OPERATING INSTRUCTION MANUAL

MODEL 2220R
ORP ANALYZER

REV. 3.0

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

TABLE OF CONTENTS

MODEL 2220R PROPORTIONAL ORP CONTROLLER
INSTRUCTION MANUAL

1.0 GENERAL INFORMATION

The AquaMetrix Model 2220R proportional ORP controller is a versatile industrial microprocessor based instrument. Proportional bands, setpoints and outputs are programmed through the menu with push buttons on the face of the instrument. Calibration is also accomplished through the front panel menu.

The instrument may be used in conjunction with AquaMetrix 5-wire differential probes or with conventional combination probes. However, the differential probes are highly recommended for most processes.

The instrument provides non-isolated 0-5 Vdc, 0-1 mA and isolated 4-20 mA analog outputs. The 4-20 mA output may be programmed to represent any segment of the measuring scale.

Bi-directional pulsed proportional control with independently adjustable high and low proportional bands is provided. Either opto-isolated output or reed relays may be ordered. Maximum pulse rate for each band is independently adjustable, as are band width and setpoints. In addition, two alarm relays with fixed deadband are provided.

The integrity of the system is ensured with a watch-dog timer and system alarm. A user-enabled password feature protects 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:
3 1/2 digit LED, 1/2" high digits

MEASURING RANGES:
ORP: 0 to 1000 mV
or -1000 to 1000 mV
or -600 to 600 mV
or 0 to 600 mV
Temperature: -10°C to 110°C

POWER REQUIREMENTS:
98-132 Vac, 50/60 Hz (less than 5 VA)
Optional: 196-264 Vac, 50/60 Hz

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

PROPORTIONAL BANDS:
Bi-drectional pulsed proportional control. Maximum pulses per minute independently adjustable for each band between 30 and 120. Pulse rate automatically decreases as setpoint is approached. Choice or reed relay or opto-isolated pulse outputs.

ALARM RELAY:
Two relays with fixed deadband of 2% of full scale.
Normal or fail-safe operation.
Rating: 5A 115/230 Vac, 5A 30 Vdc, SPDT

RELAY INDICATORS:
Three individual rectangular LEDs indicate status of the two pulsed outputs and the alarm relay.

ANALOG OUTPUTS:
Non Isolated 0-1mA, 100 ohms maximum load
Non Isolated 0-5Vdc, 1000 ohms maximum load
Isolated 4-20mA, 800 ohms maximum load
Range Expand: The 4-20 mA analog output can be made to represen200 mV ORP or larger segment of the measuring scale.
Output Hold: The analog outputs are automatically placed on hold during calibration or other setup operations.
Temperature Output: The 0-5 Vdc outputs can be programmed to follow the process temperature or ORP provided the sensor is equipped with a suitable temperature sensor.

SENSOR-TO-ANALYZER DISTANCE:
3000 feet maximum for AquaMetrix 5-wire differential electrode technique sensor.
10 feet maximum for direct connection of conventional combination electrode (an AquaMetrix Series 100 preamplifier is required for distances greater than 10 feet)

SYSTEM ERROR:
A rectangular LED indicates a system error. One of the alarm relays can be programmed to transfer upon system error.

DIAGNOSTICS: Invalid entries are identified by respective flashing LEDs. When a status error occurs, press CALL to obtain the status error number, which corresponds to a fault as described in the Status Fault Table.

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 relays, alarm relay, and outputs to be tested independently of process value.

SAFETY AND SECURITY:
Non-volatile memory (EEPROM)
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

RESPONSE TIME:
0.5 second to 90% of value upon step change

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)

APPROVAL: CSA

3.0 INSTALLATION

3.1 Location

3.1.1 Install the instrument within 3000 feet of where the AquaMetrix differential probe (P60 Series) is installed. If a conventional combination probe (P500 Series) is used the instrument must be within 10 feet of the probe for direct connection. An AquaMetrix 100 Series preamplifier may be used to extend this distance to 3000 feet.

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.

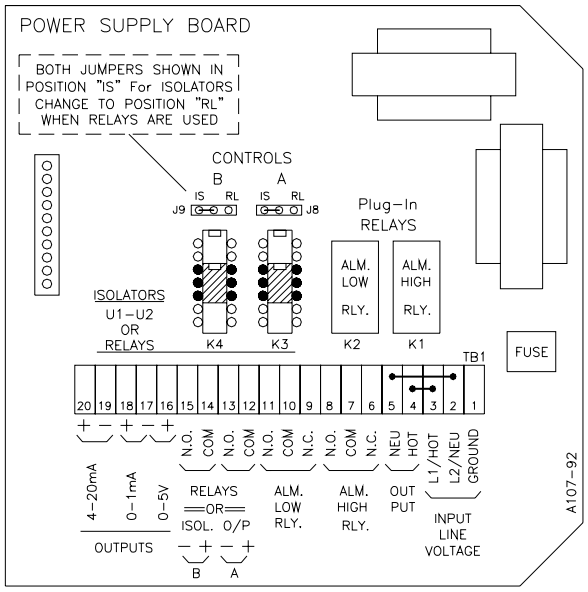
3.3.2 For convenience of internal connections the right conduit hole (viewed from the front) should be used for power connection; the next hole to the left for relay outputs; the next hole to the left for analog outputs and finally the fourth hole for sensor input.

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 swing-out board.

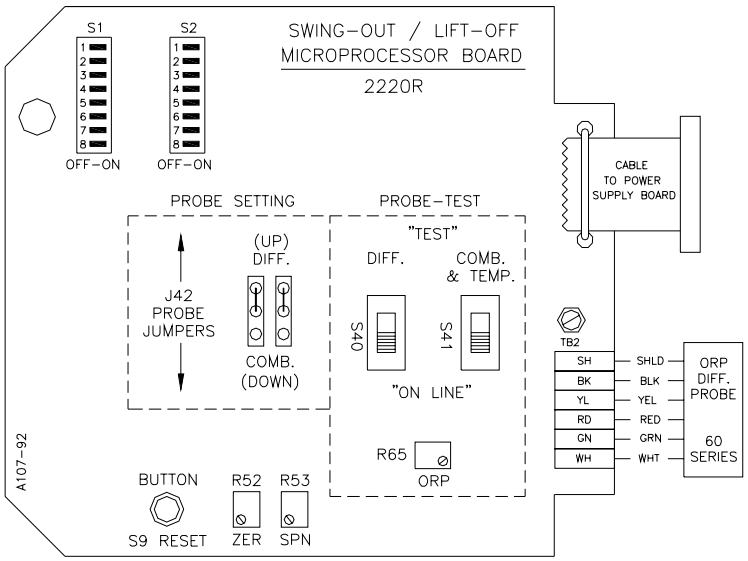
3.4.2 The terminal strip on the power supply board at the back of the instrument is labeled for power supply, relay outputs and analog outputs. Connect the wiring in accordance with this labeling. *CAUTION*: Connecting the line voltage power supply to incorrect terminals may cause serious damage.



3.5 Sensor Connections; Differential Probe (R60 Series)

4.13.1 Ensure that both J42 jumpers located on the swing-out board are towards the top in a vertical position leaving the pin nearest to the bottom exposed. See Diagram.

3.5.2 Connect the 5 wires of the probe cable to TB2 terminal strip on the swing-out board being sure to match colors as printed on the terminal strip.



3.6 Sensor Connections; Combination Probe (R500 Series)

3.6.1 a) Both J42 jumpers located on the swing-out board must be in the lower vertical position leaving the pin nearest to the top exposed. See diagram above.

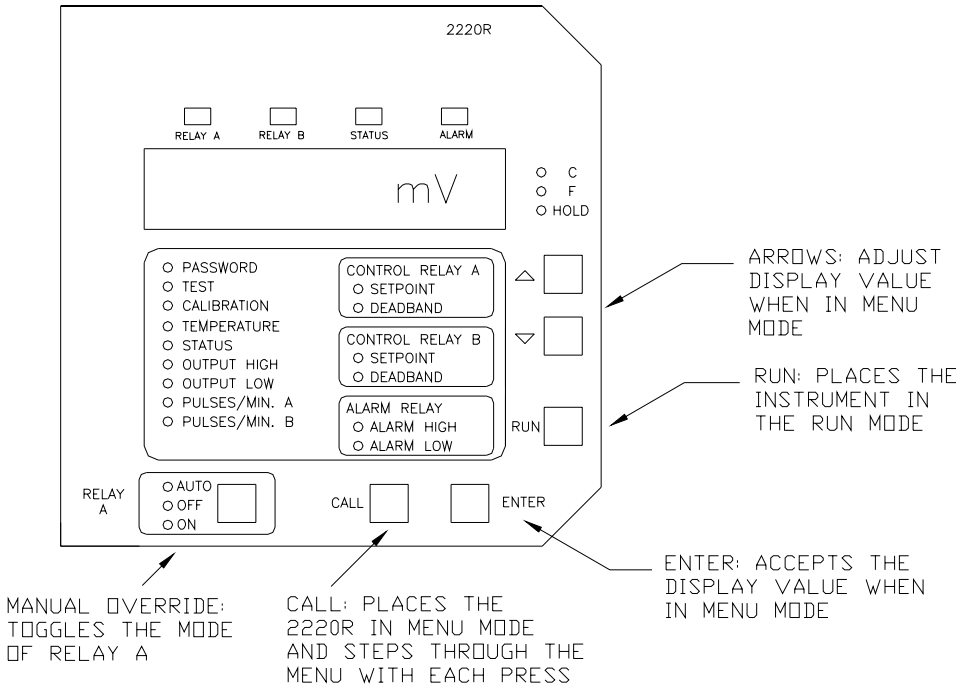
b) Connect the active electrode (ring terminal) to the terminal post on the swing-out board and connect the shield to the SH terminal of the terminal strip TB2.

c) If you have purchased an AquaMetrix probe with a temperature sensor (R575K or R585K) connect the temperature sensor wires to the YL and BK terminals of TB2 disregarding the colors.

3.7 Combination Probe with Preamplifier

3.7.1 If the analyzer is mounted in such a position that the 10 ft. cable on the probe cannot be directly connected to an AquaMetrix 100 Series preamplifier is required. The 5 wire cable from the preamplifier should be connected to the TB2 terminal strip as described in Section 3.5.2 and the jumpers must be positioned as described in 3.5.1.

4.0 DESCRIPTION OF FUNCTIONS



4.1 Overview

4.1.1 The Model 2220R is a microprocessor based proportional controller designed for industrial industrial applications. It is compatible with a wide range of AquaMetrix pH probes and offers several measurement ranges. The software in the unit makes the instrument very easy to operate and maintain.

4.1.2 The outputs include pulsed output from two proportional bands. Two alarm relays and industry standard analog transmission are indicated on the front panel by LEDs. The analog output signal transmit low power signals to peripherals such as data recorders or control systems.

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 checking for 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 2220R operates like a normal analog converter with a number of additional functions made possible by the microprocessor in the instrument.

Some of these are:

- Bi-directional pulsed proportional control
- Recall and easy adjustment to 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 provided you have ordered ORP probe with a temperature sensor

4.2 Calibration

4.2.1 Calibration can be accomplished by using solutions with known ORP at known value and adjusting the instrument to show the known ORP value. Solutions are available in 500 mL bottles from AquaMetrix. The procedure for performing calibration is very simple and is given in Section 5.2.

4.3 Temperature Compensation

4.3.1 Temperature compensation is not a requirement for ORP measurements and consequently the process temperature is not sensed by the ORP probe unless you have ordered an ORP probe with a temperature sensor to provide temperature indication and output.

4.4 Proportional Bands and Alarm Relays

4.4.1 Two proportional bands are provided which give a pulsed output. The frequency of the pulses automatically decreases as the setpoint is approached. See Section 5.5.

4.4.2 Two alarm relays are provided for independent setting of high and low alarms. See Section 5.6. The deadbands of the alarm relays are fixed at 2% of full span.

The alarms can be programmed to signal memory loss with DIP switch 5. See Section 4.7.

4.4.3 The alarm relays can be programmed for “fail-safe” operation which reverses the “normal” operation. In this mode the relays will fail-safe (transfer) in the event of power failure.

4.5 Analog Outputs

4.5.1 The analog output signals consists 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 4-20 output can be programmed to another linear range by entering two values:

- Output High: This is the ORP value at which you wish to have 100% output. i.e. 20 mA.

- Output Low: This is the ORP value at which you wish to have 0% output. i.e. 4 mA.

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 If you have ordered an ORP probe with a temperature sensor, the instrument may be used to take a temperature reading in the process either in Celsius or in Fahrenheit. The 2220R does not control temperature but the 0-5 Vdc and 0-1 mA analog output can be dedicated to follow the process temperature by the position of a DIP switch. See Section 4.7.

4.6 Operation 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 pH readings and the STATUS indicator above the display will be green. None of the LEDs in the operation menu will be illuminated.

4.6.3 Five buttons on the panel are used to operate the menu. Use the CALL button to step through the items in the menu. The red LEDs beside each item makes it very easy to follow the menu. The function of the RUN button is to return to the on-line ORP 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.

4.6.4 When in the menu mode, the display initially shows the current value of the parameters, such as the setpoint of the control relay, while putting all of the outputs on hold. The two arrow buttons are used to adjust the display value up or down. To accept the new value press ENTER twice. While the value on the display is being changed, the relay outputs and the analog outputs remain on hold.

The items that appear in the operation menu are:

- Password
- Test
- Calibration
- Auto Calibration
- Temperature
- Status
- Output High
- Output Low
- Pulse / min., A
- Pulse / min., B
- Proportional Band A
- Setpoint A
- Setpoint B
- Proportional Band B
- Alarm Relay High
- Alarm Relay Low

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 swing-out board.

4.7.2 The DIP switches are scanned only on power-up and every time the instrument is taken into the menu mode. Therefore, after changes to the DIP switch settings, you must bring up the menu by pressing CALL in order for the instrument to scan the new DIP values.

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

DIP Switch Bank S1	*Description of Use*	*Switch OFF*	*Switch ON*
1	Selects temperature unit	°F	°C
2	Enables use of Password Feature	YES	NO
3	Reserved		
4	Reserved		
5	Enables Alarm Relay to be activated for System Alarm	YES	NO
6	Sets Fail-safe for Alarm Relays	NO	YES
7	Auto return from menu to RUN if no button pressed for 10 minutes	NO	YES
8	Selects 0-5 mA outputs to track temperature or pH	Temperature	ORP

Dip Switch Bank S2

* Not used on Model 2220R

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 Operation Menu is entered by pressing CALL, the relays and the analog outputs are automatically placed on hold and remain on hold until the instrument 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 by DIP switch 7 of Bank S1. See Section 4.7.

4.8.3 The pulsed output continues at the same rate as before CALL was pressed. If this is not desired use the AUTO/OFF/ON button to discontinue the pulses.

4.9 Parameter and Operation Checking

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

4.10 Simulated Input for Testing

4.10.1 TEST is function for test and diagnostic purposes. Values can be simulated internally and adjusted with the arrow buttons to set display reading and analog outputs to any desired value without disrupting instrument calibration. You can also observe the responses of the control and alarm relay to verify your menu settings. Of course, the relays and outputs are no longer on hold once the arrow buttons are used in TEST mode.

4.11 Proportional Bands AUTO/OFF/ON Switch

4.11.1 The AUTO/OFF/ON button is used to set the status of the pulsed outputs. This useful feature allows the operator to check the operation of the controlled devices.

4.12 Utility Menu

4.12.1 The Utility Menu is provided to enable authorized personnel to change the range and to fine tune the analog outputs. See Section 7.0.

4.13 Watchdog Timer and Self Diagnostics

4.13.1 The 2220R 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. See Section 8.0.

5.0 START-UP AND OPERATION

5.1 Password

5.1.1 To enter the menu press CALL and PASSWORD will be indicated. With each press of CALL you will step through the menu. When the last item, ALARM LOW is reached the menu wraps around to TEST. If you have enabled PASSWORD by placing DIP Switch No. 2 of Bank S1 in the off position you must enter the password "6" when PASSWORD is indicated, if you wish to change any stored value. You do not need to enter the password to proceed to other items in the menu for recall of stored values.

5.2 Calibration

5.2.1 Calibration can be accomplished in CALIBRATION mode.

5.2.2 To calibrate the instrument you will need two calibration solutions, a beaker of clean water and an empty beaker. Standard 200 mV and 600 mV solutions are available in 500 mL bottles from AquaMetrix. You may also use any other solution of known mV value. To calibrate proceed as follows:

a) Enter the menu by pressing CALL and then entering the Password if enabled. See Section 5.1. Proceed by pressing CALL to light the CALIBRATION LED.

b) After removing the protective caps from the probe, rinse it in clean water, then place it in 200 mV solution. The display may flash which indicates that the instrument is receiving an unstable output from the probe. When the display is steady use the arrow buttons to make the display read 200. Press ENTER. The display will flash until ENTER is pressed again to confirm entry.

c) Rinse the probe in clean water and place it in 600 mV solution. When the display is stable use the arrow buttons to make the display read the appropriate value. Press ENTER twice as above.

d) The system is now calibrated. Press RUN to place the instrument on line or use the CALL button to proceed to other menu items.

NOTE: If a major change is necessary to make the display read the value of the known solution the CALIBRATION LED will flash when you press ENTER. This is to warn you that you may have made a mistake such as entering the wrong solution value or using a contaminated sr. If you are confident your procedure was correct, press ENTER a second time. Otherwise, repeat the calibration procedure by pressing CALL a sufficient number of times to go through the menu and return to CALIBRATION.

5.3 Analog Output Range Expand

5.3.1 The 4-20 mA isolated analog output may be spread over any section of the scale as long as that section is at least 10% (200 mV) of full scale. The best way to describe this setup is by example. Suppose you wish the 4-20mA output to span 100 mV to 600 mV. Proceed as follows:

a) Press CALL as many times as required until OUTPUT HIGH is indicated. Now use the arrows to make the meter read 600 mV. Press ENTER. The display will flash until ENTER is pressed again to confirm entry.

b) Press CALL once to indicate OUTPUT LOW. Now use the arrow buttons to make the meter read 100 mV. Press ENTER twice as above.

c) The analog output will now be at 4 mA when the ORP of the solution is 100 mV and will increase to 20 mA when the ORP of the solution is 600 mV.

d) Press RUN to place the instrument on line or press CALL for another menu selection.

NOTE: A range expand of less than 10% of full scale is an invalid entry which will be indicated by the LED flashing when you return to RUN. To correct, return to the menu and correct the output settings.

5.4 Bi-Directional or Uni-Directional Pulsed Proportional Control

5.4.1 The 2220R is fitted with two proportional bands, labelled A and B, which provides bi-directional control. The proportional bands above and below the desired operating range are independently adjustable. The minimum operating range between Setpoint A and Setpoint B is 10 mV.

The maximum pulses per minute is independently adjustable for each band for any value between 30 and 120 pulses per minute. Pulse direction is permanently set at 0.1 seconds. The number of pulses per minute automatically reduces as the setpoint is approached to a minimum one tenth of the set maximum.

Setup is best described by example. Suppose the following:

Maximum pulses per minute, Band A: 90
Maximum pulses per minute, Band B: 120
Desired operating range: 500 to 550 mV
Proportional Band A: 400 to 500 mV
Proportional Band B: 550 to 700 mV

5.4.2 To set up for above example proceed as follows. The diagram on the next page will also be helpful.

a) Enter the menu and c all PULSE/MIN A.

b) With the arrow buttons, make the display read the number of pulses per minute desired for Proportional Band A, in this example, 90. Press ENTER. The display will flash until ENTER is pressed again to confirm entry.

c) Press CALL. PULSE/MIN B will be indicated. Now make the display read the number of pulses per minute desired for the Proportional Band A, in this example, 120. Press ENTER twice as above.

d) Press CALL. CONTROL A PROP. BAND will be indicated. With the arrow buttons make the display read the low limit of Proportional Band A, in this example, 400. Press ENTER twice as above.

e) Press CALL. CONTROL A SETPOINT will be indicated. With the arrow buttons make the display read the setpoint for Proportional Band A, in this example, 500. Press ENTER twice as above.

f) Press CALL. CONTROL B SETPOINT will be indicated. With the arrow buttons make the display read the setpoint for Proportional Band B, in this example 550. Press ENTER twice as above.

g) Press CALL. CONTROL B PROP. BAND will be indicated. With the arrow buttons make the display read the high limit of Proportional Band B, in this example 700. Press ENTER twice as above.

h) Press RUN to return to on line operation or press CALL to select other menu items.

5.5 Alarms

5.5.1 The instrument is fitted with two independent relays for high and low alarm. To set the alarm proceed as follows.

a) Press CALL the required amount of times until ALARM HIGH RELAY is indicated. With the arrow buttons make the display read the desired high alarm value. Press ENTER. The display will flash until ENTER is pressed again to confirm entry.

b) Press CALL again to indicate LOW RELAY. With the arrow buttons make the display read the desired low alarm value. Press ENTER twice as above.

c) Press RUN to place the instrument on line or press CALL for another menu selection.

NOTE: The low and high alarm values must be respectively below and above the proportional band settings.

5.6 Test

5.6.1 To test your setup enter the menu and press CALL the number of times required to indicate TEST. Now by using the arrow buttons you can “sweep” the digital display and observe the control relays action and the alarm relay action. Outputs are not on hold if the arrow buttons are used in TEST mode.

5.6.2 With the instrument in TEST you can check the analog output at any desired reading with a meter connected to the appropriate output terminals.

5.6.3 Another use of this feature is to check the stability of the system. When in TEST, use the arrow buttons to select any value, say 500 mV. Now return on line by pressing RUN. Return to the meter some hours or days later. Press CALL to indicate TEST. If the instrument is still in calibration and if no one has interfered, the meter should read 500 mV.

5.7 Temperature

5.7.1 If you have ordered an ORP probe with a compatible temperature sensor, the temperature of the process can be read at any time by entering the menu and calling for TEMPERATURE. Either °C or °F will be indicated depending on the position of DIP switch No. 1.

5.7.2 The 0-5 Vdc and 0-1 mA analog outputs can be dedicated to follow the process temperature by simply placing DIP switch No. 8 of Bank S1. in the OFF position. The temperature span of the output is set to the utility menu. See Section 7.4.

5.8 Status

5.8.1 The 2220R continuously checks the integrity of all stored data and monitors the condition of the measuring system. If a fault is detected, the STATUS LED above the display will change from green to red. When this occurs, call STATUS in the operation menu. The display will show a numerical code to assist you.

The following table shows the display codes, causes and remedies:

Code	*Possible Cause*	*Suggested Remedy*
0	Normal Condition	No action required
1	ORP probe efficiency (Probe slope out of tolerance)	Clean probe and recalibrate. Probe may need replacement
2	Temperature Sensor off Scale	Check for open or short connections of temperature sensor input (Terminals BLK & YEL on TB2) if temperature sensor is fitted
3	ORP reading off Scale	Verify process. Check for open or short connections
4*	Memory Loss	Call your AquaMetrix Rep. Or AquaMetrix directly
5*	EEPROM write failure	Call your AquaMetrix Rep. Or AquaMetrix directly
6	Calibration out of limit	Check scale setting (see Range Change in Utility Menu)

NOTE: Code 4 and 5 could be serious failures so the alarm relay will activate, in addition to the status LED changing to red, if programmed by the position of DIP switch No. 5 of Bank S1. See Section 4.7.

6.0 OPERATING HINTS

6.1 Probe Care

6.1.1 Keep the probe clean using the procedure recommended in the probe manual. Although the differential probe will continue to operate when fouled, excessive fouling may cause incorrect readings or very slow response.

6.1.2 Be sure the probe cable is well protected. The probe cable should be run in conduit but never in the same conduit with line power. Sufficient excess cable should be allowed for removal of the probe for cleaning and calibrating.

6.1.3 If the system can no longer be calibrated, that is, if you cannot make the instrument read the high or low buffer value, then the probe may need to be replaced.

6.2 Calibration

6.2.1 The calibration procedures outlined in Section 5.2 are recommended. However, it is possible to calibrate with one point only or to any known value if you prefer.

6.2.2 The system will only be as accurate as your calibration technique. When first installed frequent calibration is recommended. After a while you will become familiar with how frequently you need to calibrate your particular system.

6.2.3 Use only fresh millivolt solutions. A contaminated solution will result in faulty calibration and therefore incorrect readings. Buffer solutions are available from AquaMetrix.

6.3 Ground Loop Errors

6.3.1 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 and in a junction box or a preamplifier dry and free of corrosion.

6.4 Escape

6.4.1 The operator has the option to erase all programmed values and replace them with factory set defaults, except, of course, the DIP switch settings, by performing the following procedure:

a) Turn the power off. Now press and hold RUN while turning on the power.

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 CALL. To return to on line operation press RUN. (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 RUN 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 of Bank S1 in the ON position.

7.0 UTILITY MENU

7.1 Utility Menu Functions

7.1.1 The Utility Menu is provided to enable authorized personnel to perform the following:

- Adjust the temperature output range
- 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 password. To access the Utility Menu press and hold both RUN and ENTER for five seconds until the PASSWORD LED illuminates. The green STATUS light will flash. Now with the arrow keys make the display read the password, "7". Press ENTER.

7.2.2 The Utility Menu is entirely separate from the Operation Menu but uses the same LED display. Press CALL to step through the menu items.

Below is the cross-reference between menu items:

Display LED	Meaning in Utility Menu
Output High	Temperature Output 100% (5 Vdc)
Output Low	Temperature Output 0% (0 Vdc)
Control A, Proportional Band	0-1 mA / 0-5 V Output Adjust Low
Control A, Setpoint	0-1 mA / 0-5 V Output Adjust High
Alarm High Relay	4-20 mA Output Adjust Low
Alarm Low Relay	4-20 mA Output Adjust High

7.3 Temperature Output

7.3.1 The 0-5 Vdc and 0-1 mA outputs jointly may be programmed to track the temperature of the process provided you have an ORP probe with a temperature sensor. From the factory the outputs have a linear range corresponding to 0 to 100°C (32 to 212°F). Suppose you wish the output to span 10 to 45°C. Proceed as follows:

a) Enter the Utility Menu as described in 7.2.1.

b) Press CALL to indicate OUTPUT HIGH which is “Temperature output, 100% point” in the Utility Menu (See table in 7.2.2). Now use the arrow buttons to show 45.0 on the display. Press ENTER. The display will flash until ENTER is pressed again to confirm entry.

c) Press CALL to indicate OUTPUT LOW, which is “Temperature output, 0% point” in the Utility Menu (See table in 7.2.2). Now use the arrow buttons to show 10.0 on the display. Press ENTER twice as above.

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

7.4 Adjust 0-1 mA / 0-5 Vdc Output

7.4.1 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. (DVM). Proceed as follows ignoring the instrument display:

a) Turn off the power to the instrument. Connect your DVM to 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 CALL to indicate CONTROL A PROP. BAND 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 DVM read 1.25V. Press ENTER twice to confirm.

d) Press CALL to indicate CONTROL A SETPOINT 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 DVM read 3.75V. Press ENTER twice to confirm.

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

7.5 Adjust 4-20 mA Output

7.5.1 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 (DVM). Proceed as follows ignoring the instrument display.

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

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

c) Press CALL to indicate ALARM HIGH RELAY 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 DVM read 8 mA. Press ENTER twice to confirm.

d) Press CALL to indicate ALARM LOW RELAY 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 DVM read 16 mA. Press ENTER twice to confirm.

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

8.0 DIAGNOSTICS

8.1 Description

8.1.1 The 2220R 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 4.7.3.

8.2 Invalid Calibration

8.2.1 Invalid calibration will be indicated in the following instances:

- When the difference between the two calibration solutions is less than 10% of the measuring scale span. To correct, enter the menu and calibrate with more appropriate solutions. See Section 5.2.

- When the input is out of range. This could occur if you had attempted to calibrate with a solution which was outside the range of the instrument.

8.3 Invalid Output

8.3.1 Invalid output will be indicated if the expanded range is less than 10% of full scale.

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 5.5.

8.5 Invalid Setpoint

8.5.1 The setpoint for Control A must be HIGHER than the proportional band setting. Similarly the setpoint for Control B must be LOWER than the proportional band setting. If you have not made these settings correctly, invalid entry will be indicated by the flashing of the appropriate LED when in run mode. To correct, refer to Section 5.4.

9.0 TROUBLESHOOTING AND SERVICE

9.1 Calibration / Display Problem

9.1.1 If the problem is one of inability to calibrate or the display does not appear to match the input, try the RESET feature. See Section 6.4.

9.2 Isolate the cause

9.2.1 When a measurement problem occurs, the first step is to try to isolate the cause. If the 2220R is powered, go through the menu and check your settings. A convenient way to do this is to call TEST. See Section 5.6

9.2.2 If your 2220R 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 below.

9.2.3 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 2220R. 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 change it. See Section 9.4.

9.2.4 If the process value seems wrong, clean the probe as described in the probe manual. Inspect the probe, wire and interconnections. Open the inner door and ensure that the two jumpers JP1 are in the correct position for the probe used and the probe wires are correctly and firmly connected. See Sections 3.5 and 3.6. Now place the probe into a 200 mV solution. Rinse, and place it into a 600 mV solution while observing the panel meter. If the values are close, re-calibrate and resume operation. Should there be a major discrepancy, bring the probe and calibration solutions to the 2220R, connect directly to the 2220R and repeat the procedure. If that does not solve the problem, replace the probe.

9.3 Printed Circuit Board Replacement

9.3.1 a) To replace printed circuit boards or relays shut off all power to the 2220R, 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 three screws. Remove the screws to release the circuit board.

9.4 Alarm Relay Replacement

9.4.1 The alarm relays are plugged into the power supply board just above the terminals. Be sure all the power including independent power to the relay is off. Unplug the relays in question and replace with new relays. See Section 9.7 for part numbers.

9.5 Pulsed Output Replacement

9.5.1 Your 2220R will be fitted with two reed relays (2220-X-D-X) or two opto-isolators (2220-X-C-X). These components are plugged into the power supply board. To replace, be sure all power to the instrument is off. Unplug the parts in question and replace. See Section 9.7 for part numbers.

9.6 Customer Service

9.6.1 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: (905) 946-1064
Fax: (905) 946-8064
Email: support@aquametrix.com

9.7 Parts and Accessories

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

Description	*Part #*
500 mL 200 mV Calibration Solution	35-40
500 mL 600 mV Calibration Solution	35-41
Fuse, 0.25A Quantity of 5	35-72
Relay, alarm	17-38
2220R Power Supply Circuit Board Assembly 115 Vac with reed relays for 2220R-1-D-X	35-92
2220R Power Supply Circuit Board Assembly 230 Vac with reed relays for 2220R-2-D-X	35-93
2220R Microprocessor Circuit Board Assembly (includes front panel and hinge)	35-95
2220R Power Supply Circuit Board Assembly 115 Vac with opto-isolators for 2220-1-C-X	35-96
2220R Power Supply Circuit Board Assembly 230 Vac with opto-isolators for 2220-2-C-X	35-97
Reed Relay (for 2220R-X-D-X)	17-40
Opto-isolators (for 2220R-X-C-X)	75-92

9.8 Instrument Return

9.8.1 If you are returning the instrument for service, please enclose a written description of the problem and a purchase order to cover the repair. 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.