | ***ON*** | ***OFF*** |
|---|---|---|---|
| 1 | Sample Cycling Mode | **Enabled** | Disabled |
| 2 | Timeout Alarm | **Enabled** | Disabled |
| 3 | Reserved | | |
| 4 | Reserved | | |
| 5 | Reserved | | |
| 6 | Reserved | | |
| 7 | Reserved | | |
| 8 | Reserved | | |

*Note: Items in **"BOLD"** are the factory settings that the unit will be shipped with.*

### 4.8 Output Hold

4.8.1 Output hold, is a function which freezes all output signals at the current value to prevent unwanted output signals during programming and maintenance.

4.8.2 When the Operations Menu is entered by pressing the MENU key, the relays and analog outputs are automatically placed on hold and remain on hold until the 2200BG returns to on line. The output hold will remain for a maximum of 10 minutes after the last button was pressed, if this feature has been enabled. Refer to Sec. 4.7.

### 4.9 Parameter and Operation Checking

4.9.1 The 2200BG continuously checks all parameters in its memory, while measuring the conductivity. When it detects an invalid value, it flashes the LED in the operation menu to indicate the parameter that is at fault. You must then access the operations menu to take corrective actions.

### 4.10 Simulated Input for Testing

4.10.1 TEST is function that can be used to check the setup of the 2200BG. When in the test mode the display will show a value between 0 and 5000. The arrow keys are used to change the display. The relays and analog outputs will react to the changes of the display as if it were monitoring the conductivity. This feature enables the user to verify that the 2200BG has been configured correctly, and that it will correctly react to the process. Of course, the relays and outputs are no longer on hold once the arrow buttons are used in TEST mode.

### 4.11 Manual Override for the Blow Down Relay

**4.11.1** The AUTO/OFF/ON button is used to set the operating mode of the blow-down relay. This useful feature allows the operator to check the operation of the device controlled by the relay. On power up the control relay always returns to the AUTO setting.

**4.11.2** The manual override can be selected to return to the AUTO mode if no key on the 2200BG has been pressed for 5 minutes. This safeguards against the operator forgetting to return the blow-down relay to the AUTO mode after using the manual override. This feature may be disabled with the DIP switches on the back of the main circuit board. Refer to Sec. 4.7

### 4.12 Utility Menu

4.12.1 The Utility Menu is provided to enable authorized personnel to adjust the temperature output span, maximum continuous blow down alarm timeout, and to fine tune the analog outputs. Refer to Sec. 7.0.

### 4.13 Watchdog Timer and Self Diagnostics

4.13.1 The 2200BG continuously monitors the condition of all key components of the measuring system to ensure that the measurements are reliable. Invalid entries and memory loss are indicated on the panel. Refer to Sec. 8.0.

## 4.14 Operating Modes

4.14.1 The 2200BG has 2 different operating modes depending on the type of boiler that you want to control.

Mode #1: Continuous Sample Mode

This mode is used when you have a large volume boiler, and the sensor is installed in the bleed off line which has a constant sample bleed. When the sensor measures that the conductivity is above the RELAY ON setpoint, the blow-down relay will energize and will stay energized until the sensor measures that the conductivity has dropped below the RELAY OFF setpoint. The optional cycle feature will cause the blow-down relay to cycle when the conductivity is between the RELAY ON / OFF setpoints. The on time is adjustable from0.1-10 minutes. The off time is adjustable from 0-360 minutes. The relay will cycle based on the CYCLE ON and OFF times set in the operations menu. Refer to Fig. 4 for typical installation diagram. Refer to Sec. 5.5. for mode selection.

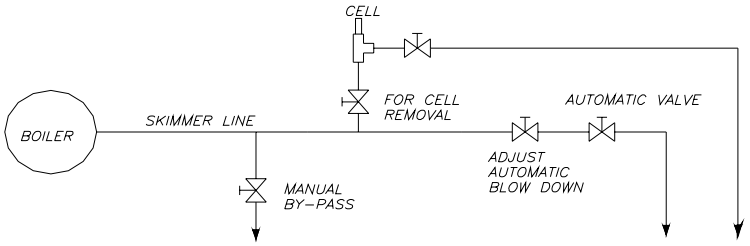



FIG. 4

Mode #2: Timed Sample Mode

This mode is used when you have a small volume boiler, and the cell is installed where it does not see a constant representation of the boiler water. (i.e. there is not a constant bleed sample)

The 2200BG will cycle the blow-down relay based on the cycle times set in the operations menu. The on time is adjustable from 0.1-10 minutes and the off time is adjustable from 1-360 minutes. During the on time the sensor will see a sample of the boiler water. If the conductivity is above the RELAY ON setpoint, at the end of the on cycle the blow-down relay will remain energized until the conductivity drops below the RELAY OFF setpoint. When the conductivity falls below the RELAY OFF setpoint, a new off cycle will begin.

During the off cycle the 2200BG will not measure the conductivity because the sample will not be an accurate representation of the water in the boiler. The display will flash displaying the time (in minutes) until the next on cycle.

If the operations or utility menu is entered, the outputs will be placed on hold. A new off cycle will begin when the RUN key is pressed to place the 2200BG back online. During the off time the operator can manually start an on cycle by pressing the RUN key for 1 seconds. Refer to Fig. 5 for typical installation diagram. Refer to Sec. 5.5 for mode selection.

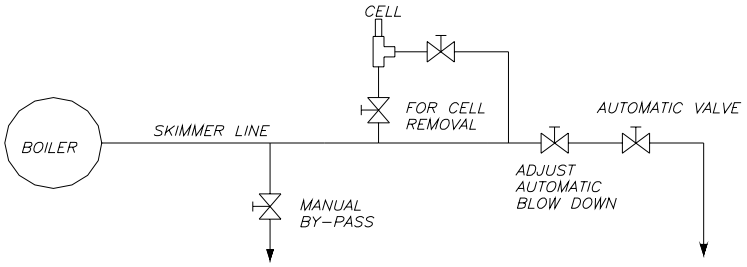



FIG. 5

### 4.15 Blow-Down Timeout Alarm

4.15.1 The blow-down timeout alarm is used to protect the boiler if the blow-down relay continues to blow down for an extended period of time. This feature can be disabled by the DIP switches on the back of the main circuit board. The maximum blow down time is set in the utility menu. It is adjustable from 1 to 60 minutes.

4.15.2 The 2200BG will monitor when the conductivity goes above the RELAY ON setpoint, and will begin timing from that point. If the blow-down relay remains energized longer than the maximum blow down time, the alarm relay will energize, the blow-down relay will de-energize and the FAIL LED will illuminate. The operator must hold the two arrow keys for 5 seconds in order to reset the alarm. If this alarm happens ensure that all components of the system are checked before returning the 2200BG online. This usually is an early warning for a failing component.

## 5.0 START-UP AND OPERATION

### 5.1 Password

5.1.1 To enter the operations menu press the MENU key, the PASSWORD LED will illuminate. If the password feature has been disabled by the DIP switch, the TEST LED will be the first menu item illuminated. With each press of the MENU key you will step through the operations menu. When the last item, ALARM LOW is reached the menu wraps around to TEST.

5.1.2 If you have enabled the password by placing DIP switch No. 2 of bank S1 in the off position you must enter the password “6” when the PASSWORD LED is illuminated. If the password is enabled, and you do not enter the correct password. All the items in the menu will be read only. To enter the password proceed as follows:

5.1.3 When the PASSWORD LED is illuminated. Use the arrow keys to make the display read 6. Press the ENTER key. The TEST LED will illuminate and you will be able to make changes to the items in the operations menu.

### 5.2 Calibration

5.2.1 There are 2 different methods of Calibrating the 2200BG. Calibration by bleeding off a sample and testing it with a certified Lab meter, and calibration by generating the signals internally. Calibration with a certified lab meter is the most accurate calibration method, and is the recommended method.

**Method #1: Calibration with a certified lab meter**

1. Bleed off a sample of the boiler water and measure the conductivity with a certified lab meter. Ensure that the lab meter has temperature compensation and that the reading is referenced to 25°C.
2. Press the MENU key to enter the operations menu. Press the MENU key until the CALIBRATION LED illuminates.
3. Use the arrow key to make the display read the value that was obtained from the certified lab meter.
4. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.
5. The 2200BG is now calibrated. Press the MENU key for another item in the operations menu or press the RUN key to place the 2200BG online.

**Method #2: Calibration with internal signal generation**

1. Place S41 in the UP position. This places a 6800 ohm resistor across the RED and GREEN, cell terminals. This simulates a process temperature of 100°C. Ensure that S43 #1 is ON, and #2 is OFF.
2. Place S42 in the UP position. This places a 160 ohm resistor across the BLACK and WHITE cell terminals. This simulates a process conductivity of 2500uS. Ensure that S44 #1 is ON, and #2 is OFF.
3. Press the MENU key to enter the operations menu. Press the MENU key until the CALIBRATION LED illuminates.
4. Use the arrow keys to make the display read 2500.
5. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.
6. The 2200BG is now calibrated. Press the MENU key for another item in the operations menu or press the RUN key to place the controller online.

### 5.3 Analog Output Range Expand

5.3.1 To increase the resolution of the analog outputs, the range may spread over any section of the scale. As long as it spans at least 10% of full scale. The best way to describe this setup is by example. Suppose you wish the outputs to span from 1000uS to 4000uS. Proceed as follows:

a) Press the MENU key to enter the operations menu. Press the MENU key until the OUTPUT HIGH LED is illuminated. Use the arrows keys to make the display read 4000. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.

b) Press the MENU key and the OUTPUT LOW LED will illuminate. Use the arrow keys to make the display read 1000. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.

c) The analog output will now be at 0% when the conductivity of the solution is 1000 µS and will increase to 100% when the conductivity of the solution is 4000 µS.

d) Press the RUN key to place the 2200BG on line or press the MENU key for another menu selection.

**NOTE:** If the OUTPUT HIGH and the OUTPUT LOW are less than 500uS apart or if the OUTPUT HIGH is set lower than the OUTPUT LOW, the OUTPUT HIGH LED will flash when the unit is placed online. To correct this problem, you must re-enter the output high and output low values.

If the process requires that the analog outputs decrease as the process increases. The OUTPUT HIGH value must be set lower than the OUTPUT LOW value. Ensure that there is a span of at least 500uS between them.

### 5.4 Blow Down Relay

5.4.1 The Blow-Down Relay is configured by programming the RELAY ON and the RELAY OFF setpoints.

- **Relay On Setpoint: This is the conductivity value at which the relay will energize**
- **Relay Off Setpoint: This is the conductivity value at which the relay will de-energize**

5.4.2 The Relay On Setpoint may be set at any point on the scale.
To program the setpoint. Proceed as follows:

a) Press the MENU key to enter the operations menu. Press the MENU key until the RELAY ON LED is illuminated. Now use the arrow keys to make the display read the desired value. Press the ENTER. The display will flash until the ENTER key is pressed again to confirm the value.

b) Press the RUN key, to place the 2200BG on line, or press the MENU key for another menu selection.

5.4.3 The Relay Off Setpoint may be set at any point on the scale, provided it is less than the value of the Relay On Setpoint.
To program the setpoint. Proceed as follows:

a) Press the MENU key to enter the operations menu. Press the MENU key until the RELAY OFF LED is illuminated. Now use the arrow keys to make the display read the desired value. Press the ENTER. The display will flash until the ENTER key is pressed again to confirm the value.

b) Press the RUN key, to place the 2200BG on line, or press the MENU key for another menu selection.

**NOTE:** If the Relay OFF Setpoint is set higher than the Relay On Setpoint the Relay On Setpoint LED will flash when the unit is placed online. To correct this problem, you must re-enter the Relay Off Setpoint so that it is lower than the Relay On Setpoint.

## 5.5 Modes Selection

5.5.1 The 2200BG has 2 different modes of operation depending on the type of boiler that you want to control. For a description of the different modes refer to Sec. 4.14.

5.5.2 Mode#1: Continuous Sampling Mode
To select Mode #1, place DIP switch No.1 of bank S2 on the back of the main circuit board to the OFF position. The relay will energize / de-energize based on the RELAY ON and RELAY OFF Setpoints set in the operations menu. The optional cycling feature can be enabled or disabled depending on the value of the CYCLE OFF time in the operations menu. To disable the cycling feature, ensure that the Cycle Off time in the operations menu is set to zero. The CYCLE ON time can be set from 0.1-10 minutes.
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5.5.3 Mode#2: Timed Sampling Mode
To select Mode#2, place DIP switch No.1 of bank S2 on the back of the main circuit board in the On position. Set the CYCLE ON time and CYCLE OFF times in the operations menu to the desired values. Maximum range for the on time is 0.1-10 minutes, and 1-360 minutes for the off time.

## 5.6 CYCLE ON AND CYCLE OFF

5.6.1 The CYCLE ON and CYCLE OFF times in the Operations menu are used if the controller is being operated in Mode #1 with the cycling feature or Mode #2. To set the CYCLE ON and CYCLE OFF times proceed as follows:

a) Press the MENU key to enter the operations menu. Press the MENU key until the CYCLE ON LED is illuminated. Use the ARROW keys to make the display read the desired On time in minutes. The maximum range is 0.1-10. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.

b) Press the MENU key and the Cycle ON / OFF LED will flash. Use the ARROW keys to make the display read the desired Off time in minutes. The range is 0-360. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.

c) Press the RUN key to place the unit online or press the MENU key for another menu selection.

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### 5.7 Alarm Relay

5.7.1 The 2200BG has one alarm relay with a high and low setpoint. The relay will activate at the alarm setpoint and de-activate when the solution changes by 100uS. To set the ALARM HIGH and ALARM LOW setpoints proceed as follows.

a) Press the MENU key to enter the operations menu. Press the MENU key until the ALARM HIGH LED is illuminated. Use the arrow keys to make the display read the desired value. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.
b) Press the MENU key and the ALARM LOW LED will illuminate. Use the arrow keys make the display read the desired value. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.
c) The Alarm Relay has been set. Press the RUN key to place the unit online or press the MENU key for another menu selection.

**NOTE:** If the ALARM LOW SETPOINT is set higher than the ALARM HIGH SETPOINT the ALARM HIGH LED will flash when the unit is placed in the online mode. To correct the problem reset the alarm setpoints.

### 5.8 Test

5.8.1 To check the setup of the 2200BG, the TEST feature can be used. The test feature will allow the user to use the arrow keys to change the display. By changing the display value the analog outputs and relay outputs will react, as if the process was actually changing. This feature enables the user to simulate the process and test if the auxiliary devices connected to the relays are functioning properly.

5.8.2 To use the TEST feature proceed as follows:

a) Press the MENU key to enter the operations menu. The TEST LED should be illuminated. Use the arrow keys to change the display. The outputs will react to the changes in the display, as if the unit was online and the process was actually changing.

b) Press the RUN key to place the 2200BG on line, or press the MENU key, for another menu selection.

### 5.9 Temperature

5.9.1 The temperature of the process can be read at any time by entering the operations menu and scrolling through until the TEMPERATURE LED is illuminated. Either °C or °F will be indicated depending on the position of DIP switch No.1 of Bank S1. Refer to Sec. 4.7.

5.9.2 The 0-5 Vdc and 0-1 mA analog outputs can be dedicated to follow the conductivity or the temperature depending on the position of DIP switch No. 8 of Bank S1. The temperature span of the output can be set in the utility menu. Refer to Sections 4.7, and 7.4.

### 5.10 Status

5.10.1 The 2200BG continuously checks the integrity of all stored data and monitors the condition of the measuring system. If a fault is detected, the FAIL LED above the display will turn red. The STATUS in the operation menu will provide a numerical code, giving a possible cause and a suggested remedy.

4.10.2

| CODE | POSSIBLE CAUSE | SUGGESTED REMEDY |
|---|---|---|
| 0 | Normal Condition | No action required |
| 1 | Blow-Down Excess Alarm | Press both Arrow buttons for 5 sec. |
| 2 | Temperature Sensor off Scale | Check for open or short connections of temperature sensor input (Terminals RD & GN on TB2) |
| 3 | Conductivity reading off Scale | Verify process. Check for open or short connections. WH and BL wires |
| 4* | Memory Loss | Call your AquaMetrix Rep. Or AquaMetrix directly |
| 5 | Calibration out of limit | Re-calibrate the unit. |
| 6 | Escape Procedure | Re-calibrate the unit Refer to Sec 7 |

**NOTE:** Code 4 could be a serious failure so the alarm relay will activate in addition to the red illumination of the FAIL LED if DIP Switch No. 5 of Bank S1 is off.

### 5.11 Range

5.11.1 This menu item is read only, it displays the range of the 2200BG. The 2200BG has a fixed range of 0-5000uS.

### 5.12 Cell Constant

5.12.1 This menu item is read only, it displays the cell constant required for the range. The 2200BG uses a fixed cell constant of 1.

# 6.0 OPERATING HINTS

## 6.1 Cell Care

6.1.1 Keep the cell clean using the procedure recommended in the cell manual. The frequency of cleaning depends on the solution being monitored.

6.1.2 Be sure the cell cable is well protected. The cell cable should run in conduit but never in the same conduit with line power. Excess cable should be cut off and never coiled.

## 6.2 Calibration

6.2.1 The system will only be as accurate as your calibration technique. With a clean cell you will need to calibrate only with a change in conditions or after installing a new cell. Refer to Sec. 5.2.

## 6.3 Reset

6.3.1 The 2200BG can be reset without losing calibration or any of the stored values by pressing and releasing the S9 reset button (located at the bottom of the board near the center) This action is equivalent to turning the power off and on. Refer to Fig.2 Sec. 3.5.

## 6.4 Ground Loop Errors

6.4.1 If there is a conductive pathway from the sensor connections to earth, ground loop errors will occur. To avoid this condition keep all terminal connections in the 2200BG or in a junction box dry and free of corrosion.

## 6.5 Output Hold

6.5.1 It may be useful during some system maintenance procedures to place the relay and analog outputs on hold. To accomplish this simply press the MENU key. To return to on line operation press the RUN key. (If the 2200BG is in TEST the outputs will not be in HOLD if the arrow buttons are touched.)

**NOTE:** To safeguard against the operator forgetting to press the RUN key, the 2200BG will automatically go back on line ten minutes after the last button was pressed provided this feature has been enabled by placing DIP switch No.7 in the ON position.

# 7.0 UTILITY MENU

## 7.1 Utility Menu Functions

7.1.1 The Utility Menu enables authorized personnel to perform the following:

- Adjust the temperature output range
- Alarm Timeout Value
- Adjust the offset and span of the 0-1 mA/ 0-5 Vdc output
- Adjust the offset and span of the 4-20 mA output

## 7.2 Access to Utility Menu

7.2.1 The Utility Menu is protected by a password. To access the Utility Menu press and hold both **RUN** and **ENTER** for five seconds until the PASSWORD LED illuminates. The RUN LED will flash to warn that Utility Menu is in use. Use with the arrow keys make the display read the password, "7". Press the ENTER key. The OUTPUT HIGH LED will illuminate.

7.2.2 The Utility Menu is entirely separate from the Operations Menu but uses the same LED display. Press the MENU key to step through the Utility Menu items.

Below is the cross-reference between menu items:

| **Operations Menu** | **Utility Menu** |
|---|---|
| Output High | Temperature Output 100% (5Vdc) |
| Output Low | Temperature Output 0% (0Vdc) |
| Cycle A | Alarm Timeout Max. Value |
| Relay On | 0-1mA / 0-5Vdc Adjust low |
| Relay Off | 0-1mA / 0-5Vdc Adjust high |
| Alarm High | 4-20 mA Output Adjust Low |
| Alarm Low | 4-20 mA Output Adjust High |

### 7.4 Temperature Output

7.4.1 The 0-5 Vdc and 0-1 mA outputs may be programmed to track the temperature of the process. From the factory the outputs have a linear range corresponding to 100°C to 200°C, (or 212°F to 392°F.) The following example explains the setup to have the span from 120°C to 180°C. Proceed as follows:

a) Enter the Utility Menu as described in 7.2.1.

d) Press the MENU key until the OUTPUT HIGH LED illuminates, which is "Temperature output, 100% point" in the Utility Menu (See table in 7.2.2). Use the arrow keys to make the display read 180. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.

e) Press the MENU key, and the OUTPUT LOW LED will illuminate, which is "Temperature output, 0% point" in the Utility Menu (See table in 7.2.2). Use the arrow keys to make the display read 120. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.

f) Press the RUN key to return to on line or press the MENU key to proceed to another item in the Utility Menu.

### 7.5 Timeout Alarm

7.5.1 The 2200BG can be programmed to go the timeout alarm mode if the blow-down relay remains energized longer the max timeout alarm time. From the factory the max timeout alarm is set to 30 minutes. The time can be changed to any value between 1-60 minutes. This feature is enabled by the DIP switches on the back onf the main circuit board. To change the max timeout alarm time proceed as follows.

a) Enter the Utility Menu as described in 7.2.1.
b) Press the MENU key until the CYCLE ON LED illuminates, which is "Max Alarm Timeout Time" in the Utility Menu (See table in 7.2.2). Use the arrow keys to make the display read the desired value. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.
c) Press the RUN key to return to the on line or press the MENU key to proceed to another item in the Utility Menu.

### 7.6 Adjust 0-1 mA / 0-5 Vdc Output

7.6.1 It may be desirable to fine tune the 0-1 mA / 0-5 Vdc output to take into account the characteristics of your particular loop. The following method involves a high and low calibration and requires the use of a digital multi-meter. (DMM). Proceed as follows ignoring the 2200BG display:

a) Turn off the power to the 2200BG. Connect your DMM in parallel with the 0-5 Vdc output terminals on the power supply board.

b) Turn on the power. Enter the Utility Menu as described in 7.2.1.

c) Press the MENU key, until the RELAY ON LED illuminates, which is "0-1 mA/ 0-5 Vdc output adjust, low" in the Utility Menu (See table in 7.2.2). Use the arrow keys to make your DMM read 1.25V. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.

d) Press the MENU key, and the RELAY OFF LED will illuminate, which is "0-1 mA / 0-5 Vdc Output adjust, high" in the Utility Menu (See table in 7.2.2.) Use the arrow keys to make your DMM read 3.75V. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.

e) Press the RUN key, to return to on line or press the MENU key to proceed to another item in the Utility Menu.

### 7.7 Adjust 4-20 mA Output

7.7.1 It may be desirable to fine tune the 4-20 mA isolated output to take into account the characteristics of your particular loop. Before deciding that the adjustment is necessary, be aware of the "Output High" and "Output Low" settings you may have programmed as described in Section 5.4. The following method involves a high and low calibration and requires the use of a Digital Multimeter (DMM). Proceed as follows ignoring the 2200BG display.

a) Turn off the power to the 2200BG. Connect your DVM in series with the 4-20 mA output terminals on the power supply board.

b) Turn on the power. Enter the Utility Menu as described in 7.2.1.

c) Press the MENU key, until the ALARM HIGH LED illuminates, which is "4-20 mA Output adjust, low" in the Utility Menu (See table in 7.2.2.) Now use the arrow keys to make your DMM read 8 mA. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.

d) Press the MENU key, and the ALARM LOW LED illuminates, which is "4-20 mA Output adjust, high" in the Utility Menu (See table in 7.2.2). Now use the arrow keys to make your DMM read 16 mA. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.

e) Press the RUN key, to return to on line or press the MENU key to proceed to another item in the Utility Menu.

# 8.0 DIAGNOSTICS

## 8.1 Description

8.1.1 The 2200BG has diagnostic features which alerts the operator to invalid entries and memory loss. Invalid entries are indicated by the flashing of the appropriate menu LED. The flashing will commence after RUN is pressed and will continue until the errors are corrected. Memory loss is indicated by the flashing of TEST and by the alarm relay if enabled by DIP Switch No. 5 of Bank S1. Refer to Sec. 4.7.

## 8.2 Invalid Calibration

8.2.1 Invalid calibration will be indicated when the input is out of range.

## 8.3 Invalid Output

8.3.1 Invalid output will be indicated if the expanded range is less than 10% of full scale. To correct, Refer to Sec.5.3.

## 8.4 Invalid Alarm Points

8.4.1 Invalid Alarm will be indicated if the Low Alarm is set higher than the High Alarm. To correct, Refer to Sec. 5.6 and 5.7.

## 8.5 Invalid Control Relay Settings

8.5.1 The Relay Off Setpoint must be lower than the Relay On Setpoint. If you have not made these settings correctly, invalid entry will be indicated by the Relay On LED flashing. To correct, Refer to Sec. 5.4.

## 9.0 TROUBLESHOOTING AND SERVICE

### 9.1 Isolate the cause

9.1.1 When a measurement problem occurs, the first step is to try to isolate the cause. If the 2200BG is powered, go through the menu and check your settings. A convenient way to do this is to call TEST. See Section 5.7

9.1.2 If your 2200BG appears dead or intermittent, check the breaker, make sure that the 2200BG is set up for the available line voltage and make sure the line voltage is actually available at the terminals. Now measure that sufficient voltage is available at all times; it should be 98 Vac to 132 Vac or 187 Vac to 243 Vac respectively. Shut line power off, making sure it is off. *CAUTION*: *Power to the relays may be supplied from a separate source, shut it off too*. Check and if necessary replace the internal 0.25A fuse. Push the connector of the ribbon cable firmly into its socket. If these steps do not solve the problem it may be necessary to replace the power supply board. See Section 9.3.1 below.

9.1.3 Should your process control element e.g. pump, valve or alarm not be activating, check that the correct power is supplied to the "floating" relay contacts, jumped over from the line voltage terminals or perhaps from a separate breaker or DC supply. Use the TEST menu feature to simulate the input values to observe the switching points.

Check that your process control elements can function independently of the 2200BG. Next check with a test light or an Ohmmeter (power off to the relay contacts, wires to the control elements disconnected) that the contacts of the respective relay are making contact when actuated. If a relay is malfunctioning, it may be necessary to replace it.

9.1.4 If the process value seems wrong, clean the cell as described in the cell manual. Inspect the cell, wire and interconnections. Calibrate and resume operation.

9.1.5 To find out whether the problem is in the sensor, or in the 2200BG, use the self-testing features. Leave the 2200BG in RUN mode and proceed as follows:

Place S41 in the UP position. This places a 6800 ohm resistor across the RED and GREEN, cell terminals. This simulates a process temperature of 100°C. Ensure that S43 #1 is ON, and #2 is OFF.

Place S42 in the UP position. This places R68,across the BLACK and WHITE cell terminals. (unit shipped with a 160ohm resistor) This simulates a process conductivity of 2500uS. Ensure that S44 #1 is ON, and #2 is OFF

Connect a test resistor R68 to the TB3 terminal strip on the swing-out board according to the following table to test other process values:

| Process Reading | R68 Value |
|---|---|
| 500 uS | 800 ohms |
| 1000 uS | 400ohms |
| 2000 uS | 200 ohms |
| 2500 uS | 160 ohms |
| 3000 uS | 133 ohms |
| 4000 uS | 100 ohms |

## 9.2 Escape

9.2.1 If the 2200BG appears to be "DEAD", for example not responding to the buttons, or not performing on line measurement and control, always try the reset feature first, as described in 6.3.1.

9.2.2 a) The "ESCAPE" procedure is to be used normally at the factory only, when the unit is powered with a new processor. As a result, the internal non-volatile memory (EPROM) is "FORMATTED" and the factory values are loaded into it.

b) The "ESCAPE" procedure is to be used if a unit is serviced for a new processor, or in case of a memory loss problem, when so advised by AquaMetrix service support.

9.2.3 Before performing the "ESCAPE" procedure it is important to know that this procedure will erase all programmed values and replace them with the factory set default values. This means that the range selection and the conductivity calibration must be performed after an "ESCAPE" procedure. After that, all the control, alarm and scaling parameters mentioned above must be set to the user values.

9.2.4 To perform the ""ESCAPE"" proceed as follows.

a) Turn off the power.

b) Press and hold the RUN button for about 3 seconds, while turning on the power. The FAIL LED will turn red and status code 7 will be obtained to show that the "ESCAPE" procedure was just performed.

9.2.5 After the "ESCAPE" procedure it is necessary to do the following:

a) Tune the analog outputs and the temperature output span to suit your particular application and loop. See Sections 7.4, 7.5, and 7.6.

b) Calibrate the system, as described in Section 5.2.

c) Set up the user values for:

- Output High and Low – Refer to Sec. 5.3.
- Control Relay - Refer to Sec. 5.4 and 5.5.
- Alarm Relay - Refer to Sec. 5.7 and 5.8.

d) After all the above operations are performed the RUN LED will turn "green" and status "0" should be obtained.

e) The unit may be tested now, using the TEST menu item (Refer to Sec. 5.8.), or the built-in self-testing feature, (Refer to Sec. 9.1.5.)

### 9.3 Printed Circuit Board Replacement

9.3.1 a) To replace printed circuit boards, shut off all power to the 2200BG, including any independent power to the relay contacts. Make a record of the external wiring, then disconnect the wires. Unplug the ribbon cable connector.

b) The power supply circuit board is fastened to the back of the enclosure by four screws, remove the screws to free the board. Reverse the procedure to mount a replacement board.

c) The microprocessor circuit board is located on the swing-out assembly behind the door. Swing the assembly out, lift it up to unseat the lower hinge pin (the upper hinge pin is spring loaded.) The assembly is now free. The circuit board is fastened to the front panel by five screws. Remove the screws to release the circuit board.

### 9.4 Customer Service

9.4.1 If a problem has not been resolved with the above procedures, a telephone consultation with your AquaMetrix representative, or directly with AquaMetrix will provide the answer.

AquaMetrix Inc.
4-30 Royal Crest Court
Markham, Ontario
L3R 9W8 Canada

Tel: (800) 742-1413
(905) 946-1064
Fax: (905) 946-8064
Email: support@aquametrix.com

### 9.6 Parts and Accessories

9.6.1 The major parts are listed below. When ordering parts please use the complete part number.

| *Description* | *Part #* |
|---|---|
| Fuse, 0.25A Quantity of 5 | A35-72 |
| Power Supply Circuit Board Assembly, 120 Vac | C13-103A |
| Power Supply Circuit Board Assembly, 240 Vac | C13-103B |
| Microprocessor Circuit Board Assembly (Includes front plate and hinge.) | C13-2200BG |

### 9.7 2200BG Return

9.7.1 If you are returning the 2200BG for service, please call and obtain a “Return Material Authorization” (RMA) number. The box must be clearly marked with the RMA number. Be sure to pack the 2200BGs adequately because AquaMetrix will not be responsible for shipping damage. For safety reasons, AquaMetrix cannot accept 2200BGs and sensors for repair that have not been thoroughly cleaned of process materials.

## STATEMENTS OF CONFORMITY FROM THE MANUFACTURER

### U.S.A.

WARNING: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment.

### Canada

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the radio interference regulations of the Canadian Department of Communications.

Le presént appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Réglement sur le brouillage radioélectrique édicté par le ministére des Communications du Canada.