OPERATING INSTRUCTION MANUAL

MODEL 2200TG
COOLING TOWER ANALYZER

REV. 7.0

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TABLE OF CONTENTS

SECTION	DESCRIPTION	PAGE
1	GENERAL INFORMATION	1
2	SPECIFICATIONS	2
3	INSTALLATION	3
4	DESCRIPTION OF FUNCTIONS	6
5	START-UP AND OPERATION	11
6	OPERATING HINTS	16
7	UTILITY MENU	17
8	DIAGNOSTICS	21
9	TROUBLESHOOTING AND SERVICE	22

MODEL 2200TG CONDUCTIVITY CONTROLLER
INSTRUCTION MANUAL

1.0 GENERAL INFORMATION

The AquaMetrix Model 2200TG tower controller is a versatile industrial microprocessor based instrument, designed to automate the bleed off of a cooling tower system. The unit has 2 operating modes: On / Off mode, and On / Off with cycling mode. Setpoints and outputs are programmed through the menu with push buttons on the face of the instrument. Calibration is achieved from the front panel menu. The instrument may be used in conjunction with an AquaMetrix MS1P or MS1S conductivity cell.

The instrument provides non-isolated 0-5 Vdc, 0-1 mA and isolated 4-20 mA analog outputs. The analog output may be programmed to represent any segment of the measuring scale. 3 relays are provided for control of a solenoid valve, chemical pump and an alarm.

The integrity of the system is ensured with a watch-dog timer and system alarm. A password feature can be enabled to protect the stored values.

The instrument 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 LED, 1/2" high digits

MEASURING RANGES:
Conductivity: 0-5000uS
Temperature: 0°C to 100°C (32°F to 212°F)

POWER REQUIREMENTS:
Standard: 98-132 Vac, 50/60 Hz (less than 20 VA)
Optional: 196-264 Vac, 50/60 Hz (less than 20 VA)
23-26Vdc (nominal current 150mA)

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

CONTROL RELAY A (Blow Down Relay):
5A 115/230 Vac, 5A 30 Vdc SPDT
Fully adjustable relay on and relay off setpoints
Manual Override Auto / Off / On
Normal or Fail Safe operation

CONTROL RELAY B (CHEMICAL PUMP RELAY):
5A 115/230 Vac, 5A 30 Vdc SPDT
Relay energizes when bleed starts and remains energized for pre-set time after bleed stops

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 indicate status of the Blow Down Relay, Chemical Pump Relay and the Alarm Relay.

OPERATING MODES:
On / Off mode: Relay will energize based on Relay On and Relay Off Setpoints
On / Off mode with cycle feature: Relay will cycle based on Cycle on / off time when conductivity is between Relay On and Relay Off Setpoints

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 made 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 menu mode.
Temperature Output: The 0-5 Vdc / 0-1mA output can be programmed to follow the process temperature or conductivity.

TEMPERATURE COMPENSATION:
Automatic 0°C to 60°C (32°F to 140°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 relays, 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
Instrument 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 instrument within 3000 feet of where the AquaMetrix MS1P or MS1S conductivity cell 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 instrument 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 mounting, four feet brackets, together with fastening screws, are provided with the instrument. These should be fastened to the back of the instrument and then it may be 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 instrument 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 instrument 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 instrument is labeled for line power, relay outputs and analog outputs. Connect the wiring in accordance with this labeling. (Refer to Fig.1)

Terminals 4 and 5 are connected directly to the input line voltage. These terminals can be used to supply power to the relays. Use the common ground of Terminal 1as 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 instrument is able to supply enough current to the auxiliary devices, to ensure proper operation of the instrument.

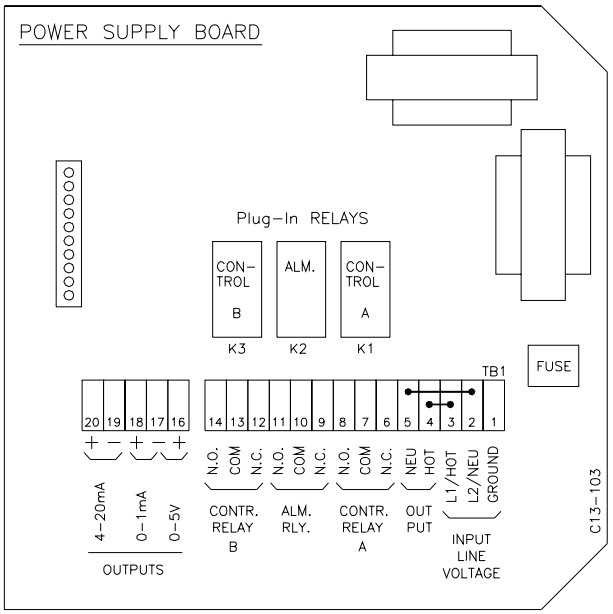


FIG. 1

***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

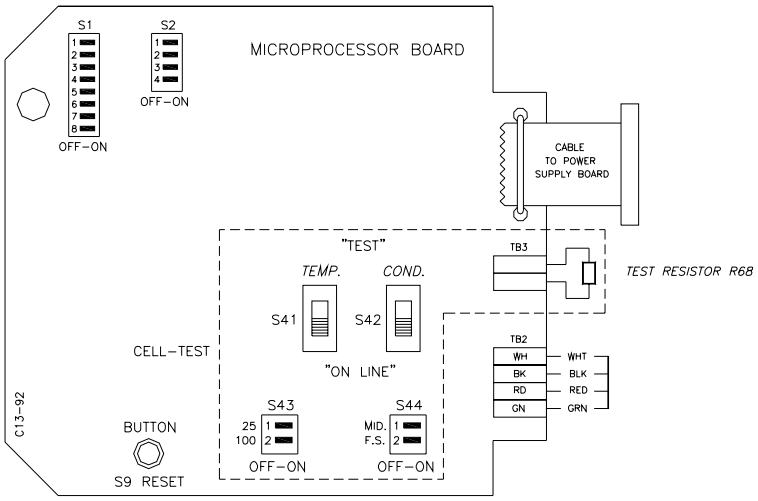
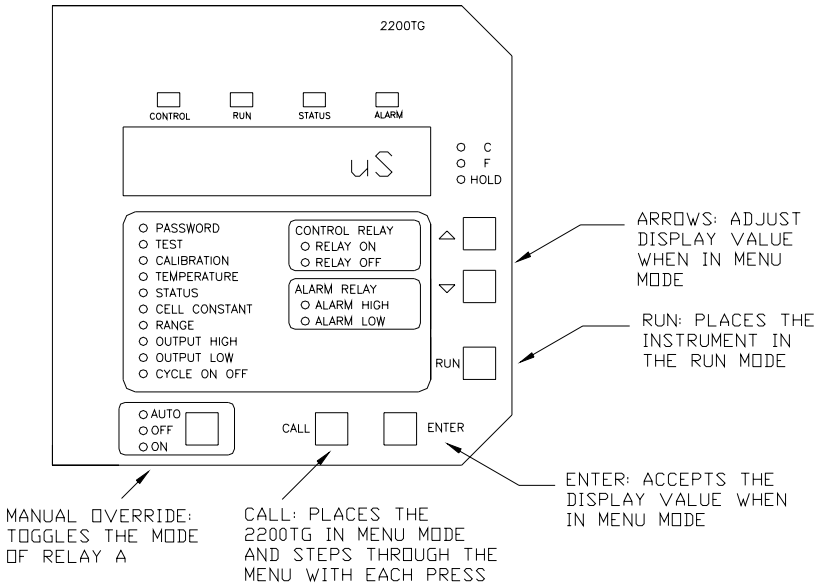


FIG. 2

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 400 ohms. This corresponds to the resistance of the cell at 2500uS and 25°C. This resistor should not be removed as it is required for the internal testing feature.

4.0 Description of Functions



4.1 Overview

4.1.1 The Model 2200TG is a microprocessor based conductivity analyzer designed for industrial applications. It is compatible with AquaMetrix's MS1P and MS1S conductivity cells. 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. Three programmable relays are provided for process control and alarm. The status of each relay is indicated on the front by a LED. The analog output signals transmit low power signals to peripherals such as data recorders or PLC's.

4.1.3 The software is designed for ease of operation. It uses a simple menu with all items indicated on the panel. The user interface consists of six buttons on the front panel. The buttons are scanned and responded 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 2200TG operates like a normal analog converter with a number of additional functions made possible by the microprocessor in the instrument.

Some of these are:
- Recall and easy adjustment of relay and output parameters
- Push button calibration
- A HOLD function for outputs
- 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. Refer to Sec.5.3.

4.3 Temperature Compensation

4.3.1 Temperature compensation is an essential component of conductivity measuring instruments. Specific conductivity increases with temperature even though there has been no addition of dissolved solids. It is therefore the industry standard to compensate for temperature change as if the temperature were constant at 25°C. The 2200TG displays all conductivity reading in uS with respect to 25°C.

4.4 Relay Outputs

4.4.1 Three 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, which is used to remove water from the tower. 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.

4.4.2 The second relay is used to control the addition of chemical through a valve or chemical pump. This relay will energize when the bleed starts and stay energized for a field selectable time after the bleed stops. Refer to Sec. 5.6.

4.4.3 The third 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 also signal memory loss in the controller. See Sections 4.7, 5.7.

4.4.4 The control and alarm 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. See Section 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 instrument. 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 instrument. 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. See Section 5.4.

4.5.4 The instrument may be used to measure the temperature of the process either in °C or in °F. The 2200TG 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 5.10.

4.6 Operations Menu

4.6.1 The operation menu allows the user to recall and to adjust the parameters, required by the analyzer functions.

4.6.2 When the analyzer 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 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 analyzer has a built-in timer, which returns the unit to the online mode if no button has been pressed for 10 minutes. This time-out has the same effect as pressing the RUN button. Refer tpo Sec.4.7.

4.6.4 When in the operations menu, the display will shows the current value of the parameter, such as the Relay On Setpoint of the control 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 outputs and the analog outputs remain on hold. Except for the test function.

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 instrument are all accessible on the control panel. 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. Therefore, after changes to the DIP switch settings, you must press a key on the front panel, in order for the 2200TG to scan the new DIP switch values.

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	Reserved		
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 (10 min)	**Enabled**	Disabled
8	0-5V / 0-1mA Select	**Conductivity**	Temperature

Bank S2

Dip Switch	***Description***	***ON***	***OFF***
1	Chemical Pump Relay	**Enabled**	Disabled
2	Excess Blow Down Timeout	**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 last value to prevent the occurrence of wild distortions during programming and maintenance.

4.8.2 When the Operations Menu is entered by pressing the MENU key, the relays and the analog outputs are automatically placed on hold and remain on hold until the instrument returns to on line. The outputs are no longer on hold as soon as an arrow key is pressed in the TEST mode. The output hold will remain for a maximum of 10 minutes after the last button was pressed, if this feature has been enabled. See Section 4.7.

4.9 Parameter and Operation Checking

4.9.1 The instrument 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 2200TG. 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 controller 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 Control Relay AUTO/OFF/ON Switch

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. ***Be sure to return to AUTO after completing your test if you wish to work automatically.***

4.12 Utility Menu

4.12.1 The Utility Menu is provided to enable authorized personnel to change the temperature output span, chemical pump on time, continuous blow down alarm timeout, and to fine tune the analog outputs. Refer to Section 7.0.

4.13 Watchdog Timer and Self Diagnostics

4.13.1 The 2200TG 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 Section 8.0.

4.14 Operating Modes

4.14.1 The 2200TG has 2 different operating modes.

Mode #1: On / Off Mode
When the sensor measures that the conductivity is above the RELAY ON setpoint, the control relay will energize and will stay energized until the conductivity drops below the RELAY OFF setpoint. Refer to Fig. 4 for typical installation diagram.

Mode #2: On / Off Mode with cycling option
When the sensor measures that the conductivity is above the RELAY ON setpoint, the relay will energize and will cycle on and off based on the cycle times set in the cycle on / off time is the operations menu. The relay will continue to cycle until the conductivity has decreased below the RELAY OFF setpoint. Refer to Fig. 4 for typical installation diagram.

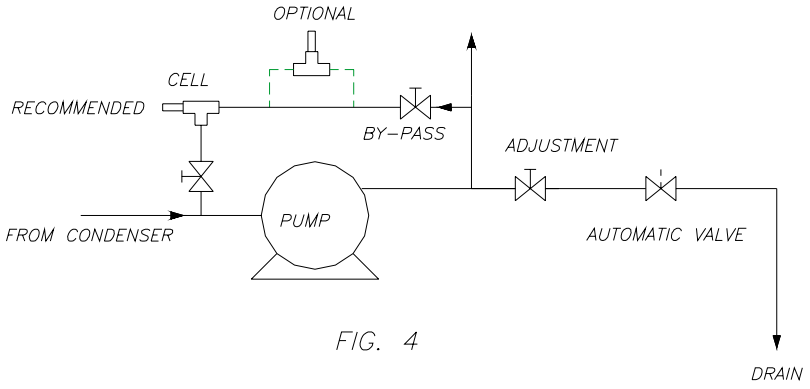


FIG. 4

5.0 START-UP AND OPERATION

5.1 Modes of Operation

5.5.1 The 2200TG has 2 different modes of operation depending on the type of tower that you want to control.

5.5.2 Mode#1: On / Off Mode
Ensure that the Cycle Off time in the operations menu is set to zero. The Cycle ON time can be set to any value. If the conductivity is above the RELAY ON setpoint the control relay will energize and stay energized until the conductivity drops below the REALY OFF setpoint. Refer to Sec. 5.5 for setting the relay on and off setpoints.

5.5.3 Mode#2: On / Off with Cycling Option
Set the Cycle On time an Cycle Off times in the operations menu to the desired values. If the conductivity is above the REALY ON setpoint, the relay will energize and will cycle on and off based on the cycle times set in the cycle on / off time in the operations menu. The relay will continue to cycle until the conductivity has decreased below the RELAY OFF setpoint. Refer to Sec. 5.5 and 5.7 for setting the relay on and off setpoints, and the cycle on / off times.

5.2 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. 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:

5.1.2 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.

5.3 Calibration

5.2.1 There are 3 different methods of Calibrating the 2200TG. Calibration by bleeding off a sample and testing it with a certified Lab meter, calibration by using conductivity buffer solution, and calibration with the internal signal simulator. Calibration with a certified lab meter is the most accurate calibration method. Calibration with the internal signal simulator is not recommended, it should only be used for testing and diagnostic purposes. It can be used if you do not have a lab meter or conductivity buffer solutions.

Method #1: Calibration with a certified lab meter

1. Bleed off a sample of the tower 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 on the controller 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 2200TG is now calibrated. Press the MENU key for another item in the operations menu or press the RUN key to place the controller online.

Method #2: Calibration using Conductivity Buffer Solution

1. Remove the sensor from the process and place it in a beaker of know conductivity solution.
2. Press the MENU key on the controller 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 of the known conductivity solution.
4. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.
5. The 2200TG is now calibrated. Press the MENU key for another item in the operations menu or press the RUN key to place the controller online.

Method #3: Calibration using the internal signal simulator

1. Place S41 and S42 in the UP position (TEST).
2. Place S43 switch 1 ON, and switch 2 OFF.
3. Place S44 switch 1 ON, and switch 2 OFF.
4. Ensure that there is a 400Ω resistor installed at TB3 (R68).
5. Press the MENU key on the controller to enter the operations menu. Press the MENU key until the CALIBRATION LED illuminates.
6. Use the arrow key to make the display read 2500.
7. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.
8. The 2200TG is now calibrated.
9. Place S41 and S42 back in the DOWN position (ONLINE). S43 and S44 are not used in the online mode so there position does not matter.
10. Press the MENU key for another item in the operations menu or press the RUN key to place the controller online.

5.4 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) Enter the menu by pressing 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 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 instrument 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.

5.5 Blow Down Relay (Control Relay A)

5.4.1 The Control 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 Relay On setpoint. Proceed as follows:

a) Enter the menu by pressing the MENU key, proceed by pressing 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 instrument 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 Relay Off setpoint. Proceed as follows:

a) Enter the menu by pressing the MENU key, proceed by pressing 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 instrument 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.

5.6 Chemical Pump Relay (Control Relay B)

5.5.4 The chemical pump relay is enabled by placing switch 1 of bank S2 in the ON position. Refer to Sec.4.7.

5.5.5 The chemical pump relay is used to control the addition of chemicals into the tower. The relay will energize with the blow down relay when the bleed starts and remain energized for a set time (set in the utility menu) after the blow down stops. When the conductivity falls below the Control Relay Off Setpoint the Control LED on the front panel will begin to flash. This indicates that the blow down has stopped but the chemical pump relay is still energized. The Control LED will continue to flash until the chemical pump relay de-energizes.

5.5.6 To set the Chemical Pump On Time, Refer to Sec. 7.3

5.7 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 #2. To set the Cycle On and Cycle Off times proceed as follows:

a) Enter the operations menu by pressing the MENU key. Press the MENU key until the Cycle On LED illuminates. Use the arrow keys to make the display read the desired On time in minuites. The acceptable range is 0.1 to 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 minuites. The acceptable 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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5.8 Alarm Relay

5.7.1 The 2200TG 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, proceed by pressing the MENU key until the ALARM HIGH LED is illuminated. 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.
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.

5.9 Test

5.8.1 To check the setup of the 2200TG, 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) Enter the menu press the MENU key, proceed by pressing the MENU key until the TEST LED illuminates. 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 instrument on line, or press the MENU key, for another menu selection.
c) Once a arrow key is pressed in the test function the outputs are no longer on hold, as they normally are in the operations menu.

5.10 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. If temperature is selected the span of the output can be set in the utility menu. Refer to Sections 4.7, and 7.4.

5.11 Status

5.10.1 The 2200TG 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.

5.10.2

CODE	POSSIBLE CAUSE	SUGGESTED REMEDY
0	Normal Condition	No action required
1	Blow Down Alarm Timeout	Hold RUN for 5 sec to Reset
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

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.

5.12 Range

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

5.13 Cell Constant

5.13.1 This menu item is read only, it displays the cell constant required for the range. The 2200TG 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. 5.3.

6.3 Reset

6.3.1 The instrument 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.

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 instrument 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 press the RUN key. (If the instrument 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 instrument 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:

- Set the Chemical Pump On Time
- Set the Temperature Output Range
- Set the Continuous Blow Down Alarm Timeout
- Fine Tune the 0-1 mA/ 0-5 Vdc output
- Fine Tune 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 ENTER. 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**
Cell Constant	Chemical Pump On Time
Output High	Temperature Output 100% (5Vdc)
Output Low	Temperature Output 0% (0Vdc)
Cycle	Continuous Blow Down Alarm Timeout
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 Chemical Pump Relay On Time

7.4.1 The chemical pump relay will energize with the blow down relay when the conductivity goes above the Relay On setpoint. It will remain energized for a set time after the conductivity falls below the Relay Off setpoint. Proceed as follow to set the chemical pump relay on time.

a) Enter the Utility Menu as described in 7.2.1.

b) Press the MENU key until the CELL CONSTANT LED illuminates, which is“Chemical Pump Relay On Time” in the Utility Menu (See table in 7.2.2). The time is set in minuites and is adjustable between 1 and 60. Use the arrow keys to make the display read the desired time. 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 on line or press the MENU key to proceed to another item in the Utility Menu.

7.5 Temperature Output

7.5.1 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 0°C to 100°C, (or 32°F to 212°F.) The following example explains the setup to have the span from 10°C to 45°C. Proceed as follows:

a) Enter the Utility Menu as described in 7.2.1.

b) 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 45.0. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.

c) 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 10.0. Press the ENTER key. The display will flash until the ENTER key is pressed again to confirm the value.

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

7.6 Continuous Blow Down Alarm Timeout

7.4.1 The 2200TG can be programmed to go into the Blow Down Alarm Timeout mode if the blow down relay remains energized longer than the max timeout alarm time. Proceed as follows to set the blow down alarm timeout max time value.

d) Enter the Utility Menu as described in 7.2.1.

e) Press the MENU key until the CELL CONSTANT LED illuminates, which is “Chemical Pump Relay On Time” in the Utility Menu (See table in 7.2.2). The time is set in minuites and is adjustable between 1 and 60. Use the arrow keys to make the display read the desired time. 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 Adjust 0-1 mA / 0-5 Vdc Output

7.5.1 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 instrument display:

a) Turn off the power to the instrument. Connect your DVM 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.

7.6 Adjust 4-20 mA Output

7.6.1 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 Multi-meter (DMM). Proceed as follows ignoring the instrument display.

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

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

d) 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.

e) 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 2200TG 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. See Section 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 Section 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 Section 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 Section 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 2200TG 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 2200TG appears dead or intermittent, check the breaker, make sure that the instrument 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 2200TG. 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 analyzer, use the self-testing features. Leave the instrument 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

a) 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	2000Ω
1000 uS	1000Ω
2000 uS	500Ω
2500 uS	400O
3000 uS	333Ω
4000 uS	250Ω

9.2 Escape

9.2.1 If the instrument 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 provides the option to 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 t he 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 -
- Control Relay -
- Alarm Relay

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

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

Bring the unit on line for measurement and control.

9.3 Printed Circuit Board Replacement

9.3.1 a) To replace printed circuit boards, shut off all power to the 2200TG, 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 and the board is free. 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.)	C13-2200TG

9.7 Instrument Return

9.7.1 If you are returning the instrument for service, please call an obtain an “Return Material Authorization” (RMA) number. The box must be clearly marked with the RMA number. Be sure to pack the instruments adequately because AquaMetrix will not be responsible for shipping damage. For safety reasons, AquaMetrix cannot accept instruments 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.