

Installation, Operation, and Maintenance Manual

MPX

Multi-Parameter Dual Channel Controller



⚠ WARNING



Read this Manual **BEFORE** using this equipment.
Failure to read and follow all safety and use information
can result in death, serious personal injury, property
damage, or damage to the equipment.
Keep this Manual for future reference.

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1. Introduction

The MPX is a multi-parameter controller that can display a single or dual-input. This dual channel controller will monitor and control up to 2 parameters simultaneously. pH, ORP, Conductivity, and flow are supported. It combines almost everything the user would need in a multi-input analyzer without the need to buy additional, expensive cards. The MPX also accepts input from any 4-20 mA analog sensor.

2. Safety

⚠ WARNING



Electrical hazard: Do not install the probe unless you have electrical training and you have read the instruction manual. The probe uses a 8-36V power supply and improper installation and handling can result in injury or damage to surrounding equipment including this probe.

NOTICE

The probe should only be installed, stored and serviced in the manner described in this manual. Improper handling may result in damage to the unit and surrounding equipment and may void the warranty.

3. Specifications

Call customer service if you need assistance with technical details.

Probe Parameters			
Sensor	DPHX	DOX	ORPX
Temperature Elements	Pt: 1000 RTD	Pt: 1000 RTD	Pt: 1000 RTD
Sensor Input	-600 to 600 mV	Modbus	-999 to 999 mV
Process Measurement Range	0 - 12 pH	0-60 ppm	-999 to 999 mV
Temperature Measurement Range	-20-70°C	-5-50°C	-20 to 120°C
Temperature Compensation	Automatic, Manual or None	Automatic	n/a
Calibration Modes	1, 2, 3 points	1 or 2 points	1 point
	Automatic (4, 7, 10)	Automatic (100%sat, 0 % sat)	Single point manual
	Manual (User defined Values)		

Outputs	
Analog	3 x fully scalable and optically isolated 4-20 mA. Max Load: 800 Ω
	Temperature or process output. Optional PID control for process.
	Channel 3 can be configured for a ratio, sum or difference of two process values
Relays	5 independent relays:
	Relays 1 and 2: SPDT 5A @ 250 VAC
	Relays 3 and 4: SPST (NO) 5A @ 250 VAC or 5A @ 30 VDC (Resistive Load)
	2 A @ 250 VAC or 2A @ 30 VDC (Inductive Load)
	Alarm Relay SPST (NO) 5A @ 250 VAC or 5A @ 30 VDC (Resistive Load)
	2A @ 250 VAC or 2A @ 30 VDC (Inductive Load)
Relay Modes	Relays 1 and 2: Process/Temperature, Rising/Falling/Range mode, Cycle On/Off, Relay Delay, Overfeed Time, Override
	Relays 3 and 4: Process/Temperature, Fail Safe, Rising/Falling/Range mode, Cycle On/Off, Relay Delay, Overfeed Timer, Override
	Relay 5: Up to 4 trigger conditions simultaneously (process 1 & 2, temperature 1 & 2) with acknowledgment and override option, each with a Rising/Falling/Range mode

Ratings	
Ingress Protection	NEMA 4X
Max. Power Input	0.2 A @ 115 VACX or 15 W
Temperature	-20 to 70°C
Humidity	0 to 90% Relative Humidity, non-condensing

Physical	
Mounting	Wall mount and panel mount with kit provided, pipe mount optional
Dimensions	Front cover: 5.5" x 5.5" (14 cm x 14 cm). Depth: 5" (13 cm)
Power	110-240 VAC 60-50 Hz
Weight	2 lbs.

Note: ORP, Combination pH, Combination ORP, Contacting conductivity, 4-20mA Input and Flow sensors can be configured with this controller. Please contact customer support for details if needed

4. Set Up

4.1 AC Power Connection

⚠ CAUTION

This instrument uses 120 or 240 50/60Hz AC power. Opening the enclosure door exposes you to potentially hazardous line power voltage which may be present on the power and relay plugs. Always remove line power before working in the area. If the relay contacts are powered from a separate source from the inline power, be sure to power off before proceeding.

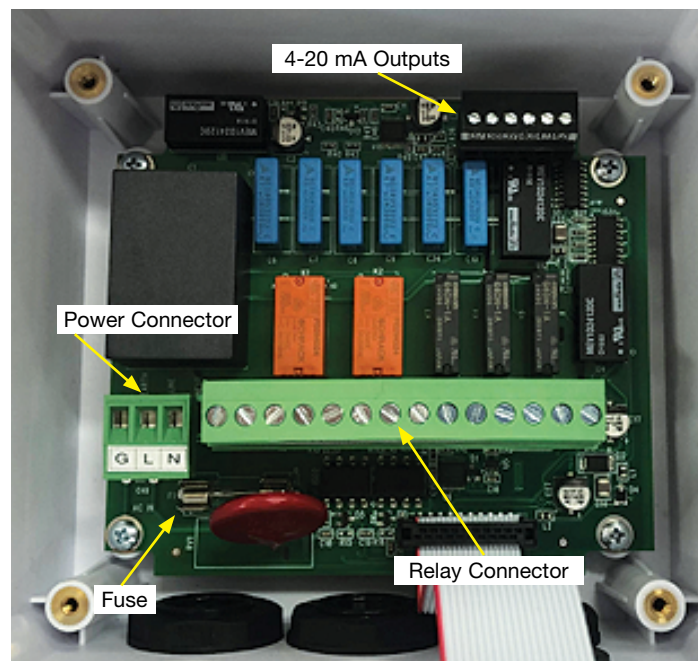


Figure 4-1 Power circuit board showing power and relay connectors

To power the controller, remove the 3-pin power terminal block and connect the wiring as printed on the board and shown in Figure 4-2. There are no jumpers or switches to convert the controller between 120 VAC and 240 VAC; the controller automatically configures the correct voltage.

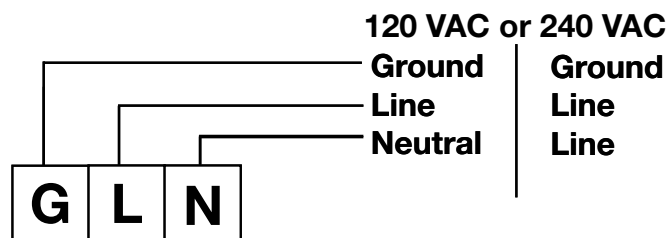


Figure 4-2 Power connection for MPX Controller.

4. Set Up (Cont.)

4.2 Conduit Connection

The MPX has six 1/2" (7/8" ID) conduit holes at the bottom of the enclosure. The unit is shipped with three conduit fittings and three holes plugged with liquid tight conduit seals. These must be left in unused holes to maintain the NEMA 4X integrity. Use approved conduit glands to ensure ingress protection.

Wire specification: size wire according to local electrical code.
Maximum current not to exceed relay specifications when used to power auxiliary devices via internal connections.

4.3 Mounting

The MPX controller can be mounted on a wall, panel or pipe. Figure 4-3 shows these options. All hardware for wall and panel mounting is included.

Pipe mounting is available for sale. It can be used to mount the controller on pipes up to 2.3" OD.

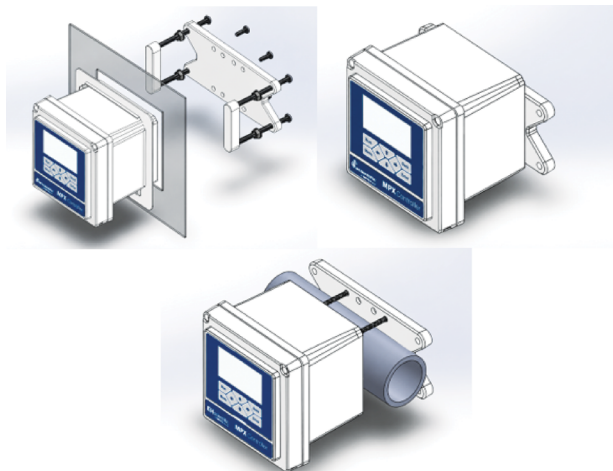


Figure 4-3 Three mounting options: wall, panel, and pipe.

4.4 Display Set up

The MPX can be configured as a single or dual input controller.

The default setting is as a dual input controller. To change to a single input display you can go to **OPTIONS >Display Channel 2 ONLY>Yes**.

Note: if the single view is selected then the DPHX or DOX sensor should be connected to the input 2 configurations.

4.5 Connecting Probes

As shown in Figure 4-4, the cover of the MPX swings open to reveal a connector block for connecting probes. A label inside the controller identifies the terminals so reference to this manual is unnecessary.

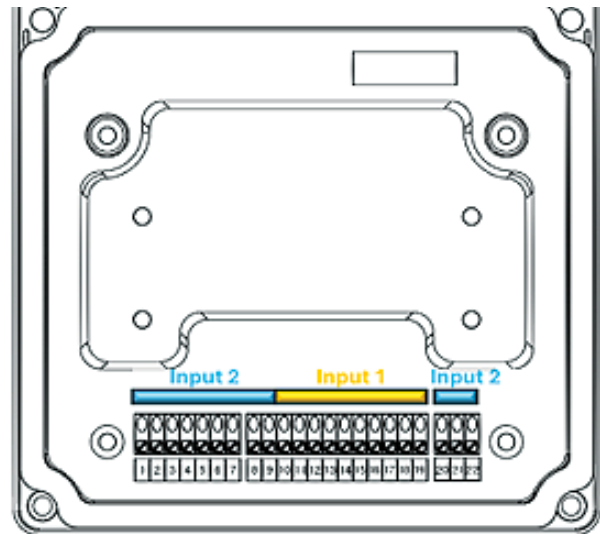


Figure 4-4 - This view of the inside of the front cover shows the connector for the probes. Blue indicates channel 1 and red indicates channel 2 (for MPX only). Note that the input 2 for "raw" output sensors is on the left (1-7), Modbus sensors (8-9, 20,21) and for the 4-20mA output sensors is on the right (20-22).

Figure 4-5 shows probe connections to the connector block.

The colors of the cells refer to the colors of the wires of the probes.

[illegible]

Figure 4-5 MPX sensor wiring.

4. Set Up (Cont.)

4.6 Analog (4-20mA) Outputs

The MPX has three adjustable and isolated 4-20 mA outputs. Each can be configured for either process or temperature. The 6-pin header is on the upper right of the power board, which is shown in Figure 4-1. Outputs are powered (current sourcing) with 24 VDC.

-	+	-	+	-	+
37	38	39	40	41	42
CH1		CH2		CH3	

Figure 4-6 Analog Outputs of MPX and AM-2250.

4.7 Relays

The MPX contains five dry contact relays. Relays 1 and 2 are SPDT, rated 5A @ 250 VAC. Relays 3 and 4 are SPDT, normally open, and rated 5A @ 250 VAC or 5A @ 30 VDC for a resistive load. For an inductive load they are rated 2A @ 250 VAC, or 2A @ 30 VDC. Relay 5 is a normally open alarm relay. The alarm relay should not be used to run heavy industrial equipment as it does not feature snubber circuit protection.

4.7.1 Wiring Relays

Though these relays will work in most process control applications, we advise for safety reasons, to use them as switches, i.e. low power DC relays that activate a second set of AC powered relays separate from the controller.



Figure 4-7 Wiring connections to the five relays. Pins 23 and 24 are powered via internal jumpers on PCB

All relays are dry contact, i.e. relay contacts do not supply voltage. For wiring convenience, the first two pins of the relay connector are internally connected to the controller power input (GLN connector).

An example of wiring 120/240 VAC pump from the Relay 1 is shown below:

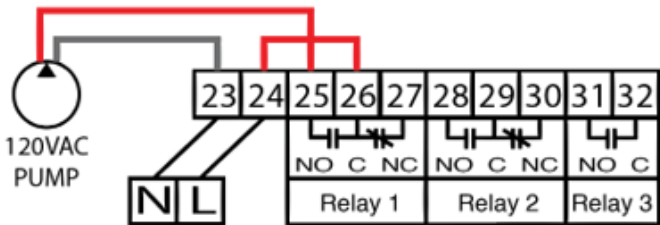


Figure 4-8 Wiring a pump to a normally open (NO) contact of the Relay #1 (AM-2250 controller). Jumper wire from pins 24 & 26 must be added to provide power to the relay.

5. Probe Setup

As discussed in section 4.4, the compatibility of probes differs between inputs. Both inputs support the DPHX while the DOX is exclusive to channel #2

When powering up the MPX the first screen presents the menus screen, to set up simply go to set up.

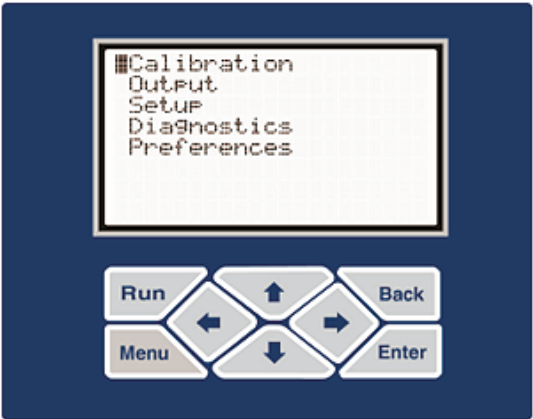


Figure 5.0 Initial start-up screen.

1. Use the ↑ and the ↓ buttons to scroll through the menu.
2. Use the ← and → buttons to move the cursor left or right.
3. Press **Enter** to select or confirm a selection.
4. Press **Back** to return to the previous screen or cancel your choice.
5. Press **Menu** to return to the main menu.
6. Press **Run** to exit from any menu and display the run display.

The setup option in the top level menu allows you to select your input, as seen below. Once the input is selected, you can configure the probe.

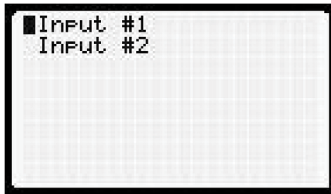


Figure 5.0A

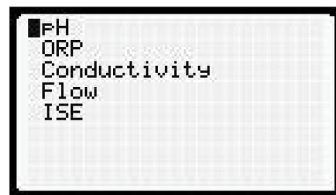
5. Probe Setup (Cont.)

5.1 DPHX (Inputs 1 & 2)

1. Scroll down the top level menu to select **Setup** and press the **Enter** key.
2. Select the appropriate input.



3. Press **Probe Selection**.



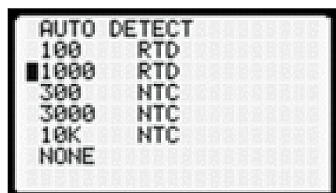
4. Select **pH** and Press **Enter**. (As the first item in the list is the default choice.)
5. The next menu lists the configuration options for the pH probe. The default selections should be used for the DPHX..



5.1 Type is **Differential**



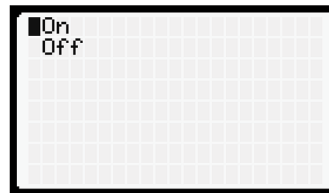
5.2 **Temp Element** is 1000 RTD:



6. Select the preferred units of temperature (**Temp Unit**):



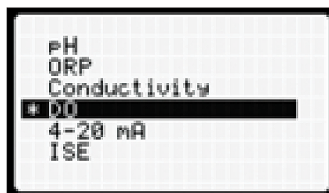
7. Choose whether you want to keep temperature compensation.



8. Press **Run** to confirm that controller displays pH units and reasonable temperature values.

5.2 DOX (Input 2 only)

1. From the Input 2 menu select **DO**.



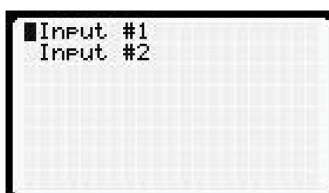
2. Select the preferred units of temperature (**Temp Unit**):



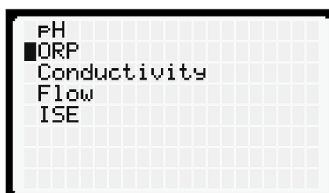
The default temperature units are Celsius.

5.3 OPRX (Input 1 or 2)

1. Scroll down the top level menu to select **Setup** and press the **Enter Key**.
2. Select the appropriate input.



3. Press **Probe Selection**.



4. Select **ORP** and press **Enter**.

5.3 OPRX (Input 1 or 2) (Cont.)

5. The next menu lists the configuration options for the pH probe. The default selections should be used for the ORPX.

```
Type
Temp Element
Temp Unit
Temp Compensation
```

- 5.1 Type is differential.

```
■ Differential
Combination
```

- 5.2 Temp Element is 1000 RTD.

```
AUTO DETECT
100 RTD
■ 1000 RTD
300 NTC
3000 NTC
10K NTC
NONE
```

6. Select the preferred units of temperature (**Temp Unit**):

```
■ Celsius
Fahrenheit
Kelvin
```

7. Press Run to confirm that controller displays pH units and reasonable temperature values.

6. Calibration

The calibration menu automatically presents choices appropriate for the probe chosen. If the menu choices for calibration appear wrong, you probably chose the wrong probe.

Note: If you select the probe type and wish to immediately calibrate, you must put the controller in **Run** mode first. You can press the **Run** button while in any menu.

6.1 pH Calibration

```
PH - 1 Point
PH - 2 Points
PH - 3 Points
Temperature
```

6.1.1 About pH Calibration

Most pH analyzers allow the user to calibrate a probe with only two points, using two of three standard calibration solutions: pH 4, 7 and 10. For two point calibration use the two standards that are closest to your expected process values. For example, if your process is mostly acidic (< pH 7) then calibrate using standards pH 4 and pH 7.

For the pH readings that span a wide range encompassing neutral (7pH) the MPX controller offers the option of three-point calibration. An algorithm uses linear least squares to calculate the slope and offset, as a result the error will be spread across the full pH range.

A pH probe that operates according to theory outputs 59.16 mV at 25°C for every unit change in pH. The actual change in output for a real probe is likely to be different and is the slope for that probe. An ideal probe in pH 7 solution (at 25°C) outputs 0 volts. The actual output is likely to be different and is the offset. The slope yields the efficiency of the probe. A probe that outputs 59.16 mV at 25°C is 100% efficient. If the probe outputs, say, 57.34 mV then the efficiency is $57.34\text{mV}/59.16\text{mV} \approx 96.9\%$ efficient.

When a probe leaves the HF Scientific factory it is tested three times to ensure that its offset and efficiency are within an acceptable tolerance (± 50 mV and $>90\%$ slope, respectively). As probes age their efficiency decreases. Note that a probe with low efficiency will still be accurate but it will not be precise, i.e. its reading will have a large uncertainty. We recommend cleaning or replacing a sensor when its efficiency drops below 80%. Before discarding a probe showing low efficiency make clean it according to the probe manual's instruction. A large offset usually indicates that the reference solution is contaminated and should be replaced.

6.1.2 One Point Calibration

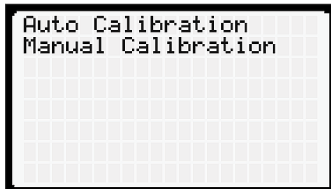
While one-point calibration is offered as an option, it is not recommended if accuracy is desired. One-point calibration can be used as a correction for sensor error by introducing an offset. It will compare a tested sample to the desired value. It can be implemented when removing the probe is not practical or possible.

6. Calibration (Cont.)

6.1.3 Two Point Calibration

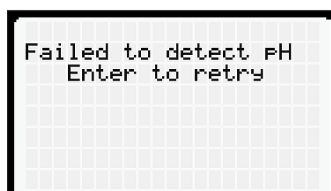
As stated above, use the two calibration standards that encompass the pH range of your process. If target reading is around pH7, then it is recommended to use pH4 and pH7 buffer standards.

There is a choice between **auto** and **manual** calibration.



6.1.3.1 Auto Calibration

In auto calibration the AM- 2252 reads the probe output when it is in a buffer and decides whether the buffer is pH 4, 7 or 10. Ideal voltages for these buffers are 177, 0 and -177 mV respectfully. If the output of the probe is within 59.16 mV (1 pH unit) from any of these values auto calibration assumes it “knows” the calibration standard in which the probe is immersed. If the output is greater than 59.16 mV auto calibration will fail.



There are several reasons why this can happen:

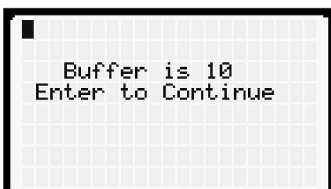
1. The offset of the probe is greater than 59 mV.
2. The efficiency of the probe is less than 67%.
3. The buffer is non-standard (i.e. neither 4, 7 or 10).
4. The buffer has aged and is no longer at its nominal pH value.

To initiate auto calibration:

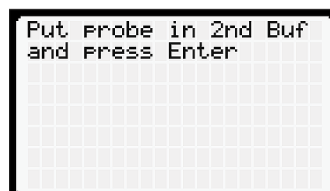
1. Select **Auto Calibration**.
2. Follow the directions on the next screen and immerse the probe in the first calibration standard.



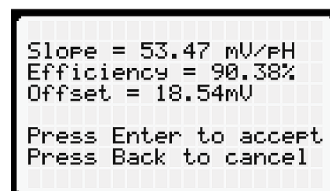
Press **Enter**. Allow at least one minute for the probe reading to settle down. It helps to swirl the probe around in the solution. After a minute or longer, press the **Enter** key as instructed. (If you press the **Enter** key too soon the analyzer will accept an inaccurate probe reading and the efficiency is likely to be lower than it should.)



3. The screen will display **Calibrating** for a few seconds as it reads the probe output and stores the probe output value. The next screen will appear and will direct you to immerse the probe in the second calibration standard. (*Always rinse the probe in clean tap water before immersing it in a new buffer.*) As before, wait at least one minute before pressing **Enter** to record the probe output value of the second calibration solution.



4. The screen will again display Calibrating for a few seconds and will display the results of the calibration - the efficiency and offset. An example is:

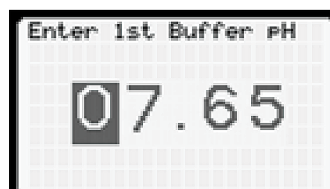


If you are satisfied with the measured efficiency and offset, press **Enter** to accept the calibration. If not, press **Back** to repeat calibration. Pressing **Menu** brings you back to the top menu.

6.1.3.2 Manual Calibration

As explained above, manual calibration can be used if the probe has a very large offset, has low efficiency or is being calibrated with non-standard buffer solutions.

1. Select **Manual Calibration**.
2. Place the probe in the first buffer. As opposed to auto calibration, it is okay to press **Enter** without waiting for the probe output to settle down. The next screen will display the current output reading of the probe.
3. When the reading settles down press **Enter**. The next screen allows you to change the value of the displayed pH value to correspond to the actual pH of the calibration solution. Use the **↑** and **↓** arrow buttons to change the value and the **←** or **→** button to change the cursor position. Press the **Enter** key to lock in the correct value.



4. The results of the calibration (identical to the one shown for auto calibration) will display.
5. Place the probe in the second buffer. Again, there is no need to wait for the probe reading to settle down prior to pressing **Enter**.
6. When the reading settles down press Enter. Change the pH value display to equal the pH of the calibration standard.

6.2 DOX Calibration

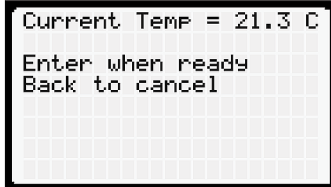
6.1.4 3-Point Calibration

The instructions for 3-point calibration are the same as for the 2-point calibration with the obvious exception that three standards are used instead of two.

5.1.5 Temperature Calibration

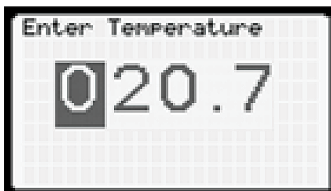
Since all pH readings are temperature compensated, an accurate pH reading depends on an accurate temperature.

1. Select **Temperature**.



Current Temp = 21.3 C
Enter when ready
Back to cancel

2. The screen displays the current temperature reading. Make sure the temperature reading has settled down. Keep in mind that most temperature elements in pH probes are encapsulated inside the probe, which results in a temperature lag of several minutes for the element to equilibrate with the temperature of the solution.
3. The temperature calibration procedure is analogous for manual pH calibration. It's not necessary to immerse the probe in solution. Knowing room temperature enables you to calibrate the probe in air. As with manual pH calibration, ensure that the temperature reading settles down prior to pressing **Enter**. The next screen allows you to change the temperature reading to match the actual temperature. Press **Enter** when done or **Menu** to go back to the top menu.



Enter Temperature
020.7

6.2.1 About Optical Dissolved Oxygen Calibration



* 100% Sat (Air)
0 ppm (0%)
Pressure
Salinity

The calibration of the DO sensors through the MPX UI actually saves and stores the calibration locally on the sensor. This allows users to leverage the factory calibration, calibrating offsite or simply calibrating on site. The DOX sensor has 4 calibration parameters: 100% Sat (often called Air), 0ppm (or 0%Sat), pressure and Salinity. Air and Zero are actual calibration methods where Pressure and Salinity are user adjustable values to adjust accuracy based on the installation method and location of the sensor's use.

6.2.2 100% Sat (air)

1. Saturate a sponge with deionized water and insert it into the calibration cup.
2. Gently dry the probe and sensor cap with a paper towel. Remove all water and debris.
3. Place the ODO-TX probe in the calibration cup so the sensor surface is about 2.5 cm (1") above the sponge.
4. Wait 5 to 10 minutes for temperature stabilization, but do not leave the probe in the calibration cup for more than 30 minutes. Condensation can form on the sensor surface, which may result in false readings after calibration. If condensation occurs, remove and thoroughly dry the probe.
5. To complete the calibration, simply press enter when the reading appears to be stable. The MPX will walk you through stability as shown below.

Reading: 7.88 PPM Status: UNSTABLE Enter to Calibrate Back to cancel	Reading: 7.87 PPM Status: STABILIZING Enter to Calibrate Back to cancel	Reading: 7.87 PPM Status: STABLE Enter to Calibrate Back to cancel
---	--	---

6. If successful, you will get a screen depicting the new slope and offset saved to the sensor.



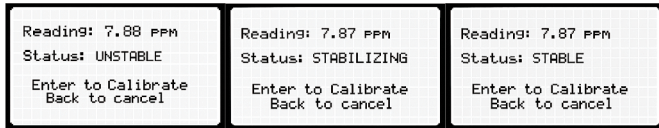
Slope: 1.02
Offset: 0.2
Calibration Complete
Press Enter or Run

6.2.3 0 ppm (%)

1. Remove the sponge from the calibration cup. Fill the cup with approximately 40 ml of fresh sodium sulfite solution. (This should be filled to about the bottom of the vented cap.)
2. Place the instrument in the calibration cup. Leave at least 13 mm (1/2") between the tip of the sensor and the bottom of the cup.
3. Make sure the membrane cap is completely submerged in the solution.
4. Allow at least five minutes for the temperature to stabilize.

6.2 DOX Calibration (Cont.)

- To complete the calibration, simply press enter when the reading appears to be stable. The MPX will walk you through stability as shown below.



- If successful, you will get a screen depicting the new slope and offset saved to the sensor.



- After calibration, remove the probe. Thoroughly rinse the probe and sensor to remove all sodium sulfite solution.

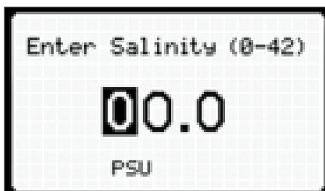
6.2.4 Pressure

As noted above, the pressure is a user entered value. The default value is 1013.25 mbar. The user can adjust this by toggling left or right to desired unit and then toggling up or down to adjust. Simply press enter to save and back to reject.



6.2.5 Salinity

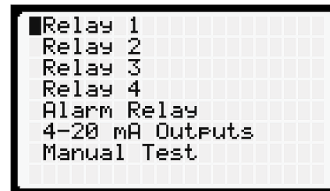
As noted above, the pressure is a user entered value. The default value is 0 PSU. The user can adjust this by toggling left or right to the desired unit and then toggling up or down to adjust. Simply press enter to save and back to reject.



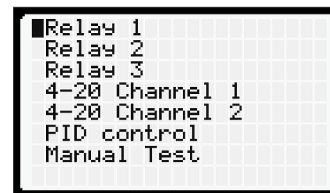
7. Output

The MPX has two output modes:

- Five dry contact relays, one of which is the alarm relay.
- Three isolated 4-20mA outputs.



Note: If channel 2 display only is selected, then the controller will only have three dry contact relays and two isolated 4-20mA outputs.

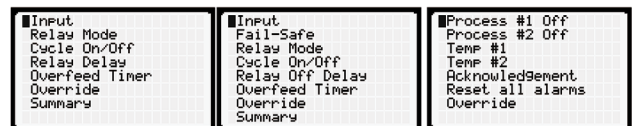


7.1 Relays

The MPX is equipped with five relays. Three relays give users the capability of controlling four processes and a physical alarm.

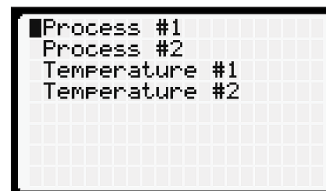
Note: All instructions assume a relay is wired as normally open (NO). If relay is wired normally closed (NC) then activate or open should be reversed, i.e. deactivate or close.

MPX: Relays 1, 2 Relays 3,4 Relay 5



7.1.1 Input (Relays 1, 2, 3, and 4 of MPX)

Allows you to select which input is controlling the relay. The options are:



Only one can be selected.

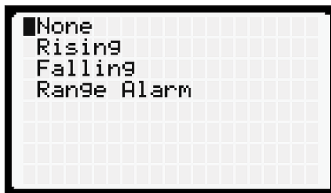
7.1.2 Relay Mode

There are three relay modes available: rising, falling and range alarm:

- A rising process is one that triggers a relay when the process value rises above the set-point.
- A falling process triggers a relay when the process value drops below the set-point.
- A range alarm is triggered when the process value is (a) either above the high-set point or below the low set-point or (b) inside the two set-points. In most applications, it is an out of range alarm.

7. Output (Cont.)

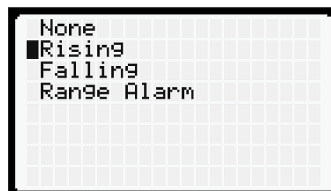
For rising and falling set-point there is a second set-point at which the relay deactivates. The gap between the set-point and the deactivation point is the dead-band. For instance, if you may be controlling a process whose pH naturally rises. If you want to lower the pH when it reaches pH 9 then set the relay set-point to 9. Presumably, at pH 9, a relay closes and starts a pump, which dispenses acid to bring the pH back down below 9. The pH value at which the relay opens again must be less than 9. If it is too close to 9.0, e.g. 8.9, the chemical pump will cycle on and off too frequently. Even more problematic is the relay activating before the pH has a chance to equilibrate. The result is that the process is never stabilizes. For these reasons the relay deactivation must be sufficiently below the activation, e.g. pH 8.0 in this menu figure below.



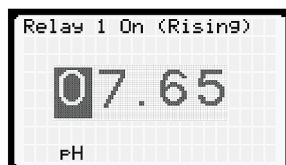
For obvious safety reasons, the relays of every new 2252 are deactivated. The menu selection, **None**, signifies this choice. Selecting **None** is the fastest way to remove an unwanted relay setting. The following describes the process for setting a relay in one of the three possible modes in the **Relay** menu.

7.1.2.1 Rising Process

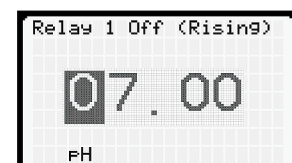
1. Select **Rising**. A relay cannot be set for a rising process AND a falling process. If you previously set a relay for a falling process, and you set it again for a rising process, then the falling process mode automatically turns off.



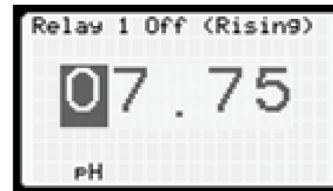
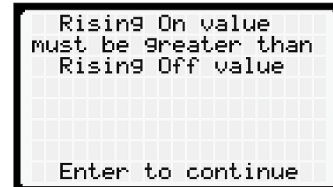
2. Enter the value of the process variable (e.g. pH) at which the relay turns on, i.e. the set-point. Press **Enter** to accept this value.



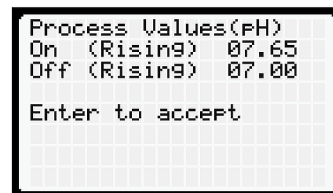
3. Enter the value of the set-point at which the relay turns off. Press **Enter** to accept this value. As explained above the off value must be lower than the on value.



4. If you choose an off-value that is higher than the set-point, the following warning message appears:



5. Confirm by pressing **Enter**.



7.1.2.2 Falling Process

The configuration process is identical to rising process (section 6.1.2.1) except that the on set-point must be lower than the off set-point. As stated above, a relay cannot be set for a rising process AND a falling process. If you previously set a relay for a rising process and you set it again for a falling process, then the rising process mode automatically turns off.



7. Output (Cont.)

7.1.2.3 Range Alarm

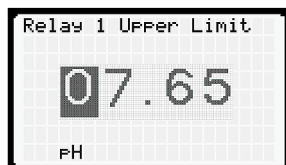
The Range Alarm mode setting is used—as the name implies—typically as an alarm which is activated if the process value is either **outside** a specified range or **inside** it. In most applications it will be used for out-of-range process values. When the relay is normally open (NO) the range alarm is out-of-range. When the relay is normally closed (NC) the range alarm is in-range.

Unlike rising or fall processes there are no "Off" set-points. To prevent an excessively frequent cycling of the relay, consider configuring Relay Off Delay (Section 7.1.5).

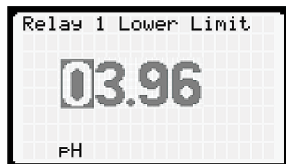
1. Select **Range Alarm**.



2. Enter the value of the upper set-point. Press **Enter** to accept this value.



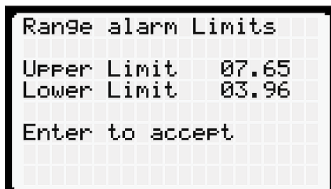
3. Enter the value of the lower set-point. Press **Enter** to accept this value. The lower value must be lower than the upper value.



4. If **your lower value is higher than your lower value**, the following message appears:



5. Confirm by pressing **Enter**.



7.1.3 Fail-safe (Relay 3,4 of MPX)

Fail-safe revert NO contact such that one can use relays 3 and 4 in NC configuration so long as there is power. Please note, that if input power is lost or disconnected, the relay will be held in NO position.

7.1.4 Cycle On/Off

The cycle on/off parameter is very useful for preventing overshoot of a process controlling action—usually the dispensing of a chemical. If the response time of the process to the added chemical is slow compared to the rate at which the chemical is being introduced, then the process variable will overshoot its target (as described in Section 6.1.1 for a rising process).

] Choosing set-points for activating and deactivating the relay is a first line defense against overshoot. The cycle on/off feature is a second line defense. As Figure 6 1 shows, the duty cycle is expressed as the duration over which the relay is activated divided by the total time of the complete on-off cycle. If the relay is on for 10 seconds and off for 30 seconds, then the complete cycle is 40 seconds and the duty cycle is 25%. The slower the response time of the process to the added chemical (or other process control mechanism) the lower the duty cycle or time-on should be.

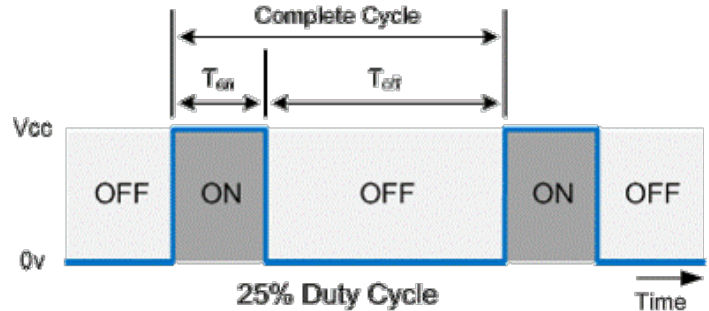
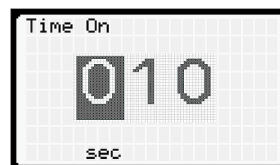


Figure 7-1 Duty cycle the On cycle being 1/4 of the complete cycle. An example of a duty cycle expressed in seconds is 10 seconds on and 30 seconds off.

7.1.4.1 Configuring Cycle

The controller ships with cycle on/off deactivated.

1. Select **On**.
2. Enter the value for the amount of time, in seconds, the relay is on (activated). Press **Enter** to accept this value.

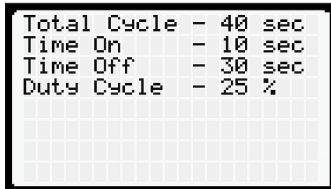


3. Enter the value for the amount of time, in seconds, the relay is off (Deactivated). Press **Enter** to accept this value.



7. Output (Cont.)

- Press **Enter** to confirm the displayed value or cancel by pressing **Back**.



```
Total Cycle - 40 sec
Time On    - 10 sec
Time Off   - 30 sec
Duty Cycle - 25 %
```

7.1.5 Relay Off Delay

There are instances in which a process value can initially spike upon addition of a chemical. An example is acid that is dispensed very close to a pH sensor such that, when the acid is first dispensed the probe pH drops precipitously and then rises as the acid is mixed. This is the opposite of a problem that occurs if the probe is far from the injection point such that there is a long delay in the change in pH and that calls for cycle on/cycle off control. Placing the sensor in the correct position would preempt the need for a relay delay but, for systems that are not easily modified, this option is a good solution.

- Select **On**.
- Enter the value for **Relay Off Delay**, the amount of time the relay is off (deactivated), in seconds. Press **Enter** to accept this value.



```
Relay Off Delay
060
sec
```

7.1.6 Overfeed Timer

If a probe malfunctions, it is possible for a relay to activate and stay permanently activated. Using the above example of a relay connected to an acid dispenser: The relay is programmed to activate at 9 and deactivate at 8. If the probe failed and remained stuck at pH 8 or higher, then the chemical pump that dispenses the acid would operate until it emptied out the entire container of acid. Perhaps worse is that the actual pH of the process would drop to a dangerously low level and cause serious damage to the processing equipment.

The overfeed timer option prevents this. By specifying the maximum amount of time that a relay can remain activated, the damage caused by a faulty probe signal is contained. Although this feature is turned off by default, we strongly recommend always setting this option.

- Select **On**.
- Enter the value for the maximum time, in minutes, the relay can remain activated.

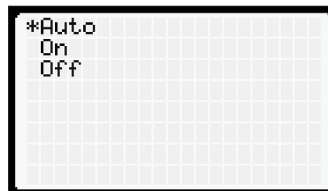


```
Overfeed Timer
010
min
```

- Press **Enter** to accept this value.

7.1.7 Override

This simple control manually forces the relay on or off. It can be used as a switch to turn the process control function off and on and is normally used for either testing or emergency purposes.



```
*Auto
On
Off
```

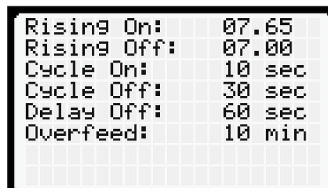
Auto: Disable override so that the relay behaves as set up.

On: Activate the relay.

Off: Deactivate the relay.

7.1.8 Summary

The summary menu item lists only configured relay parameters described in this section.



```
Rising On: 07.65
Rising Off: 07.00
Cycle On: 10 sec
Cycle Off: 30 sec
Delay Off: 60 sec
Overfeed: 10 min
```

Press **Back** or **Enter** to continue.

7.1.9 Relay 5 (Alarm relay)

The alarm relay is quite different from the other four relays. The main difference is that it can be configured for more than one input, i.e. you can trigger the relay with Process #1 and Temperature #1 and Process #2 and Temperature #2.

Each input is configured individually and there is an easy way to clear all alarms without erasing other settings - just click on "reset all alarms".

Acknowledgment option allows to lock alarm until an operator clears it manually. There are two ways to acknowledge the alarm:

- From the keypad.
- Using a totalizer reset switch (see page 18 for wiring).

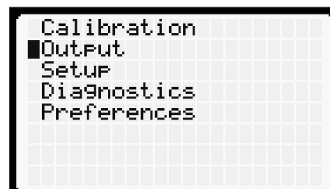
7.2 4-20 mA Output Channel Configuration

The MPX hosts three 4-20 mA outputs on the power circuit board. Channel outputs can be configured linearly for process of temperature in pH, ORP, or conductivity mode.

For either output the 4 mA and 20 mA values can be set to any value. Customizing the range maximizes the accuracy of the 4-20 mA signal.

7.2.1 Relay 5 Configuring Channels for Linear Process

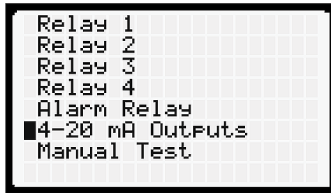
- From the main menu select **Output**.



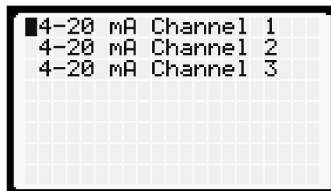
```
Calibration
Output
Setup
Diagnostics
Preferences
```

7.2 4-20 mA Output Channel Configuration (Cont.)

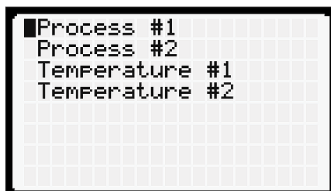
2. Select 4-20 mA Outputs.



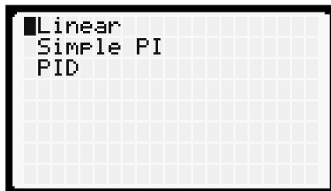
3. Select the channel you wish to configure.



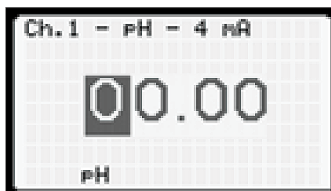
4. Select Input.



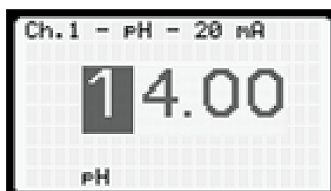
5. Select Linear.



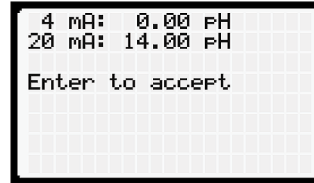
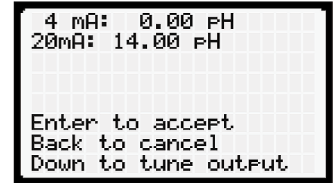
6. Enter the value of the process variable that corresponds to 4 mA.



7. Enter the value of the process variable that corresponds to 20 mA. This is usually the highest value you expect to observe. Its default value depends on the setup parameters for the probe.



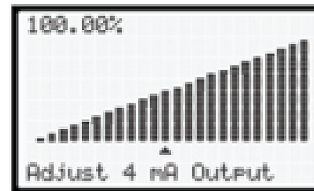
8. The next screen summarizes your choice of 4 and 20 mA values.



9. Press Enter to accept this value or Back to start over.

Note that the 4 mA value can be higher than the 20 mA value. This simply reverses the direction of the 4-20 mA signal as the process variable changes.

10. If for some reason the 4-20 mA output is not measured accurately on the measuring device (PLC or datalogger), one can adjust the factory 4-20 mA calibration by pressing the **Down Arrow** (↓) button on the previous screen.



11. Once in the "Tune output" screen, the controller is set to the fixed 4.00 mA output. Use **Left** or **Right** arrow buttons to decrease or increase the mA output while comparing it to the measurement on the measuring device (PLC or datalogger).
12. Repeat the process for the 20.00mA point.
13. Press Enter to store both the linear output configuration and the tuned 4-20mA output setting.

7.2.2 Relay Configuring Channels for Temperature

Steps for temperature will remain the same as 7.2.1. Instead of being in terms of pH, enter data for temperature.

7.3 Manual Test

Manual Test allows you to ensure that the outputs operate as intended without requiring the probe to deliver the actual output needed to test a relay or 4-20 mA output. For instance, if you set a relay for a rising process that activates when the pH reaches 9.0 you might test it by immersing it in pH 9.1 solution and verifying that the relay activates. Manual testing enables this test to be done without the solution. Simply dial in the pH value to 9.0 and observe the state of the relay on the screen. Temperature values can also be simulated. Press Enter to switch inputs between two processes and two temperatures.

The Manual Test screen also displays 4-20 mA output values. In the example below (right screen for AM-2250) Relay 1 was set to activate at pH 9.0. Relays 2 or 3 were either set to activate at a higher pH, a falling process below 9.0 or were not turned on at all. The Channel 1 4-20 mA corresponding to pH 9.0 is 14.3 mA (based on the 4-20 range corresponding to 0 to 14). The 4-20 Channel 2 mA corresponds to the temperature (Based on the 4-20 range corresponding to 0 to 100C).

7.3 Manual Test (Cont.)

Manual Test allows you to ensure that the outputs operate as intended without requiring the probe to deliver the actual output needed to test a relay or 4-20 mA output. For instance, if you set a relay for a rising process that activates when the pH reaches 9.0 you might test it by immersing it in pH 9.1 solution and verifying that the relay activates. Manual testing enables this test to be done without the solution. Simply dial in the pH value to 9.0 and observe the state of the relay on the screen. Temperature values can also be simulated. Press Enter to switch inputs between two processes and two temperatures.

The Manual Test screen also displays 4-20 mA output values. In the example below (right screen for AM-2250) Relay 1 was set to activate at pH 9.0. Relays 2 or 3 were either set to activate at a higher pH, a falling process below 9.0 or were not turned on at all. The Channel 1 4-20 mA corresponding to pH 9.0 is 14.3 mA (based on the 4-20 range corresponding to 0 to 14). The 4-20 Channel 2 mA corresponds to the temperature (Based on the 4-20 range corresponding to 0 to 100C).

```
PH1: 14.00 pH
R1: OFF R2: OFF
R3: OFF R4: OFF
Alarm Relay: OFF
CH 1 4-20: 0.0 mA
CH 2 4-20: 0.0 mA
CH 3 4-20: 0.0 mA
Enter to change field
```

Note: Manual Test cannot simulate Relay Cycle, Relay off Delay, Overfeed, PID.

If the 4-20mA have not been configured, the output will be 0 mA.

8. Operation

8.1 Run Mode

Press **Run** from just about any menu to set controller in operation mode. The screen for "Run" mode shown on Figure 8-1 below.

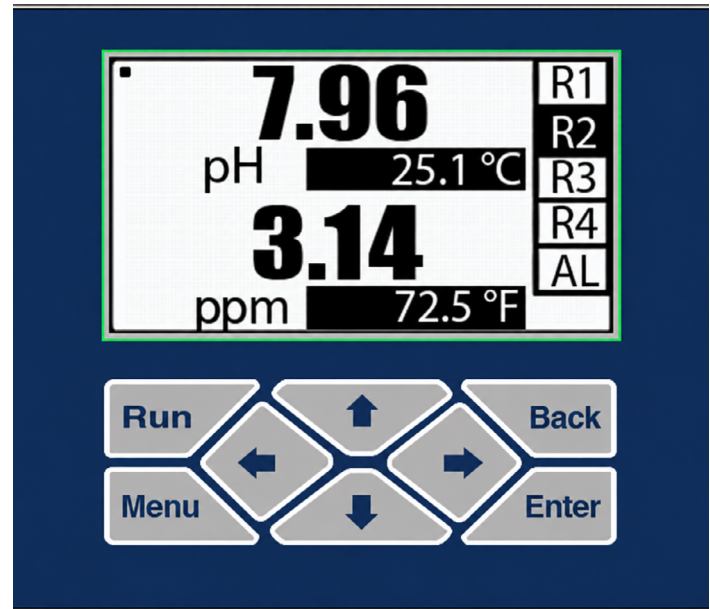


Figure 8-1 MPX in "run" mode.

8.2 Display Features

The screen refreshes every second. A blinking dot in the top left corner indicates that measurements are occurring. The blinking dot also confirms that the controller is operating even though the process and temperature values may be so stable that they appear to be "frozen." (if the process value changes too frequently consider increasing "Damping").

The process values are displayed in the middle. The font size and number of decimal points are set to minimize user error. The temperature reading is displayed under process values in the user's selected units. All units of measure will contain one decimal point. The MPX also displays relay indicators on the right side: if a relay has not been activated an empty box is displayed, as shown for R1, R3, R4 and AL in Figure 7 1 above. If a relay has been activated the box appears solid, as shown for R2 on Figure 8 1.

8.3 Maintenance

To perform a calibration or change the probe configuration, press the **Menu** button.

```
Calibration
Output
Setup
Diagnostics
Preferences
```

As soon as main menu appears on the screen the controller automatically activates "Hold" mode. While you are in menu screen:

- Process and temperature measurements are paused.
- Activated relays are deactivated.
- 4-20 output(s) freeze on the last reported value.

8. Operation (Cont.)

Placing relays on hold during calibration is essential as calibration standards might activate their target (usually a pump). If, however, a relay must be kept activated during calibration/maintenance time activate Override (described in section 7.1.7).

9. Diagnostics

The diagnostic menu has five options.

```
■Sensor Output
  Calibration #1 Data
  Calibration #2 Data
  Factory Reset
  Firmware Upgrade
  About
```

```
Calibration Data
Sensor Output
Factory Reset
About
```

```
Restore Controller
to Factory Settings

All User Values Will
Be Permanently Lost

Enter to Proceed
Back to cancel
```

9.1 Calibration Data

This menu has one screen, which displays the result of the latest calibration.

- **DPHX:** Number of calibration points (2 or 3), slope, offset, efficiency and calibration temperature.
- **DOX:** Slope, offset, air calibration value, 0 calibration value.

9.2 Sensor Output

This diagnostic screen displays the raw signal coming from a probe. It is invaluable for diagnosing probe problems.

- **pH:** A pH probe outputs a voltage. The temperature element (if present) outputs a resistance. For diagnosing a problematic pH probe the voltage output should be $(7.0 - \text{pH}) \times 59 \text{ mV}$ within about 50 mV. A smaller value indicates a low efficiency, which may be ameliorated by cleaning the electrode, changing the reference solution or changing the salt bridge. If the probe output does not change upon changing from one calibration solution to another then the probe is dead.

The resistance of the temperature element should be close to the nominal resistance, which is usually 1100Ω (for a pt1000RTD). A resistance reading far removed from its nominal value is indicative of a defective element or the improper selection of the element.

- **ORP:** An ORP probe also outputs a voltage. The temperature element (if present) outputs a resistance. Unlike a pH probe, the ORP value is not temperature compensated.

The resistance of the temperature element should be close to the nominal resistance, which, depending on the element is usually 1100Ω (for a pt1000RTD). A resistance reading far removed from its nominal value is indicative of a defective element.

- **ISE:** An ISE probe also outputs a voltage. The temperature element (if present) outputs a resistance.
- **Conductivity:** A conductivity sensor measures resistance (which is inversely proportional to conductance). The temperature element outputs resistance as well.

The resistance of the temperature element should be close to the nominal resistance, which, depending on the element is usually 1100Ω (for a pt1000RTD). A resistance reading far removed from its nominal value is indicative of a defective element.

- **Flow:** A paddle-wheel or magnetic flow meter outputs a pulse train. The raw output is the pulse frequency. There is no temperature measurement.

- **4-20mA:** This type of sensor is expected to change its output between 4 and 20 mA. The current mA reading will be displayed. Temperature is disabled for this type sensor.

9.3 Factory Reset

This feature restores the controller to its factory default state. It resets all user calibrations, 4-20 outputs, tuning, and relay set-points values.

9.4 About

This feature displays the current firmware version and its release date. If you experience issues with your analyzer you will want to know the firmware version running before contacting us.

10. Preferences

The preferences menu has three options that only affect the user experience.



10.1 Auto Return

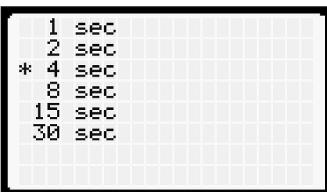
This feature allows you to return the 2250 to Run mode if you walk away from the 2250 while exercising a menu item. The choices are:



If you choose "None" then the menu which was active when you left will be active indefinitely. If you choose one of the other options, e.g. 10 min, then the screen will revert to the run screen after 10 minutes of inactivity. This feature is invaluable if the 2250 is transmitting data to a PLC or SCADA. While a menu item is being exercised the controller ceases to send data, which can cause an undue alarm or relay at the PLC or SCADA.

10.2 Damping

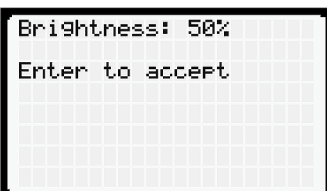
Signal averaging, aka "damping", smooths fluctuating process values—both on the display and on the 4-20 mA output. The options are shown here:



The signal averaging is a rolling average. For example, if damping is set to 4 seconds, then each process value data point equals the average of the preceding four points. The default value is 4 seconds.

10.3 Backlight

This option allows you to change the brightness level of the LCD screen. It is useful for matching the screen brightness to the ambient brightness. For darkened interiors, turning down the brightness helps prevent eye strain. Adjustment is done by pressing the $\uparrow$ or $\downarrow$ buttons while in that menu screen. Press **Enter** to confirm or **Back** to cancel.



Notes

Notes

HF scientific Municipal Market Products Limited Warranty

The online warranty for this product is located on the Watts website (<https://www.watts.com/resources/warranty-information>), and in the event that the terms or conditions of this manual conflict with the online warranty, the terms and conditions of the online warranty shall control. HF scientific, LLC (the "Company") warrants each municipal market instrument product to be free from defects in material and workmanship under normal usage for a period of one (1) year from first use or two (2) years from date of the Company's invoice from the original sale of the product, whichever occurs first. In the event of such defects within the warranty period, the Company will, at its option, replace or recondition the product without charge. Parts which by their nature are normally required to be replaced periodically, consistent with normal maintenance, specifically reagents, desiccant, sensors, electrodes and fuses, are excluded. Also excluded are accessories and supply-type items.

Proof of purchase from the Company (invoice or paid order confirmation) and/or first use (commissioning) must be provided when making a product warranty claim.

THE WARRANTY SET FORTH HEREIN IS GIVEN EXPRESSLY AND IS THE ONLY WARRANTY GIVEN BY THE COMPANY WITH RESPECT TO THE PRODUCT. THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESSED OR IMPLIED. THE COMPANY HEREBY SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

The remedy described in the first paragraph of this warranty shall constitute the sole and exclusive remedy for breach of warranty, and the Company shall not be responsible for any incidental, special or consequential damages, including without limitation, lost profits or the cost of repairing or replacing other property which is damaged if this product does not work properly, other costs resulting from labor charges, delays, vandalism, negligence, fouling caused by foreign material, damage from adverse water conditions, chemical, or any other circumstances over which the Company has no control. In addition, the Company shall not be responsible for any costs incidental to the Company's warranty response efforts, including, without limitation, costs associated with the removal and replacement of systems, structures or other parts of facilities, de-installation, decontamination and re-installation of products, or transportation of products to and from the Company. This warranty shall be invalidated by any abuse, misuse, misapplication, improper installation or improper maintenance of the product, alteration of the product or use of any parts or accessories (including but not limited to reagents) not provided by the Company.

Some states do not allow limitations on how long an implied warranty lasts, and some states do not allow the exclusion or limitation of incidental or consequential damages. Therefore the above limitations may not apply to you. This Limited Warranty gives you specific legal rights, and you may have other rights that vary from State to State. You should consult applicable state laws to determine your rights.

SO FAR AS IS CONSISTENT WITH APPLICABLE STATE LAW, ANY IMPLIED WARRANTIES THAT MAY NOT BE DISCLAIMED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO ONE YEAR FROM THE DATE OF ORIGINAL SHIPMENT.



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