WQM-100
Water Quality Monitor

Instruction Manual

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Hydro Instruments
WQM-100 Water Quality Monitor

Table of Contents

I. GENERAL INFORMATION

1. **Important Operational Information**

   To increase the life expectancy, accuracy and response of the electrode adhere to the following operational guidelines:

   1. Keep the electrode wet. Allowing the electrode to dry out will lead to slow response, erroneous readings and damage.
   2. Clean the electrode regularly
      - Take care when cleaning the electrode. Never use a brush or coarse surface for cleaning.
      - To clean, simply rinse the electrode with water. Blot (do not rub) with a lint-free paper towel to remove excess moisture.
      - Specially formulated cleaning solutions can be used to clean the electrode too.
      - Wiping the glass can produce a static charge which interferes with the electrodes ability to read.

2. **Important Handling Considerations**

   The electrodes are shipped in a cap containing a solution. The electrode should only be removed from this solution when it is ready to be installed and used.

   NOTE: If the electrode will be subject to infrequent use it should be stored in Storage Solution or in a pH 4 buffer solution if Storage Solution is not available. Do not store the electrode in deionized (DI) water as this will damage the electrode.

3. **Electrode Lifespan**

   Just like any piece of equipment, electrodes need to be replaced from time to time as regular maintenance. As sensors age they become less responsive. The offset and slope are metrics by which to measure the electrodes functionality. Refer to Appendix A in this document for more information.

   The manufacturing lot number can be found on the label on the electrode. This information can be used to determine the age of the electrode.

II. INSTALLATION

Refer to Figure 3 for this section.

1. **Sample Water Connection and Control:** The following are some considerations relating to the sample water supply. The WQM-100 Water Quality Monitor requires a constant supply of sample water at a controlled rate and pressure. Precautions should also be taken to ensure that the sample water reaching the measurement cell is not altered as it passes through the sample water piping. Also, the connection to the sample point should be made in such a way to avoid receiving air or sediment from the pipe. Consider figure 4 when creating your sample water line

   Flow: The sample water flow rate should be controlled at an ideal rate of 500 ml/minute (8 GPH). A flow meter and rate control valve may be necessary to achieve and maintain this flow rate. This can be installed upstream from the measurement cell.

   WARNING! Do not run the instrument without sample water running through it. Lack of, or interruption of water flow can cause premature failure of the electrodes.

   Pressure: Where the sample point has a water pressure higher than 87 PSI (6 bar), a pressure-reducing valve must be employed to deliver the sample water to the measurement cell. The sample water entering the measurement cell should be at a pressure below 87 PSI (6 bar). If the sample point pressure is too low, then it may be necessary to use a sample pump to deliver the sample water to the measurement cell.

   Other Considerations: It should be considered, that any biological growth inside the sample piping system will have some adverse effects. This can cause the sample water reaching the measurement cell to not be an accurate sample. For example, the ORP could change as the sample water passes through the sample water piping system. For this reason, it may be necessary to periodically clean the sample water piping system to prevent any biological growth or clear out residual chemical buildup. Also, it is generally not recommended to use a filter in this piping system because as the filter collects particles it can lead to inaccurate readings. However, in certain installations with significant amounts of solids in the sample water (particularly iron and manganese) the use of sample water filters may be necessary.

2. **Sample Water Disposal Considerations:** If no reagent and/or pH buffer chemical is being injected, then the disposal of the water departing the measurement cell is usually not a significant concern. However, if some reagent and/or pH buffer chemicals are being injected, then all applicable regulations should be considered before making the decision of how and where to dispose of the wastewater exiting the measurement cell. Refer to the MSDS of the chemical in question for instructions on proper disposal.

3. **Sample Point Selection:**

   There are at least two general concepts to consider when selecting the sample point location. First, is to select a point that allows reliable determination of the parameter to be measured at the most critical point for the particular installation. Second, is to take into consideration any chemical injection control timing. A balance between these considerations must be reached.

   Each system is unique, however in general the goal of the chemical injection is to achieve some result by maintaining a certain measurement at a particular point in the system. For example, to maintain a specific chlorine residual at the exit of the drinking water facility. The location should be selected so that the injected chemical is already fully mixed so that an accurate sample can be sent to the measurement cell.

It should also be considered that the sample point should be located such that the residual reading can be used as a control signal for the chemical injection. Especially, it should be considered that if there is a long time delay between chemical injection changes and the change being detected by the measurement cell, then chemical injection control is adversely affected. The delay time should be kept as short as possible. We recommend that the time be less than 5 minutes.

FIGURE 1 (Sample Water Piping Examples)

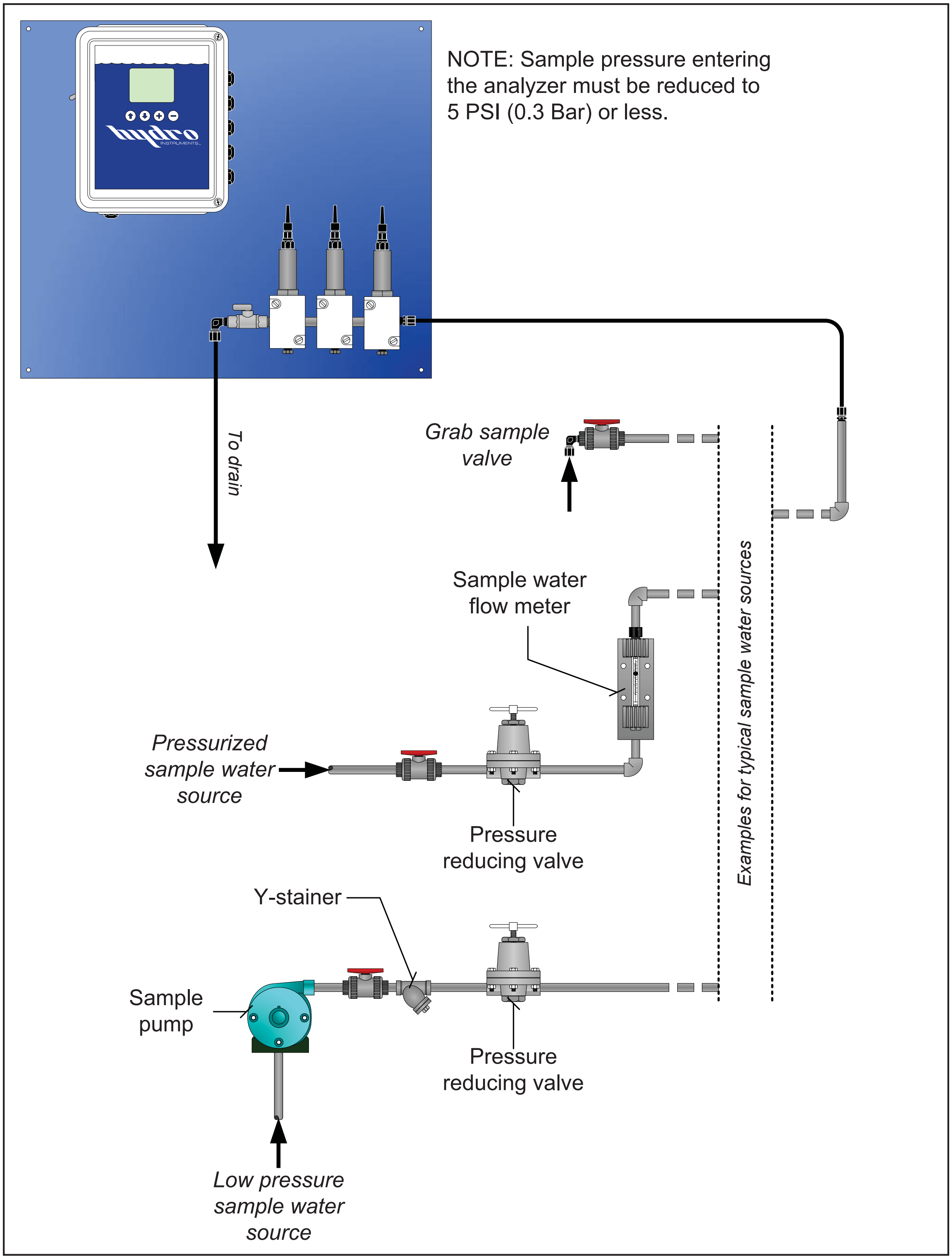


FIGURE 2 (Sample Point Sources)

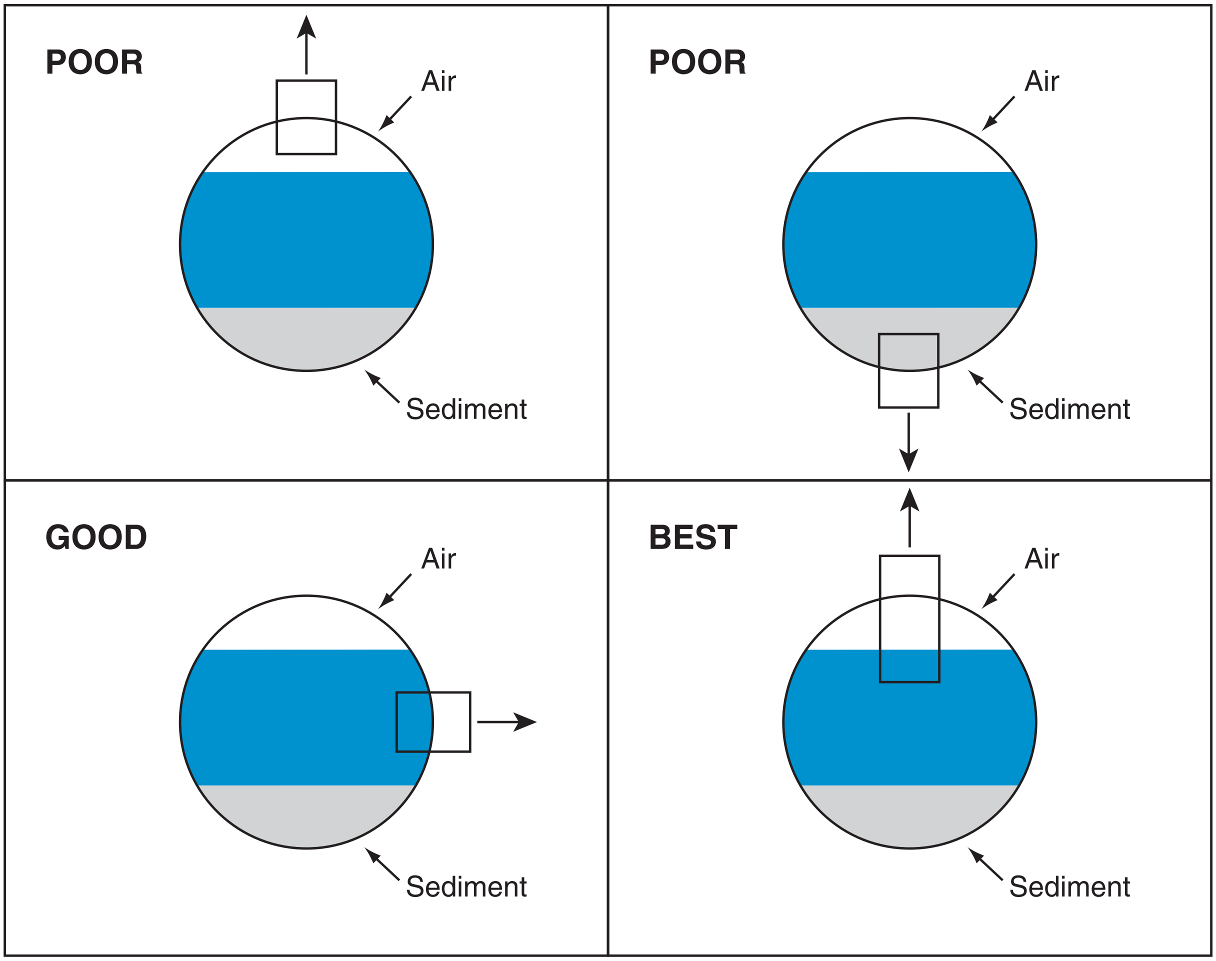
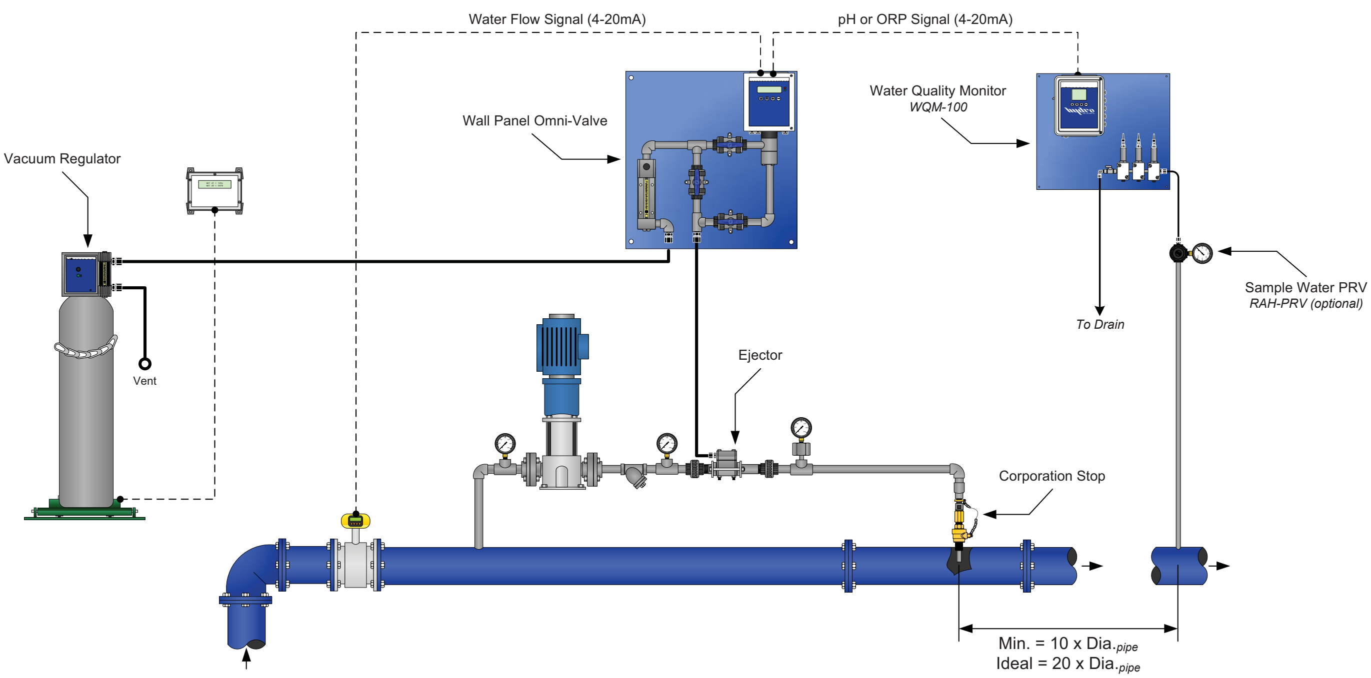


FIGURE 3 (Installation Example)



4. **Mounting the Electrodes:** If applicable, install the necessary hardware to mount the electrode. This may be a separate acrylic pot or a PVC gland that threads into the flow cell.
    1. Remove the electrode from its buffer cap and place it into its mounting gland. Secure it into place by gently threading it into the gland, rotating clockwise until it stop.
    2. Connect the quick-disconnect cap & cable assembly to the top of the pH or ORP electrode by gently threading the cap on, rotating clockwise until it stops.
5. **Wiring the Electrodes:** The WQM-100 will have its electrode connections pre-wired and only the electrode(s) need to be connected. If an electrode is being added that the unit was not originally supplied with or if the cable assembly is being replaced, please referece the following installation points.

    NOTE: If installing an electrode that the equipment was not supplied with, it may be necessary to add an additional liquid tight cable grip into the controller enclosure. This hardware will have been provided with the new electrode that is to be installed.

    WARNING! Electrical hazards are involved with this installation. Only qualified personnel should perform this installation.

    1. With the instrument powered off, run the cable portion of the electrodes quick-disconnect cap & cable assembly through the liquid tight cable grip in the controllers enclosure.
    2. Refer the circuit board figure (FIgure 8) for wiring connection terminals for the electrode that is being connected.

FIGURE 4 (Mounting Gland, Quick-Disconnect Cap & Cable)

6. **Installation Inspection:** Reference the troubleshooting table in this document if needed.
    - Make sure that the sensing glass is fully submerged.
    - Make sure that the sensing glass is free of air bubbles.
    - There should be a reading on the instrument display.

III. CALIBRATION AND PROGRAMMING

1. **Conditioning:** Before calibration is carried out, the water quality monitor must be operated for several hours to allow the readings to stabilize.

   a. Start the sample water flow to the measurement cell(s).

   c. An ideal flow rate of 500 ml/minute (8 GPH) should be provided. Under all circumstances, the electrodes must be kept wet, even if the sample water flow stops periodically. Maximum sample water pressure is 5 psig. See Figure 1.

   d. Turn on the power to the monitor.

   e. Check for air bubbles in the sample line and measurement cell(s). Remove any air bubbles.

   f. Allow the equipment to operate with the sample water flowing for several hours. After this, the electrode(s) can be calibrated.

2. **Programming the WQM-100 Water Quality Monitor**

   a. ***Operation (See Section VII):*** This is the normal operation state of the WQM-100. It provides a display of the current readings; Temperature, (optional) pH, (optional) ORP, (optional) Conductivity, Live Charts and any alarm conditions that may exist.

   b. ***Configuration and Calibration (Programming) (See Section VIII):*** These screens are used to set up the display options, operational parameters and other features.

   c. ***PID Control (See Section IX):*** These parameters configure the PID Control program in the software. These parameters perform proportional, set-point or compound loop control. One or more of the analog outputs (AO1 through AO4) can be programmed to transmit a 4-20 mA control signal.

3. **Programming Access**

   a. ***Operation Mode:*** This is the standard operatonal state during initial powering of the device. To return to this mode from any other screen simply press the ⬆ button repeatedly.

   b. ***Configuration and Calibration:*** This is accessed from the Operation screen by pressing the ⬇ button until the password screen is reached. Then enter the password "100" and then press the ⬇ button.

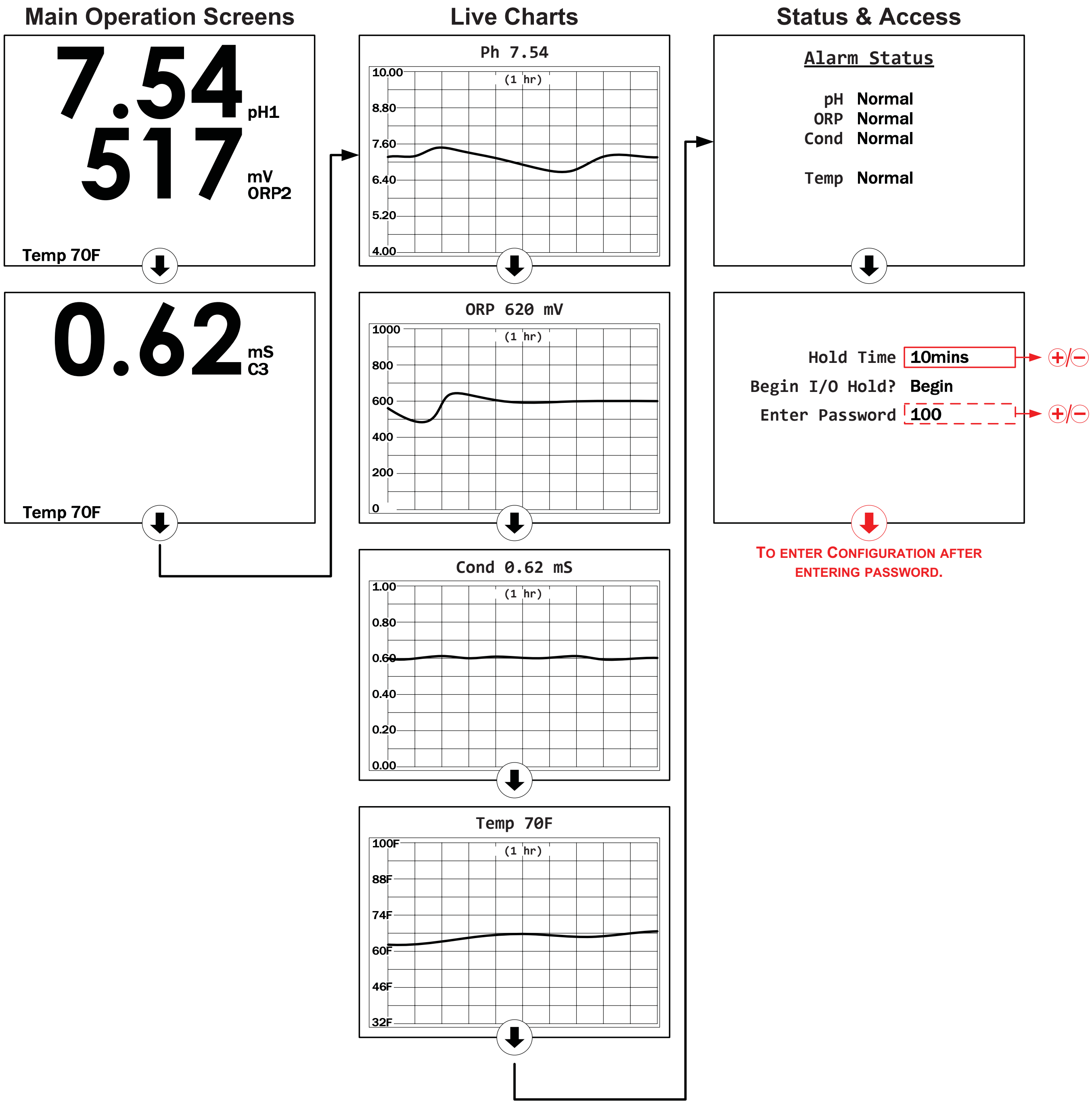
   c. ***PID Control:*** These parameters will display several general status and control screens in the Operation Mode. Access to the screens which allow this program to be set-up are listed among the other operational parameters in the Configuration menus. Press the ⬇ button (in the Operation Mode) until the password screen is reached. Then enter the password "100" and press the ⬇ button.

4. **Operating the keypad**

   1. ***Navigation:*** To move from one screen to another, simply press the ⬆ and ⬇ buttons to reach the desired screen. Navigation between screens is possible in either direction.

   2. ***Adjustment of Displayed Parameters:*** To adjust a displayed parameter in the Configuration Mode, simply use the ⊕ and ⊖ buttons to increase or decrease. Once a parameter has been set to the desired position, pressing either ⬆ or ⬇ button to leave the screen will cause the new parameter to be stored. To select a blinking option (such as "Temperature Cal – Yes/No"), use the arrow buttons as needed to make the desired selection blink then press the ⊕ button.

FIGURE 5 (Operation Menu Flow Chart)



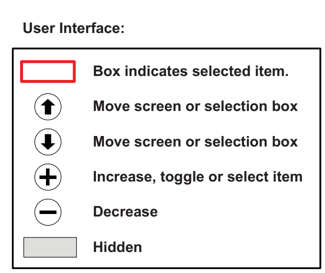
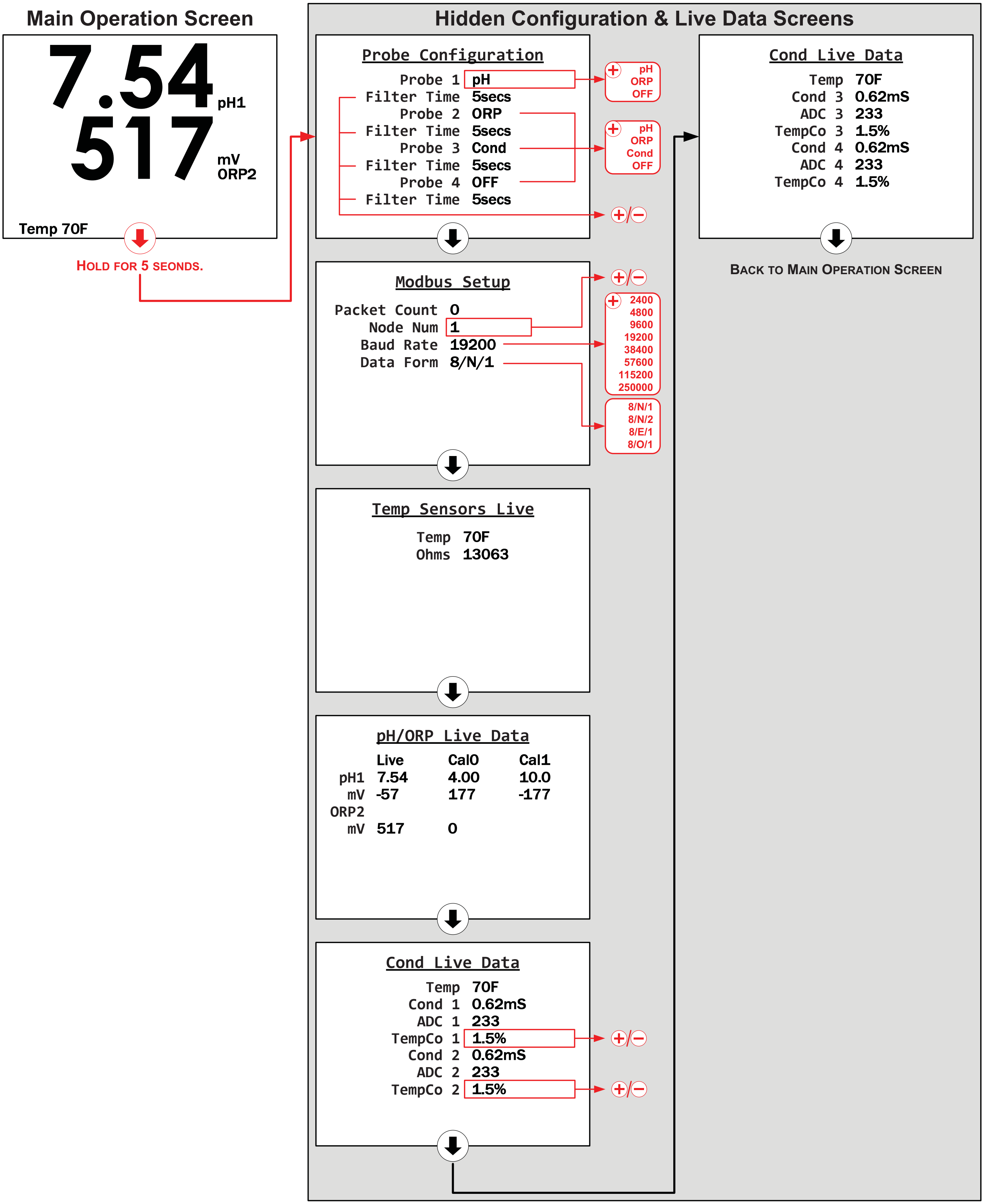
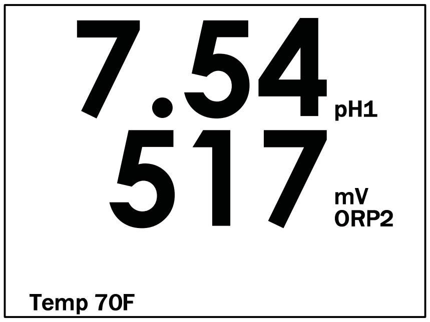


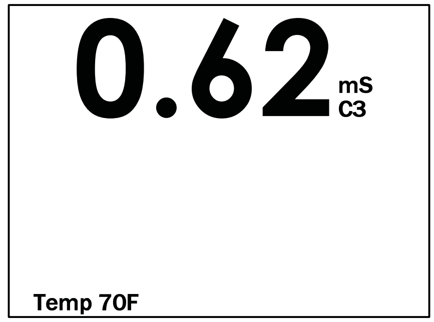
FIGURE 6 (Hidden Configuration & Live Data Screens)



IV. EXPLANATION OF OPERATION MODE SCREENS

Main Screen: This screen will display the live readings for installed and active electrodes (e.g. pH, ORP and/or conductivity) and temperature sensors. The values shown in extra-large font size are live readings. A value may show in red color if there is an active Alarm condition for the respective electrode.





pH Chart: This screen shows curves which graphically depict pH values for active pH sensors over a user-adjustable time period. The pH chart will not be present if neither channel 1 nor channel 2 is set for pH.

ORP Chart: This screen shows curves which graphically depict ORP values for active ORP electrode over a user-adjustable time period. The ORP chart will not be present if neither channel 1 nor channel 2 is set for ORP.

Conductivity Chart: This screen shows curves which graphically depict conductivity values for active conductivity electrodes over a user-adjustable time period. The Conductivity chart will not be present if no conductivity electrodes are present.

Temperature Chart: This screen shows curves which graphically depict temperature values for active thermistors over a user-adjustable time period.

Alarm Status Screen: This screen will show a list of current alarm conditions for active probes and sensors. Typically, a non-normal alarm condition will be shown in red color.

Access Screen: In addition to allowing access to the WQM-100 Configuration screen (after adjusting the password value to “100”), users can initiate an “I/O Hold” from this screen.

FIGURE 7A (Configuration Menus)

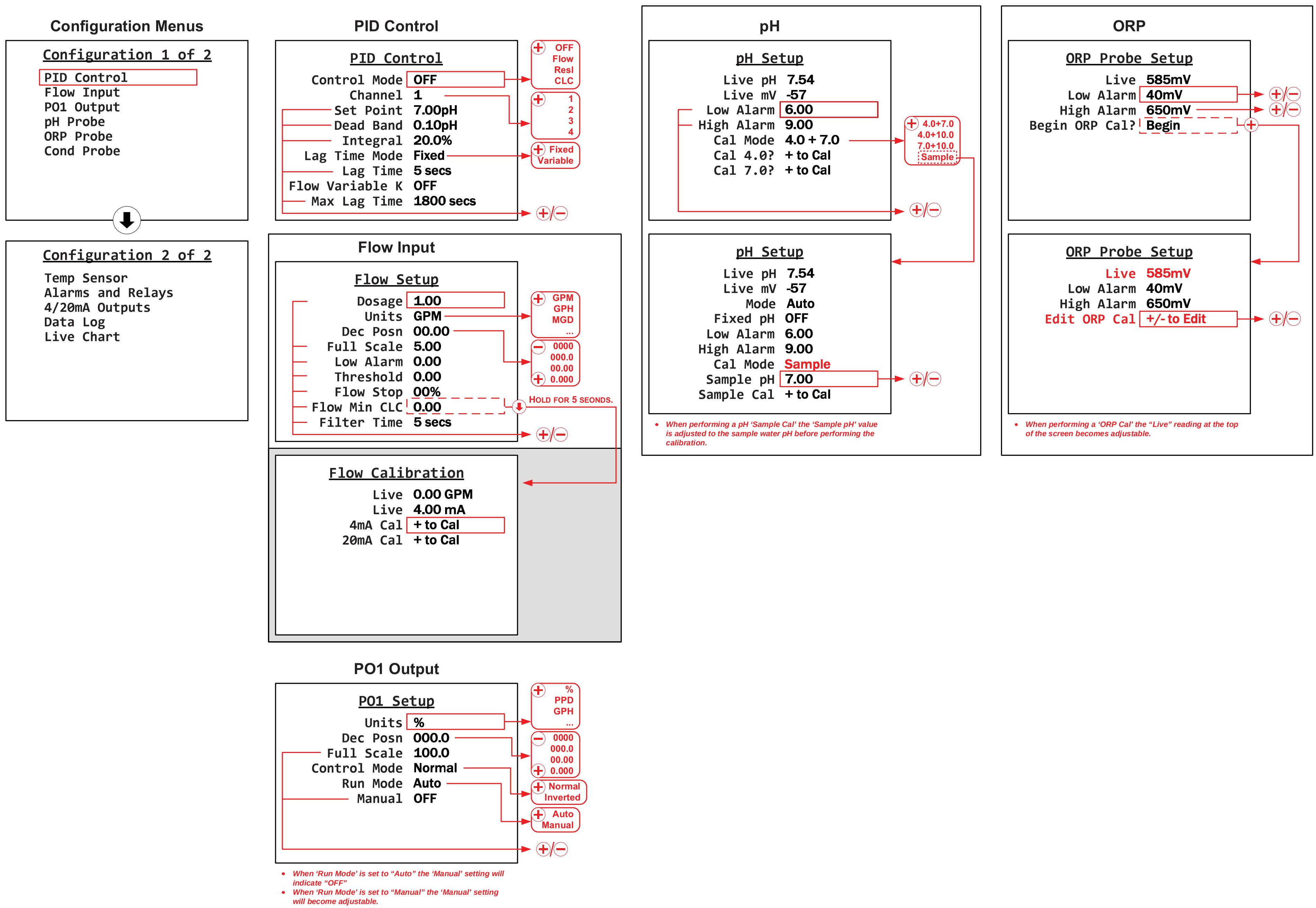
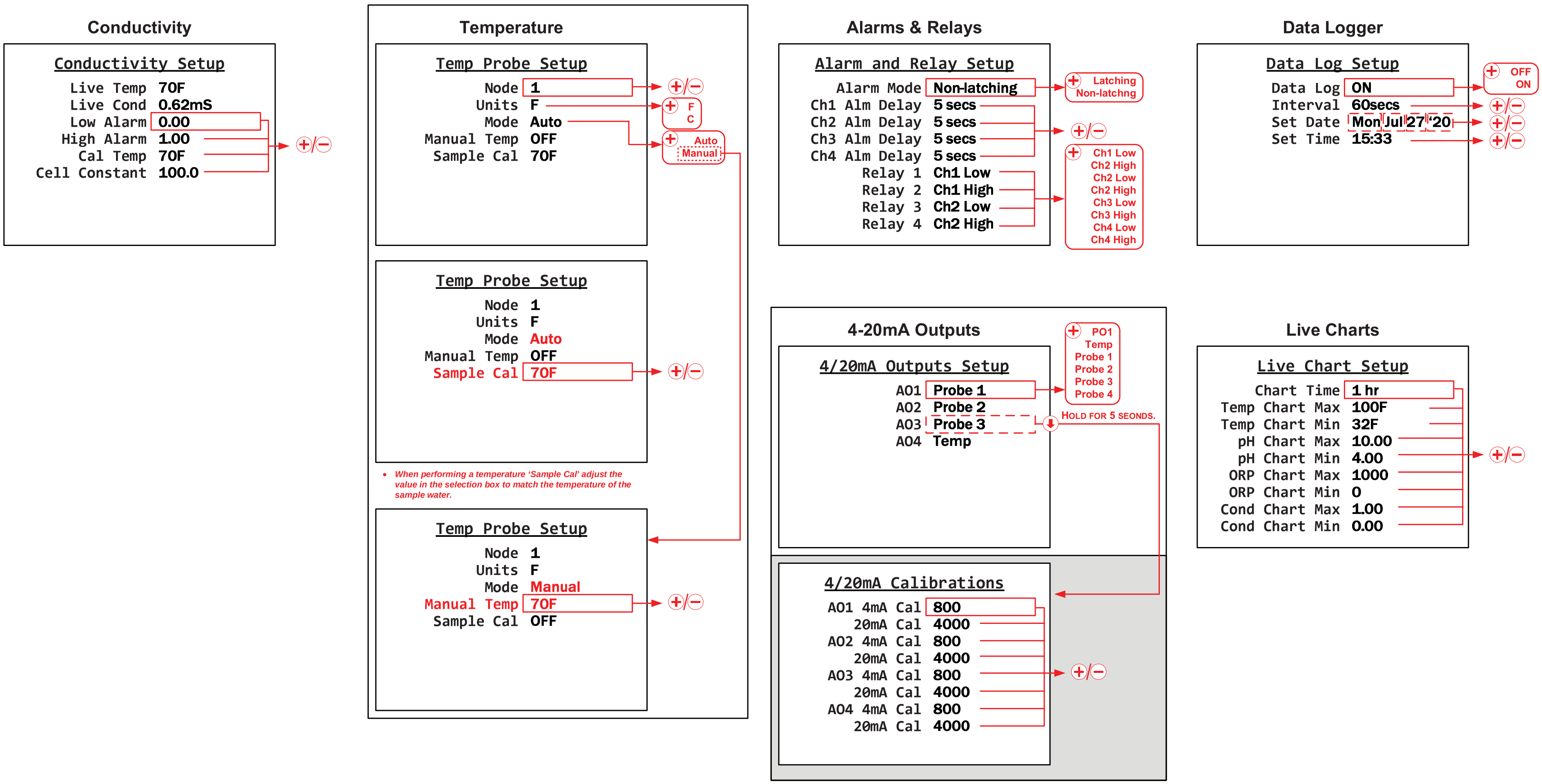


FIGURE 7B (Configuration Menus)



V. EXPLANATION OF CONFIGURATION MODE SCREENS

WQM-100 Configuration Screen: This screen lists titles of accessible Setup screens for the electrodes, outputs, data logging, and charting. Use the ⬇ button to select an option, and then press the ⊕ button to access the associated screen(s).

pH Electrode Setup: This screen will show the live readings (in pH and mV) from the pH electrode and allows the user to change the following values and parameters:

Low Alarm: Adjust the low pH alarm trip-point (in pH).

High Alarm: Adjust the high pH alarm trip-point (in pH).

Cal Mode (pH Calibration Mode)**:** The water quality monitor allows the user to select from four different pH calibration methods including: ('Sample', '4.0 and 7.0', '4.0 and 10.0', '7.0 and 10.0'). The calibration type to use is completely up to the user. However Hydro Instruments recommends using the following selection criteria:

A. If pH buffers are not available, then use the "Sample" calibration. This is only a one point calibration (your sample) and will automatically calculate an ideal calibration slope. This provides reasonable accuracy if the sample pH is close to seven and pH of the process is relatively stable.
B. If sample pH is less than seven, use the '4.0 and 7.0' calibration method.
C. If sample pH is greater than seven, use the '7.0 and 10.0' calibration method.
D. If sample stream is subject to wide swings in pH, use the '4.0 and 10.0' calibration method.

Quick notes to increase calibration accuracy:

- Before placing the pH electrode into a buffer for calibration, blot the bottom of the probe with a clean microfiber cloth.

  CAUTION: Take care not to scratch the probe surface as this will damage the probe and affect your readings.
- Allow the pH meter to sit in the buffer solution for a few seconds prior to calibration. The longer it sits in the buffer solution, the closer it will be to the ideal value. Generally 15-30 seconds for a new probe. When calibrating the pH electrode the controller software will count down from 25 seconds to ensure good calibration.
- Keep the pH sensor and buffer solution still when calibrating your instrument. Vigorous movement of the sensor can disrupt readings and lead to inaccurate calibrations, should the pH electrodes reading be disrupted during calibration the countdown will reset.
- Select a pH range for calibration that will be similar to your operating conditions. For example, if the operating range is 7.80 to 8.10 then perform a 7.00 and 10.00 calibration.
- When calibrating your sensor, always use a fresh buffer solution and discard the buffer after use.
- Be aware of the temperature of the buffers being used. Generally buffer manufactures write on their label at what temperature the pH is its true value (generally 77°F, 25°C). Temperature can influence dissociation and thus if your calibration is done with a buffer not at its prescribed temperature, your calibration will be inaccurate. It is best to calibrate with buffers that have an accurate pH close to your operating conditions.
- Air bubbles and other liquids can form around the outside of the sensor and affect the accuracy of the reading. Be sure to remove any air bubbles upon installation.

'4.0 and 7.0', '7.0 and 10.0', and '4.0 and 10.0' pH calibration methods:

Cal 7.0? (or Cal 4.0?): Calibrate the lower pH for the selected method and span, following notes below.

Cal 10.0? (or Cal 7.0?): Calibrate the upper pH for the selected method and span, following notes below.

These are two point calibrations carried out with two known pH buffer solutions.

1. In the Temperature calibration screen, set the Temperature mode to manual and enter the actual buffer solution temperature.

   NOTE: pH buffer calibrations are somewhat temperature dependent. pH buffers are usually accurate at 25ºC. Error in pH readings can occur if buffer temperatures are drastically different from their prescribed temperature (+/- 5ºC). If the temperature difference is greater than this margin, consider adjusting buffer temperature or performing a sample calibration.

2. Once the calibration method is selected, the first buffer solution required will be displayed on the screen. Place the pH electrode into the appropriate buffer and select 'Begin'.
3. The software waits for the reading to stabilize for 25 seconds before accepting or rejecting it as a valid calibration point. The countdown timer will appear on the screen in real-time. Note: The pH value will not be displayed.
4. If the calibration point is accepted, an "accepted" screen will appear. Press down to clear the screen and the next buffer solution required will appear.
5. Place the pH electrode in the appropriate buffer solution and select 'Begin'.
6. The software will wait for a stable reading over 25 seconds. If the second calibration point is accepted, an "accepted" screen will appear. Press down to clear and the pH calibration is complete.
7. Place the pH electrode back into the sample solution and change the Temperature back to the original operating conditions.

Sample Calibration: This calibration is carried out with the pH electrode left installed in its holding cell with the sample water flowing through it. However, be sure that the Temperature displayed on your unit is accurate before calibrating the pH.

1. If this calibration option has been selected, the following screen will require the operator to enter the pH of the sample water in which the calibration will be done.
2. Use a hand held pH meter to measure the pH of the sample water and then enter the pH of the sample on the screen.
3. Before proceeding check that no air bubbles have formed on the tip of the pH electrode. Select 'Begin'; the software will wait for a stable reading over 25 seconds before accepting or rejecting the calibration point. If the calibration point is accepted, press the down key and the pH calibration is complete.

   NOTE: If at any point your pH calibration is rejected, the entire calibration procedure will need to be repeated. If the problem persists, see the troubleshooting section below.

ORP Electrode Setup: This screen shows the live ORP readings (in mV) from its respective ORP electrode and allows the user to change the following values and parameters:

Low Alarm: Adjust the low ORP alarm trip-point (in mV).

High Alarm: Adjust the high ORP alarm trip-point (in mV).

Single Pt Cal (Single Point Calibration)**:** Press the ⊕ key to begin ORP calibration.

Conductivity Electrode Setup: This screen shows the live Conductivity readings (in mS/cm) from its respective conductivity electrode and allows the user to change the following values and parameters:

Low Alarm: Adjust the low conductivity alarm trip-point (in mS/cm).

High Alarm: Adjust the high conductivity alarm trip-point (in mS/cm).

Single Pt Cal (Single Point Calibration)**:** Press the ⊕ key to begin conductivity calibration.

Temp Sensor Setup: This screen shows the live reading from its respective temperature sensor (thermistor) and allows the user to change the following values and parameters:

Units: Select 'F' (Fahrenheit) or 'C' (Celsius)

Mode: Select 'AUTO' (Automatic) or 'MANL' (Manual)
Automatic enables the temperature to be automatically detected via the thermistor.

Manual Temp: This will show 'OFF' unless the mode is 'MANL', in which case the value is adjustable.

Sample Calibration: This line is visible when the temperature mode is set to 'AUTO'. The temperature displayed represents what the program interprets the current temperature reading to be. If necessary, adjust the displayed temperature using the ⊕ and ⊖ buttons.

Alarm and Relay Setup: This screen allows the user to change the following values and parameters for the four alarm relays (Relay 1, Relay 2, Relay 3, Relay 4):

Alm Mode (Alarm Mode): Select 'Latching' or 'Non-latching'
A latching relay will require manual acknowledgement of any alarm condition (by pressing the [MINUS] button with the Main Screen active). When Non-Latching is selected, alarms will clear themselves whenever the alarm condition no longer exists.

Alm Delay (Alarm Delay): Adjust the delay time. Any alarm condition must then exist for this period of time before tripping the relay. This delay can help avoid false alarms and is recommended to be set at 5 seconds or longer.

Relay 1, 2, 3 or 4: The monitor is equipped with four alarm relays. Each of these relays can be individually set to represent any of the following alarm conditions:

pH High/Low Alm	*(pH High or Low Alarm)*
ORP High/Low Alm	*(ORP High or Low Alarm)*
Cond High/Low Alm	*(Conductivity High or Low Alarm)*
PV1 Low	*(PID control water flow low alarm.)*
Any Alm	*(Any of the listed alarm conditions.)*

4/20mA Outputs Setup: This screen accesses the settings for the four 4-20mA output channels.

AO1, AO2, AO3 or AO4: Each analog output channel can be individually set to represent one of the following live readings (with corresponding values shown for 4mA and 20mA outputs):

		4mA	**20mA**
pH	*(pH)*	0 pH	14 pH
Temp	*(Temperature)*	0º C (32º F)	50º C (122º F)
ORP	*(ORP)*	ORP Chart Min	ORP Chart Max
Cond	*(Conductivity)*	Cond Chart Min	Cond Chart Max
PO1	*(PID Process Output)*	zero process feed	full scale process feed

[HIDDEN] 4/20mA Calibration: This hidden screen can be accessed by holding the ⬇ button when the AO3 line is selected (on the 4/20mA Outputs Setup screen). While using an ammeter to measure the output current, the following calibration values can be adjusted using the ⊕ and ⊖ buttons:

NOTE: Adjustable values on this screen are Digital-to-Analog Converter (DAC) values.

AO1 4mA Cal: Adjust the DAC value that corresponds to 4mA for Analog Output 1 (AO1)
20mA Cal: Adjust the DAC value that corresponds to 20mA for Analog Output 1 (AO1)
AO2 4mA Cal: Adjust the DAC value that corresponds to 4mA for Analog Output 2 (AO2)
20mA Cal: Adjust the DAC value that corresponds to 20mA for Analog Output 2 (AO2)
AO3 4mA Cal: Adjust the DAC value that corresponds to 4mA for Analog Output 3 (AO3)
20mA Cal: Adjust the DAC value that corresponds to 20mA for Analog Output 3 (AO3)
AO4 4mA Cal: Adjust the DAC value that corresponds to 4mA for Analog Output 4 (AO4)
20mA Cal: Adjust the DAC value that corresponds to 20mA for Analog Output 4 (AO4)

Data Log Setup: This screen allows user to change the following values and parameters for setting the optional data logger:

Data Log: Select ‘ON’ or ‘OFF’ to enable/disable data logging.
Interval: Adjust the frequency at which data will be recorded.
Set Date: Set the current date (Day, Month, Year). Hidden if Data Log is ‘OFF’.
Set Time: Set the current time (Hour:Minute). Hidden if Data Log is ‘OFF’.

Live Chart Setup: This screen allows the user to change the following values:

Chart Time: Adjust the duration of time shown graphically on the three charts after the Main Screen.
Temp Chart Max: Adjust the maximum temperature shown on the Temperature Chart.
Temp Chart Min: Adjust the minimum temperature shown on the Temperature Chart.
pH Chart Max: Adjust the maximum pH value shown on the pH Chart.
pH Chart Min: Adjust the minimum pH value shown on the pH Chart.
ORP Chart Max: Adjust the maximum ORP value shown on the pH Chart.
For any analog outputs (i.e. AO1 through AO4) set to represent ORP, a 20mA signal will represent this ORP Chart Max value.
ORP Chart Min: Adjust the minimum ORP value shown on the pH Chart.
For any analog outputs (i.e. AO1 through AO4) set to represent ORP, a 4mA signal will represent this ORP Chart Min value.
Cond Chart Max: Adjust the maximum conductivity value shown on the Conductivity Chart.
For any analog outputs (i.e. AO1 through AO4) set to represent conductivity, a 20mA signal will represent the Conductivty Chart Max value.
Cond Chart Min: Adjust the minimum conductivity value shown on the Conductivity Chart.
For any analog outputs (i.e. AO1 through AO4) set to represent conductivity, a 4mA signal will represent the Conductivity Chart Min value.

VI. EXPLANATION OF PID CONTROL SCREENS

PID Control: The PID Control program can be accessed via Configuration screen 1. It uses the first three menu options: “PID Contorl”, “Flow Input” and “PO1 Output”. The Configuration sceens can accessed from the operation mode, scroll down and enter “100” as the password when prompted.

Control Mode: Select desired control type.

<u>OFF</u>: When “OFF” is selected, the PID Control program will be deactivated.

<u>Flow Pacing</u>: This control type will provide a process output (PO1) proportional to the AI1 proportional input signal (and multiplied by the Dosage setting). This control method does not factor the eletrode readings in any way.

<u>Set Point</u>: This control type will provide a process output (PO1) that is adjusted as needed to maintain the “Set Point” value.

<u>Compound (Compound Loop)</u>: This control type will provide a process output (PO1) that is adjusted as needed to maintain the “Set Point” value and also factors in changes registered through the proportional input signal (and multiplied by the Dosage setting). This control method type will not appear as an option unless the needed input signals are detected.

Channel: Select the channel (i.e. measurement) that the PID control will use in its calculations (e.g. pH, ORP or Conductivity).

Set Point: Set the target measurement value that the PID control will use to adjust chemical feed.

Dead Band: This is a dead band around the Set Point. As long as the reading is within (+ or -) this amount from Set Point, the program will consider the Set Point met. This is used to avoid excessive, continual adjustments.

Integral: A factor used in the calculation of needed adjustments to the process output. This value ranges from 0 – 100%. Essentially, the program makes a calculation of how much the output needs to be adjusted in order to reach Set Point and this factor. Increasing the Integral will increase the rate of each individual adjustment (and vice versa).

Lag Time: This is the time that elapses between a change in chemical feed rate and the change in measurement observed by the monitor. The PID Control program will wait-out this amount of time between each adjustment to PO1. Instruments should be installed to minimize lag time in order to optimize control (ideally limit this time to less than 5 minutes).

Max Lag Time: A maximum Lag Time, which can be used in Compound Loop Control only. When in use, this sets limits the maximum lag time that can be calculated by the variable lag time formula.

Lag Time Mode: Select “Fixed” or “Variable”. If “Fixed” is selected, only the “Lag Time” will be used. If “Variable” is selected, the lag time used will vary as the flow varies, but will be limited to the Max Lag Time.

Flow Variable K: Enter desired flow level. If “Variable” is selected, the lag time will be calculated as follows: Flow at Variable Lag divided by the current flow rate and then multiplied by the Lag Time.

<u>NOTE</u>: In applications where flows vary greatly, lag times may also change significantly. In these instances, the use of variable lag times will improve control timing.

<u>NOTE</u>: If “Fixed” is selected as “Lag Time Method”, the settings of “Max Lag Time” and “Flow at Variable K” are ignored.

Flow Input: This branch accesses the settings for the proportional (flow) input.

Dosage (Gain): This value will adjust the ratio of chemical feed to the PV1 water flow. It is effectively a multiplication factor that is applied to the calculated chemical feed rate.

Units: Select desired units (MGD, GPM, GPD, LPM, MLD, %, M^3/H).

Dec Posn: Select desired decimal position.

Full Scale: Enter the proportional input full scale. This setting should be what a 20 mA proportional input (AI1) signal represents.

Low Alarm: Enter low flow alarm trip point (if desired).

Threshold: This setting allows the user to set a value (above zero) to be treated as zero for the proportional input (AI1) signal. In proportional (Flow Pacing) control, this would mean the output signal (PO1) would remain at zero (4mA) until the proportional input reached this value.

Flow Stop: This setting is only used in Compound Loop Control (CDC) to prevent PO1 adjustment based on the Set Point when PV1 water flow has stopped. The user can enter a PV1 water flow value below which the PO1 output will go to and remain at 4mA until the PV1 water flow returns to a value greater than the entered Flow Stop value.

Filter Time: This is an adjustable span of time over which the PV1 input signal will be continually averaged. It is recommended that it be set to 5-10 seconds.

PO1 Output: This branch accesses the settings for the PID Control output signal.

Units: Select desired units (PPD, GR/H, KG/H, GPH, GPM, GPD, %).

Dec Posn: Select desired decimal place.

Full Scale: Enter the desired output full scale. This is what a 20 mA output signal (selected as PO1) will represent.

NOTE: A minimum of three integers must be used. Therefore, if the PO1 Full Scale is set below 100, one decimal position must be used (ex: 99.9)

Control Mode: Select either "Normal" or "Inverted". These two selections are basic classifications of what chemical type the PID Control program is controlling. "Normal" represents any chemical that will increase the reading and "Inverted" represents and chemical that will decrease the reading.

Run Mode: The PID control can be set to run automatically "Auto" or the user can input a desired PO1 output value "Manual".

VII. MAINTENANCE AND CLEANING

The quality of the water greatly effects the frequency of cleaning that is required. Cleaning requirements will be different at each installation. Visually checking the condition of the electrodes regularly is the best way to determine the required frequency of cleaning.

1. **Inlet Filter Screen**: Some installations may require an inlet filter screen to filter large particles out of the sample water. If there is an inlet filter screen installed, regularly check the inlet filter screen and condition. If it is found to be dirty, then clean it with clean water before reinstalling.

2. **Flushing the Measurement Cell:** If water will not flow through the measurement cell and their is a visable blockage then follow this procedure to flush it:
   a. Turn off the power to the monitor.
   b. Remove the flush plug in the flow cell and allow to drain.
   c. Reinstall the flush plug.
   d. Repeat as necessary before turning the power back on.

3. **Thermistor:** If the thermistor fails, then it will give a very high or very low signal. To test the thermistor, follow this procedure:
   a. Turn off power to the monitor.
   b. Open the monitors NEMA 4x enclosure and remove the two thermistor wires from the MB128 board (RS1 and AIC).
   c. Use an ohm meter to check the resistance of the thermistor. If the ohm meter shows a stable resistance reading around 10 kohms, then the thermistor is not defective. If the reading is zero or infinite, the thermistor is defective and must be replaced.
   d. After replacement, thermistor recalibration may be required.
   e. If the thermistor fails, the monitors temperature mode can be set to “Manual” to allow for proper operation until a replacement thermistor is installed.

4. **pH Electrode:** The pH electrode will periodically require replacement. The frequency of replacement is dependent on the quality of the water. Also, all handling instructions must be followed carefully to avoid damaging the pH probe. Failure of the pH probe can be indicated by an excessively high or low reading. If the probe cannot be recalibrated, then it must be replaced. Instructions for replacement will be included with the replacement pH probes available from Hydro Instruments.
   Refer to sections I.1, II.4, VI, and Troubleshooting of this manual.

5. **ORP Electrode:** The ORP electrode will periodically require replacement. The frequency of replacement is dependent on the quality of the water. Also, all handling instructions must be followed carefully to avoid damaging the ORP electrode. Failure of the ORP electrode can be indicated by an excessively high or low reading. If the probe cannot be recalibrated, then it must be replaced. Instructions for replacement will be included with the replacement ORP electrode available from Hydro Instruments.
   Refer to sections I.1, II.4, VI, and Troubleshooting of this manual.

6. **Conductivity Electrode:** The conductivity electrode will periodically require replacement. The frequency of replacement is dependent on the quality of the water. Also, all handling instructions must be followed carefully to avoid damaging the conductivity electrode. Failure of the conductivity electrode will be indicated by an excessively high or low reading. If the probe cannot be recalibrated, then it must be replaced. Instructions for replacement will be included with the replacement conductivity electrode available from Hydro Instruments.
   Refer to sections I.1, II.4, VI, and Troubleshooting of this manual.

VIII. TROUBLESHOOTING

Accurate calibration is critical to proper operation. With regards to the recommended troubleshooting points that follow, consider that;

General Troubleshooting

If at any time an electrode is not reading accurately or fails to calibrate, refer to this section to understand possible causes and their resolution.

Electrode Cleaning

Coatings on the electrodes surface will result in erroneous readings and calibration and may even mimic the effects of a failing electrode. Regular cleaning of the electrode can help prevent this and prolong its lifespan.

Caution: Use all recommended precautions when using chemicals of any kind, including protective eyeware, gloves, face shields, etc.

The type of coasting will determine the appropriate cleaning method.

Soft Coatings - These can be removed by vigorous stirring of the electrode in clean water or by gently wiping with a soft, clean, non-abrasive cloth.
NOTE: Do not use a brush or abrasive cleaner to clean the glass as this will damage the electrode.

Hard Coatings - These types of coatings can be removed chemically. Clean the pH electrode using specially formulated solutions ideal to the application. For example, accumulation of calcium carbonate can be removed with a weak (e.g. 5%) muriatic acid.

Oily Coatings - These types of coatings are best removed with detergents or solvents that will not harm the electrode. For example, isopropyl alcohol can be used, but not acetone as the acetone will chemically dissolve plastic.

Organic Coatings - These types of coatings are best removed with detergents or solvents that will not harm the pH electrode. For example, isopropyl alcohol or bleach can be used, but not acetone as the acetone will chemically dissolve plastic.

Protein-based Coatings - These are best removed with an enzyme-based cleaner.

Temperature

Temperature reading is not correct

1. Independently test sample water temperature and verify the temperature.
2. If the displayed temperature is not correct, recalibrate the temperature.
3. If the displayed temperature is extremely high or extremely low, the thermistor has either lost connection to the circuit board or has failed, requiring replacement. This is a 10K Ohm resistor and replacements are available from Hydro Instruments.

Thermistor is damaged or missing

1. Replace thermistor.
2. The temperature compensation mode can be set to “Manual” to allow for continued operation until the thermistor is replaced.

pH

pH reading does not match independent pH meter measurement

1. Recalibrate pH.
2. Clean the pH electrode.
3. Recalibration can be performed at a single point (“grab cal”) or at two points using known pH buffers.
4. If the pH being displayed is dramatically incorrect or fluctuating drastically and cannot be corrected, check all pH electrode cable connections as well as the cable connector at the electrode. If all connections are verified and the problem cannot be corrected through through cleaning and/or a two-point calibration, replace the pH electrode.
5. If the raw pH sensor mV values are outside the acceptable ranges then replace the pH probe.

ORP

ORP reading does not match independent ORP measurement

1. Recalibrate ORP electrode.
2, Clean the ORP electode.
3. If the ORP being displayed is dramatically incorrect or fluctuating drastically and cannot be corrected, check all ORP cable connections as well as the cable connector at the electrode. If all connections are verified and the problem cannot be corrected through cleaning and/or recalibration, replace the ORP electrode.

Conductivity

Conductivity reading does not match independent conductivity meter measurement

1. Recalibrate conductivity electrode.
2. Clean the conductivity electrode.
3. If the conductivity being displayed is dramatically incorrect or fluctuating drastically and cannot be corrected, check all conductivity cable connections as well as the cable connector to the electrode. If all connections are verified and the problem cannot be corrected through cleaning and/or recalibration, replace the conductivity electrode.

Display and Circuit Board

Display is blank

1. Verify the power is turned on to the unit.
2. If it is, check the DC voltage to the monitor circuit board on Modbus terminal connections V- and V+. Refer to Figure 9.
3. A blank display may indicate a failure of the display, the power supply board or the primary circuit board. Consult Hydro Instruments or an authorized representative for assistance.

4-20 mA Output channel values are not accurate

1. Verify the output selection is correct. For example, if the output signal for a pH electrode is measuring something other than 12mA at 7.00 pH, verify that the output you are measuring is configured to “pH”.
2. Check the output calibrations at 4mA and 20mA by accessing the appropriate output channel calibration as detailed in Figure 7B.

   <u>NOTE</u>: The output calibration numbers from the factory calibration are recorded on the inside of the electronics enclosure for future reference.

Communication Errors

The MB410 Display board is communicating with the other boards by Modbus over the ribbon cable. If the ribbon cable is not properly connected to each board, then the MB410 Display board may lose communication with one or more circuit boards. If so, you would see a "COMM ERROR" message such as "Node 1 Error". Node numbers are identified on Table 2 below. As can be seen there, the MB128 board is Node 1. If such an error occurs, check to ensure that the ribbon cable is properly connected to all relevant circuit boards per Figure 8.

TABLE 2: Circuit Board Descriptions and Node Numbers

Node Number (Comm Error)	Circuit Board	Board Description	Application
1	MB128	pH/ORP1, Temp1, PV1	Probe #1 (pH or ORP), Temp and Flow mA input
2	MB128	pH/ORP2. Temp2	Probe #2 (pH or ORP)
2	MB130	Cond2, Temp2	Probe #2 (Conductivity)
3	MB128	pH/ORP3, Temp3	Probe #3 (pH or ORP)
3	MB130	Cond3, Temp3	Probe #3 (Conductivity)
4	MB128	pH/ORP4, Temp4	Probe #4 (pH or ORP)
4	MB130	Cond4, Temp4	Probe #4 (Conductivity)
5	MB114	Four Analog Outputs Board	4-20mA outputs
6	MB104	Four Relay Board	Relay outputs
-	MJ500	Real-time Clock	Data Logger

IX. OPTIONAL DATA LOGGER

1. **Description:** When enabled in the analyzer software, the data logger records the measured pH, ORP, conductivity and temperature (when applicable electrodes are installed) at a selectable frequency. This data is recorded on the Micro SDHC memory card and can be retrieved using any text-reading program. The Micro SDHC memory card is installed in the slot on the MB410 board as indicated on Figure 11 of this manual. To use the data logger the controller must be provided with the MJ500 Real Time Clock board (which mounts directly on the MB410 board as shown on Figure 11).

2. **Operation:** To enable, enter the configuration menu on the water quality monitor control software and select the option “DL”. The first menu option that appears will be the On/Off menu. The menus which follow allow for adjustment of the data logger frequency and for changes to the clock (date and time). See figure 7.

    a. ***Frequency***: The frequency is the time interval between data recordings. The frequency is adjustable in seconds, with a minimum setting of 5 seconds.

    b. ***Data Logger Clock***: The clock is factory-set before shipment. However, because the clock is set on Eastern Standard time it may be necessary to change the date and time upon start-up.

3. **Stored Data Files:** The data will be written to text files on the Micro SDHC memory card. The formatting and handling of these files is as described below:

    a. ***File Format:*** The following is an example data file to illustrate the format used. As you can see, there is a three line header for each file. The fourth and fifth lines are headers for the data. You will see that each header and data entry is delimited by a comma.

    b. ***File Name:*** Each data file will be named according to the date on which it was created. For example if created on May 24, 2016, the file name would be May24_16.txt

        i. If the Micro SDHC memory card already has a file started earlier on the same day, then data will be written onto the existing file.

        ii. The text files are limited to 5 MB. Once this limit has been reached, a new file will automatically be created to allow data to continue to be written.

    c. ***Importing data into Excel:*** The data files can be imported into Excel as follows:

        <u>NOTE</u>: This assumes use of Excel 2007 version.

        i. Select the “Data” tab.

        ii. Among the “Get External Data” tabs on the toolbar, select “From Text”

        iii. A pop up window will appear allowing you to search for and select the data file that you wish to import. After you have selected the file, click on “IMPORT”.

        iv. Another pop up window “Text Import Wizard – Step 1 of 3” will then appear.

            1. Here under “Original Data Type” you must select “Delimited”.

            2. Lower down you are asked to select “Start import at row:___”. In order to eliminate the 3 line file header, you can select “4” here to start the data import on row 4 of the file.

            3. Then click “Next”.

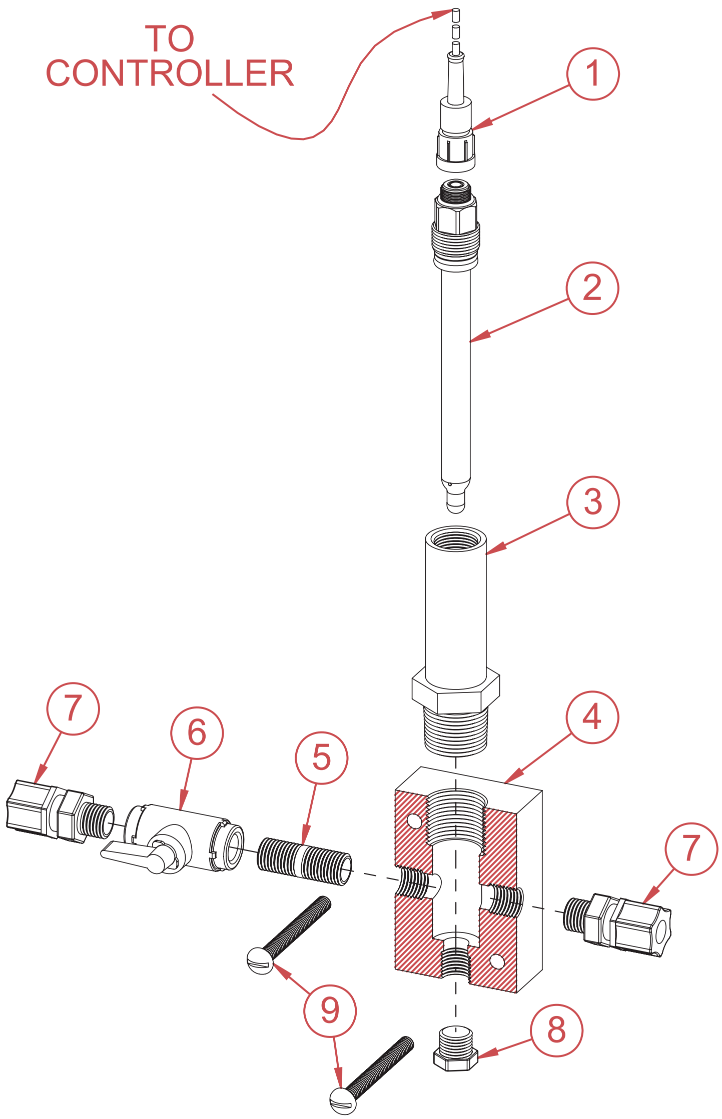
        v. On the next pop up window “Text Import Wizard – Step 2 of 3” you need to select the type of delimiter being used in the data file. The data entries in these files are delimited by commas and so you must select “Comma”. After selecting Comma and only Comma, then click “Next”.

        vi. On the next pop up window “Text Import Wizard – Step 3 of 3” you can accept the “Column data format” setting of “General” and then click “Finish”.

vii. On the next (and final) pop up window “Import Data”, it is asking you whether you will import to the worksheet that is open or if you want to import it to a new worksheet. Make your selection and then click “OK”. Now the data should have been imported into the Excel spreadsheet.

TABLE 3: WQM-100 Data Log File Example

Date	Time	Temp	pH	ORP	Cond	Flow
MM/DD/YEAR	HH:MM:SS	C		mV	mS	
05/24/2016	11:25:06	23	7.80	512	0.62	0
05/24/2016	11:26:06	23	7.80	512	0.62	0
05/24/2016	11:27:06	23	7.81	514	0.65	0
05/24/2016	11:28:06	23	7.81	514	0.65	0
05/24/2016	11:29:06	23	7.81	514	0.65	0



Item No.	Description	Quantity	Part No.
1	Probe Cable	1	PHE-14-S7
2	pH Electrode	1	PHE-14-135
2	ORP Electrode	1	ORP-135
2	Conductivity Electrode	1	CON-135
3	Probe Gland	1	PHV-GLAND
4	Fixure	1	AFC-CHP-025
5	¼" x 1½" PVC Nipple	1	880-015
6	¼" Ball Valve	1	22321
7	Tubing Connector	2	BKF-64
8	¼" PVC Plug	1	850-002
9	¼-20 x 2¼" SS (PHMS)	2	BTH-RA-129
10	Tubing Guide	1	RAH-460

hydro INSTRUMENTS™
WATER QUALITY MONITOR
pH/ORP/CONDUCTIVITY PROBE

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FIGURE 8 (WQM-100 Circuit Boards)

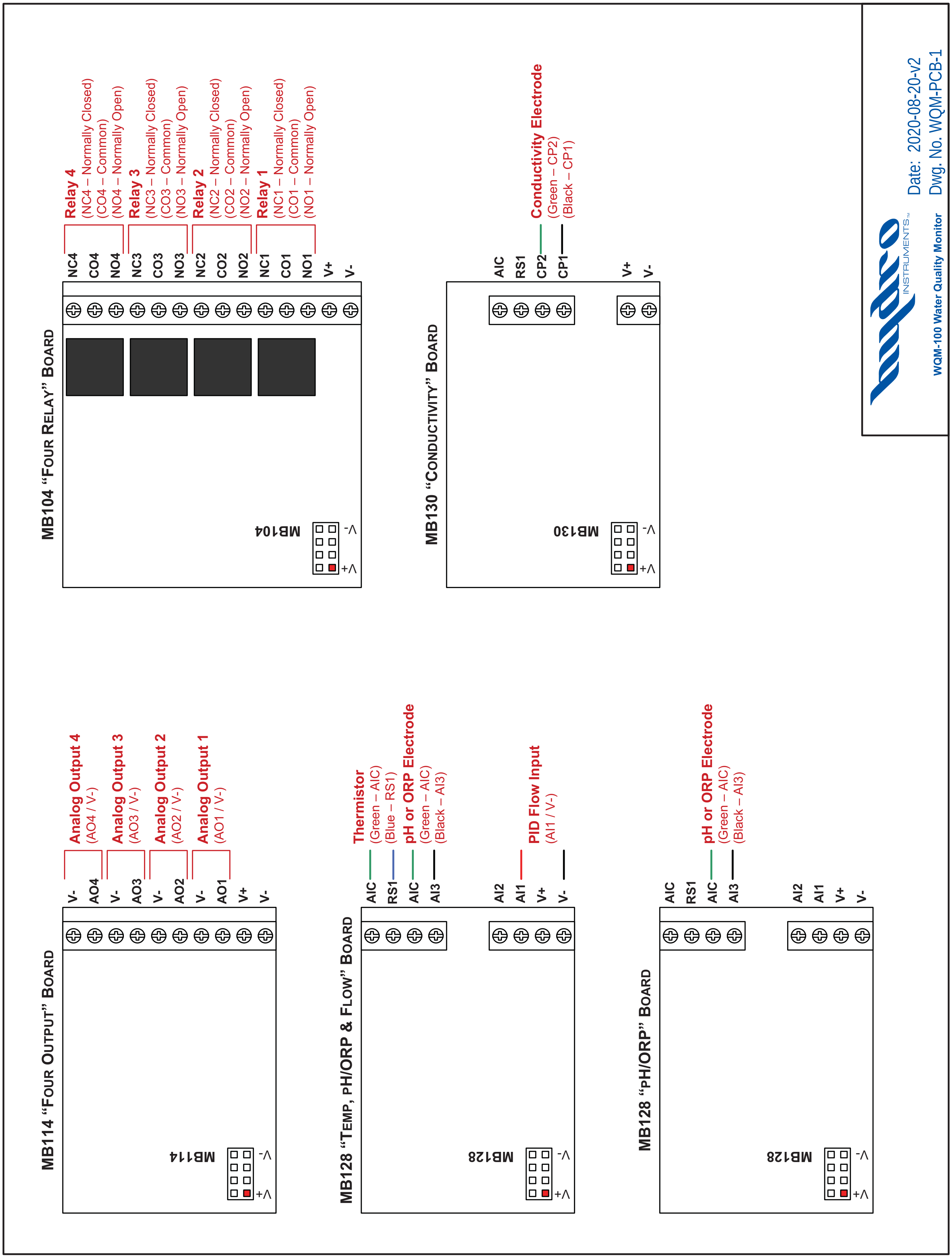

FIGURE 9 (Monitor Internal Wiring and Connections)