WNI Series
Electroless Nickel Controller
Instruction Manual

Notice

5 Boynton Road, Holliston, MA 01746 USA
(508) 429-1110

Printed in USA

Proprietary Material

Statement of Limited Warranty

WALCHEM Corporation warrants equipment of its manufacture, and bearing its identification to be free from defects in workmanship and material for a period of 24 months for electronics and 12 months for mechanical parts and electrodes from date of delivery from the factory or authorized distributor under normal use and service and otherwise when such equipment is used in accordance with instructions furnished by WALCHEM Corporation and for the purposes disclosed in writing at the time of purchase, if any. WALCHEM Corporation's liability under this warranty shall be limited to replacement or repair, F.O.B. Holliston, MA U.S.A. of any defective equipment or part which, having been returned to WALCHEM Corporation, transportation charges prepaid, has been inspected and determined by WALCHEM Corporation to be defective. Replaceable elastomeric parts and glass components are expendable and are not covered by any warranty.

THIS WARRANTY IS IN LIEU OF ANY OTHER WARRANTY, EITHER EXPRESS OR IMPLIED, AS TO DESCRIPTION, QUALITY, MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE OR USE, OR ANY OTHER MATTER.

P/N 180098.I1
Feb 2006

Table of Contents

1.0 Introduction

The WNI310 series nickel controllers are optoelectronic on-line analyzers that may be used in electroless nickel plating applications. Because the sensors are made with glass, do not use these controllers in baths that contain fluorides.

There are up to four relays that may be used as control outputs that are activated simultaneously. The direction of control is selected via software. The outputs each have timers associated with them, that may be used to track the total volume of chemistry added, the total time that the output has been on or the number of metal turnovers. Output 3 may be used for pH control if the optional pH board is installed.

An optional 4-20 mA output that is proportional to the nickel concentration or pH, but not both, is available. A flow through out-of-tank sensor is used.

2.0 Specifications

2.1 Measurement Performance

Ni

Concentration Range:	.01 - 25 g/L	(.001 - 3.32 oz/gal)
Concentration Resolution:	.001 g/L	(.0001 oz/gal)
Concentration Accuracy:	.01 g/L	(.001 oz/gal)

pH (optional)

Range:	0 to 14 pH
Resolution:	.0015 pH units (.01 pH displayed)
Accuracy:	Electrode and calibration dependant
Temp Comp (optional):	Automatically detects and accepts 100 or 1000 ohm platinum RTDs
Temperature Range:	32-212°F (0-100°C)
Temperature Resolution:	0.09°F (.05°C)
Temperature Accuracy:	±0.18°F (±.1°C)

2.2 Electrical: Input/Output

Input Power

Controller	110-120 VAC 50/60 Hz, 60 mA	or	220-240 VAC 50/60 Hz, 30 mA

Input Signal

Interlock (optional)	Isolated dry contact closure required (i.e., flow, level, etc.)
Nickel Sensor	0 - 2 VDC
pH (optional)	±500 mV
pH Temp Comp	PT100 or PT1000

Output

Mechanical Relays	@ 120VAC, 10A resistive, 1/8 HP @ 240 VAC, 5A resistive, 1/8 HP Internally powered, four control relays and one non-programmable diagnostic alarm relay.
4 - 20 mA (optional)	Fully isolated, internally powered, 600 W max. resistive load. Resolution .001% of span, accuracy ± 1% of reading.

Nickel Sensor (supplied by Controller)	+5 VDC, 150 mA
pH Pre-amp (optional; supplied by Controller option board)	±5V DC, 5 mA

Agency Approvals

UL	UL 61010-1, 2nd Edition
CSA	C22,2 No.61010-1 2nd Edition
CE Safety	EN 61010-1 2nd Edition
CE EMC	EN 61326 :1998 Annex A*

Note: For EN61000-4-6,3 the controller met performance criteria B.

*Class A equipment: Equipment suitable for use in establishments other than domestic, and those directly connected to a low voltage (100-240 VAC) power supply network which supplies buildings used for domestic purposes.

2.3 Mechanical

Controller

Enclosure:	Fiberglass
NEMA Rating:	NEMA 4X
Dimensions:	8.5" x 6.5" x 5.5"
Display:	2 x 16 character backlit liquid crystal
Operating Ambient Temp:	32 - 122°F (0 - 50°C)
Storage Temperature:	-20 to 180°F (-29 to 80°C)
Shipping Weight:	7 lbs (approximately)

Sensor

Enclosure:	ABS
NEMA Rating:	NEMA 4X
Dimensions:	6.75" x 4.75" x 2.25"
Operating Ambient Temp:	32 - 122°F (0 - 50°C)
Storage Temperature:	-40 to 185°F (-40 to 85°C)
Solution Temperature:	200°F (93°C) maximum
Maximum cable length:	80 ft.

3.0 Unpacking and Installation

3.1 Unpacking the unit

Inspect the contents of the carton. Please notify the carrier immediately if there are any signs of damage to the controller or its parts. Contact your distributor if any of the parts are missing. The carton should contain a WNI310 controller and instruction manual. Any options or accessories will be incorporated as ordered.

3.2 Mounting the electronic enclosure

The WNI series controller is supplied with mounting holes on the enclosure. It should be wall mounted with the display at eye level, on a vibration-free surface, utilizing all 4 mounting holes for maximum stability. . Use M6 (1/4" diameter) fasteners that are appropriate for the substrate material of the wall. The enclosure is NEMA 4X rated. The maximum operating ambient temperature is 122° F (50° C). The enclosure requires the following clearances:

Top:	2"
Left:	8"
Right:	4"
Bottom:	7"

3.3 Installing the Flow Through Sensor/Sample Lamp

IN ORDER TO AVOID SENSING ERRORS DUE TO CONDENSATION, THE SENSOR COVER SHOULD NEVER BE REMOVED.

The flow through sensor is designed for out-of-tank monitoring. It is provided with a mounting plate and 20 feet of cable. Extension cable is available if the sensor cannot be placed within 20 feet of the controller. The maximum cable length is 80 ft.

The sample loop consists of a shut off valve, a cooling coil or plate, a sensor, an optional pH adapter assembly, a pump, or any combination thereof. The shut off valve is to quickly isolate the system if necessary. A cooling coil or plate is necessary to cool the nickel solution down to a temperature acceptable to a sample pump and/or pH electrode (if applicable). Cooling the solution is also recommended to help reduce the amount of plate out which may form in the sample loop. The pH adapter assembly is used to mount an in-line pH electrode. It should be mounted such that the electrode is always immersed in the 'U' trap. The pump may be either a stand-alone sample pump (which will typically have high temperature restrictions), or a high temperature pump (which is usually a branch off of the recirculation pump).

The flow through sensor/sample loop must be installed according to the following guidelines:

- Mount the sensor on a vibration-free, vertical surface so that the sensor tubing inlet connection is at the bottom and the outlet is at the top. The vertical orientation will prevent air bubbles from being trapped in the sensor.

Installation including degasser

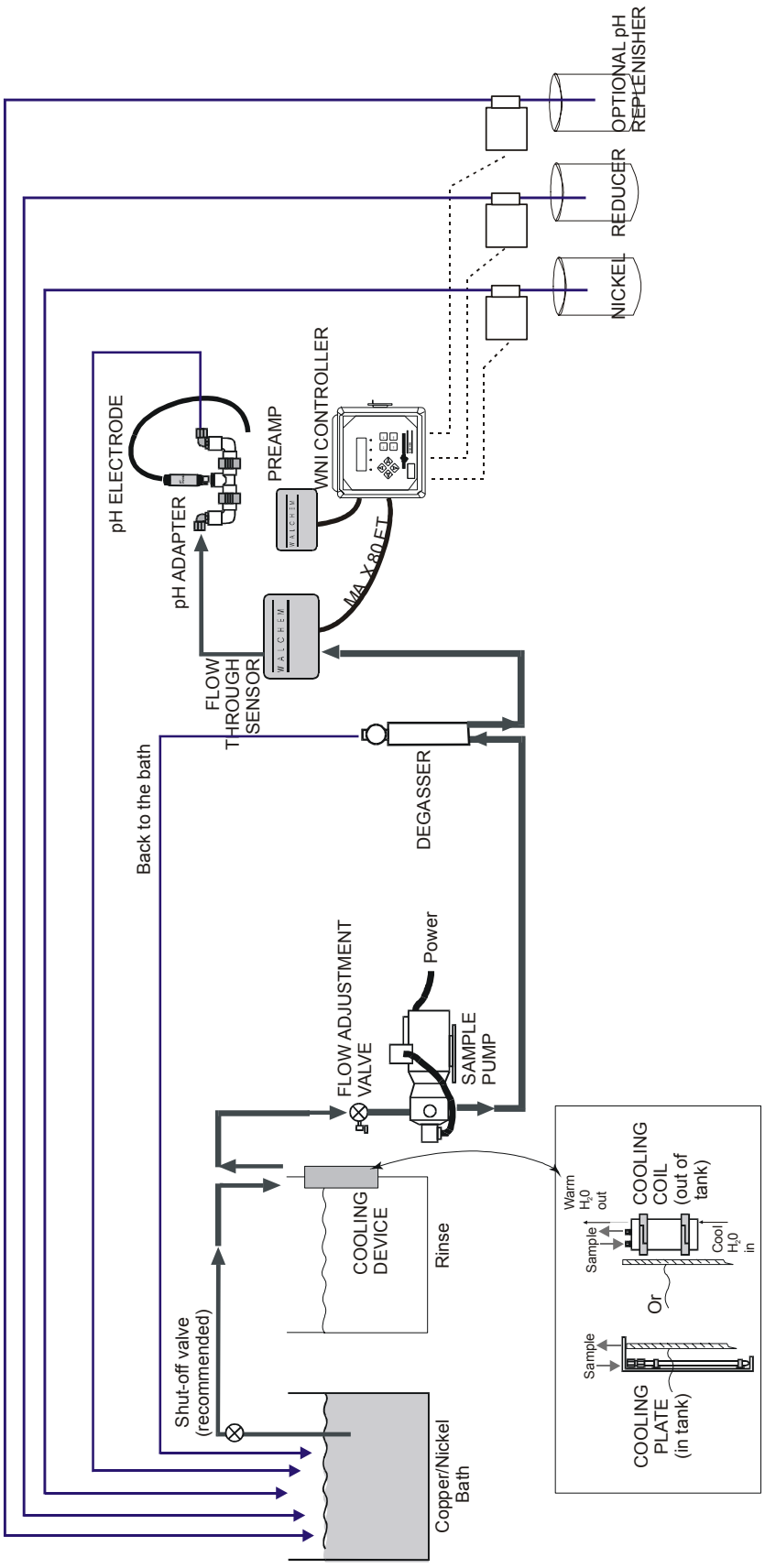


Figure 1a Typical Installation including degasser

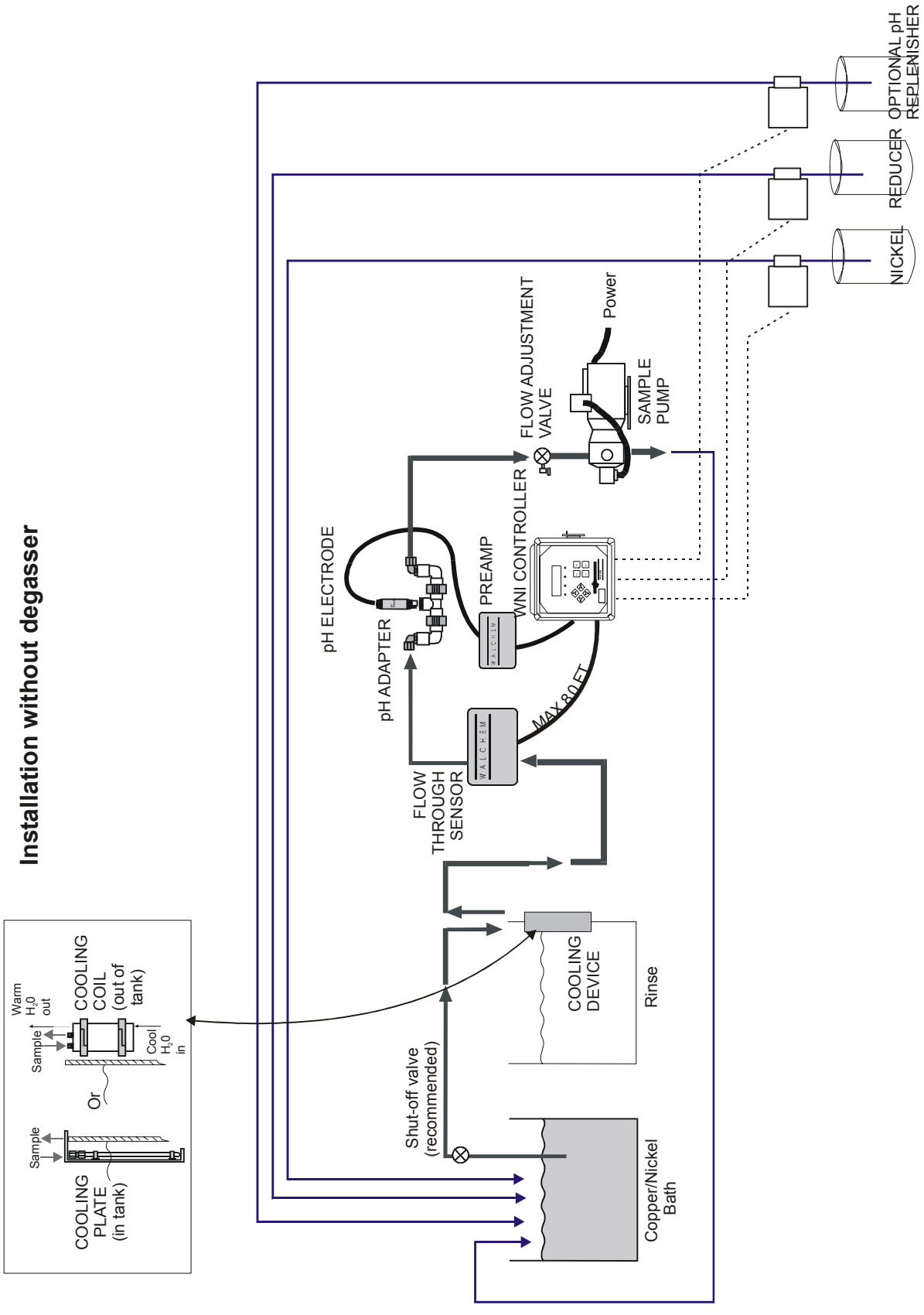


Figure 1b Typical Installation without degasser

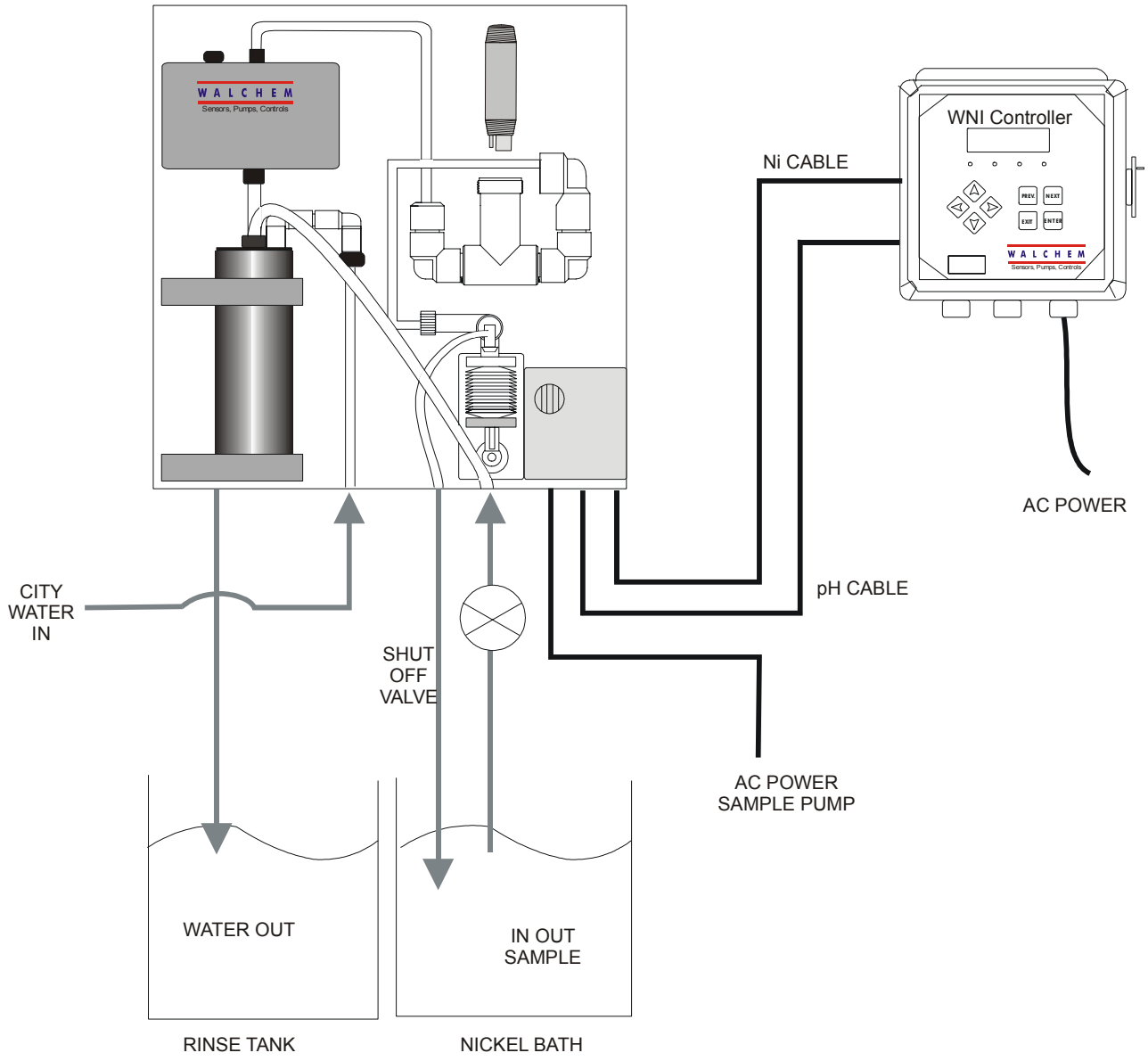


Figure 1C Electroless Nickel Sample System Installation

- Install a shut-off valve at the beginning of the sample loop so that the system may be shut off quickly if necessary.

- If a sample pump is to be used, it must be installed last, after the cooling coil or cooling plate, the flow through sensor, and the pH adapter assembly, if applicable.

- If a high temperature recirculation pump is to supply flow, adjust flow rate through the sample loop between 400 - 500 mL/min (approx. 0.11 - 0.13 gal/min). This flow rate will help ensure adequate cooling of the solution while maintaining a reasonable lagtime in longer runs of tubing. If this is not possible or is undesirable, see Application Notes below.

Other installation guidelines which may be helpful in the overall system:

- Mount the sensor as close to solution as possible. Keep tubing distances to the sensor inlet as short as possible to avoid hydraulic lag time. Maximum recommended length of tubing from solution to sensor is 25 feet. If this is not possible, see Application Notes below.

- The solution inlet should draw sample from an area of good solution movement in order to respond quickly to chemical additions. However, the solution inlet should *not* draw too near to where the chemistry is added to avoid artificial 'spikes' in concentration.

- The solution discharge should be open to atmospheric pressure in order to ensure proper flow.

- The cable connector to the controller is keyed, do not force!

Application Notes

If the distance from the solution to the sensor is further than the recommended length of 25 feet, the maximum lagtime must be calculated from the desired control band to determine a pump flow rate based on a given distance of standard, uniform tubing. The maximum lagtime is the maximum allowable time for the solution to continuously get to the sensor in order to achieve the desired control band.

To calculate maximum lagtime:

$$\text{Max. Lagtime} = \frac{\text{Desired Control Band*}}{4 \times \text{Depletion Rate}}$$

where Control band = Maximum deviation of concentration
Depletion rate = Rate at which the bath will deplete per unit of time

The deadband should be adjusted so that it is 1/4 the desired control band.

For Example: The set point is 4.00 g/L.

If the desired control band is 0.20 g/L (± 0.10 g/L or 2.5%) and the bath is depleting at a rate of 1.25 g/L every 15 minutes (0.08333 g/L every minute),

$$\text{then Max. Lagtime} = \frac{0.20 \text{ g/L}}{4 \times (0.08333 \text{ g/L /min})} = 0.60 \text{ minutes}$$

So, 0.60 minutes is the maximum time it should take for the solution to reach the sensor.

To calculate pump flow rate:

$$\text{Minimum Pump Flow Rate} = \frac{\text{Volume of System}^*}{\text{Maximum Lagtime}}$$

where Volume of system = $\pi \left(\frac{\text{Tubing I.D.}}{2}\right)^2 \times$ Length of tubing

Maximum lagtime = Previously calculated time to get solution to sensor.

* Volume is based on length from solution to sensor, not the return.

For Example: If the system parameters are: Tubing is 3/8" O.D. ' 1/4" I.D.
Length is 30 feet (360 inches)

$$\text{then the volume of the system} = \pi \left(\frac{0.25 \text{ in}}{2}\right)^2 \times (360 \text{ in}) = 17.7 \text{ in}^3$$

Note: 1 U.S. Gallon = 231 U.S cubic inches	1 Liter = 61.03 U.S. cubic inches
Volume of Cooling Coil: 0.018 Gallons 0.068 Liters	Volume of Cooling Plate: 0.023 Gallons 0.088 Liters
Volume of 3/8" O.D. x 1/4" I.D. (0.59 in3/ft): 0.00255 Gallons/linear ft 0.00965 Liters/linear ft	

$$\text{Volume of the system} = \frac{17.7 \text{ in}^3}{231 \text{ in}^3 / \text{gallon}} = 0.0765 \text{ gallons}$$

Maximum lagtime = 0.60 minutes (previously calculated)

$$\text{So, the minimum pump flow rate} = \frac{0.0765 \text{ gallons}}{0.60 \text{ minutes}} = 0.127 \text{gal/min (483 mL/min)}$$

Caution: The calculated pump flow rate is the minimum required to obtain the desired control band, however, if the flow rate increases over the recommended rate of 500 mL/min (approx. 0.13 gal/min) the rate of cooling will decrease. This may be compensated for by re-evaluating the system criteria: length / desired control band or to double up on the cooling plate/coil.

Consult factory with any further installation questions.

3.4 Control Module Installation

Once the enclosure is mounted, the output pumps may be located at any distance from the controller. The sensor(s) may be placed up to 80 feet from the controller. Consult the factory for extension cable. Always route AC voltage wiring in conduit that is separated a minimum of 6 inches from low voltage DC signal lines (such as the sensor signal).

3.5 Icon Definitions

Symbol	Publication	Description
	IEC 417, No.5019	Protective Conductor Terminal
	IEC 417, No. 5007	On (Supply)
	IEC 417, No. 5008	Off (Supply)
	ISO 3864, No. B.3.6	Caution, risk of electric shock
	ISO 3864, No. B.3.1	Caution

3.6 Electrical Installation

Based on the model number, the following voltages are required:

WNI31X-1XX	120 VAC, 50/60 Hz, prewired
WNI31X-4XX	120 VAC, 50/60 Hz, hardwired
WNI31X-5XX	240 VAC, 50/60 Hz, hardwired

The various standard wiring options are shown in Figure 2. Your WNI series controller will arrive from the factory prewired or ready for hardwiring. Depending on your configuration of controller options, you may be required to hardwire some or all of the input/output devices. Refer to figures 3 and 4 for circuit board layout and wiring.

Note: when wiring the optional 4-20 mA output or a remote flow switch, it is advisable to use stranded, shielded, twisted pair wire between 22-26 AWG. Shield should be terminated at the controller ground stud (see figure 4).

CAUTION! There are live circuits inside the controller even when the power switch on the front panel is in the OFF position! The front panel must never be opened before power to the controller is REMOVED!
If your controller is prewired, it is supplied with a 8 foot, 18 AWG power cord with USA style plug. A tool (#1 phillips driver) is required to open the front panel.

CAUTION! When mounting the controller, make sure there is clear access to the disconnecting device!

CAUTION! The electrical installation of the controller must be done by trained personnel only and conform to all applicable National, State and Local codes!

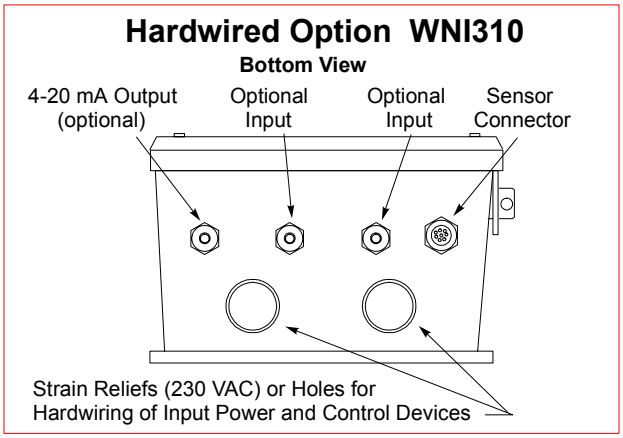
CAUTION! Proper grounding of this product is required. Any attempt to bypass the grounding will compromise the safety of persons and property.

CAUTION! Operating this product in a manner not specified by Walchem may impair the protection provided by the equipment.

3.7 Option Board Installation

To upgrade a WNI controller to allow pH input, order Walchem part number 190809 and follow the installation procedure that comes with the option board.

After installation, on power-up, the unit should display "Model Number WNI311". If it does not, check the ribbon cable header, its placement, and the orientation of the pin 1 marker (red stripe). If it still does not recognize the option board, consult factory.



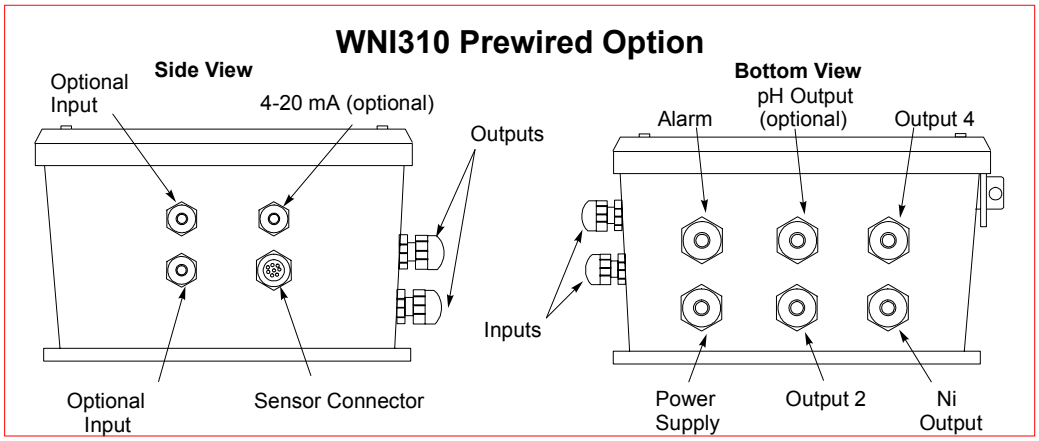


Figure 2 Conduit/Wiring

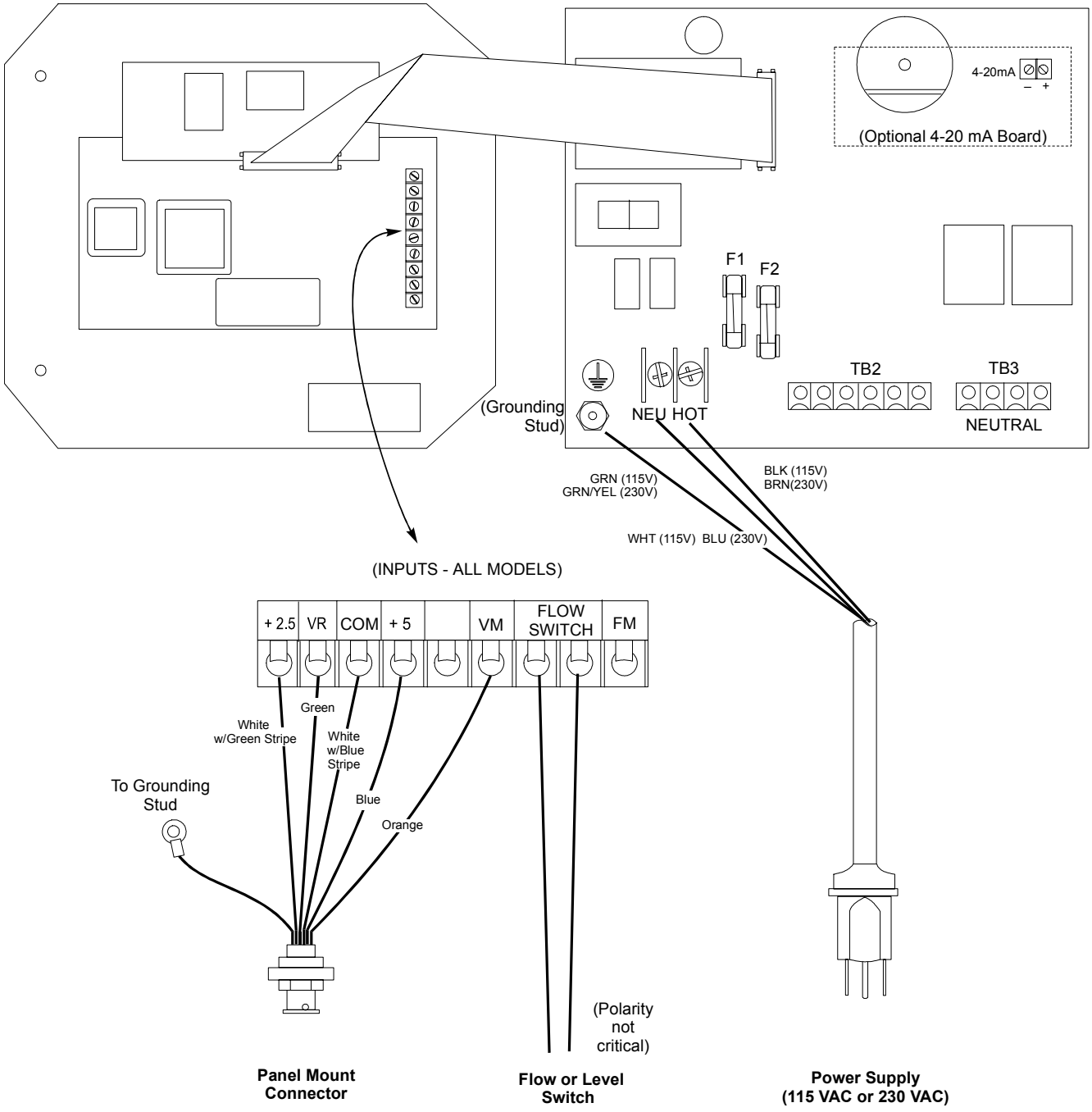


Figure 3 Inputs (for power relay board 190873)

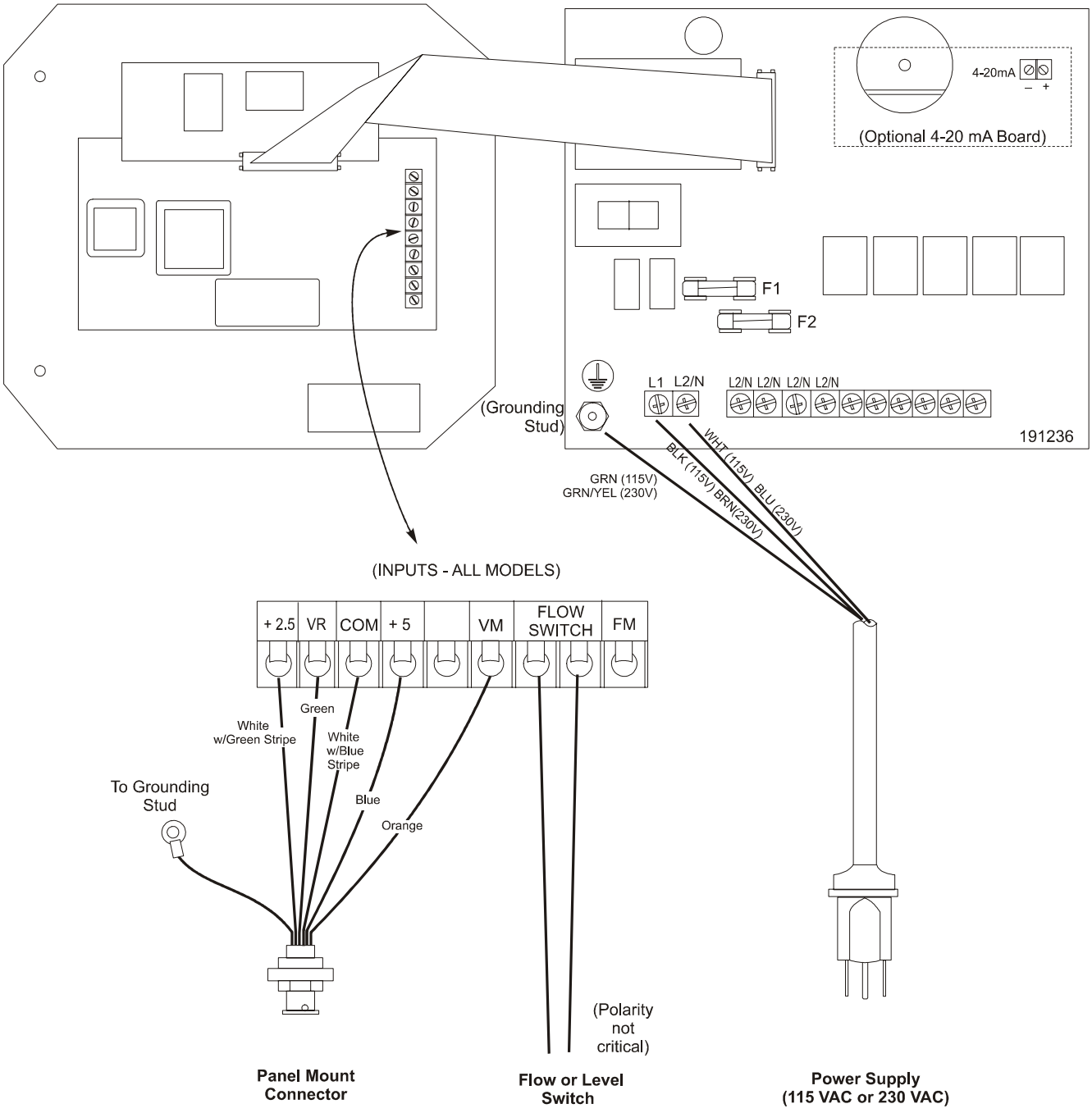


Figure 3a Inputs (for power relay board 191236)

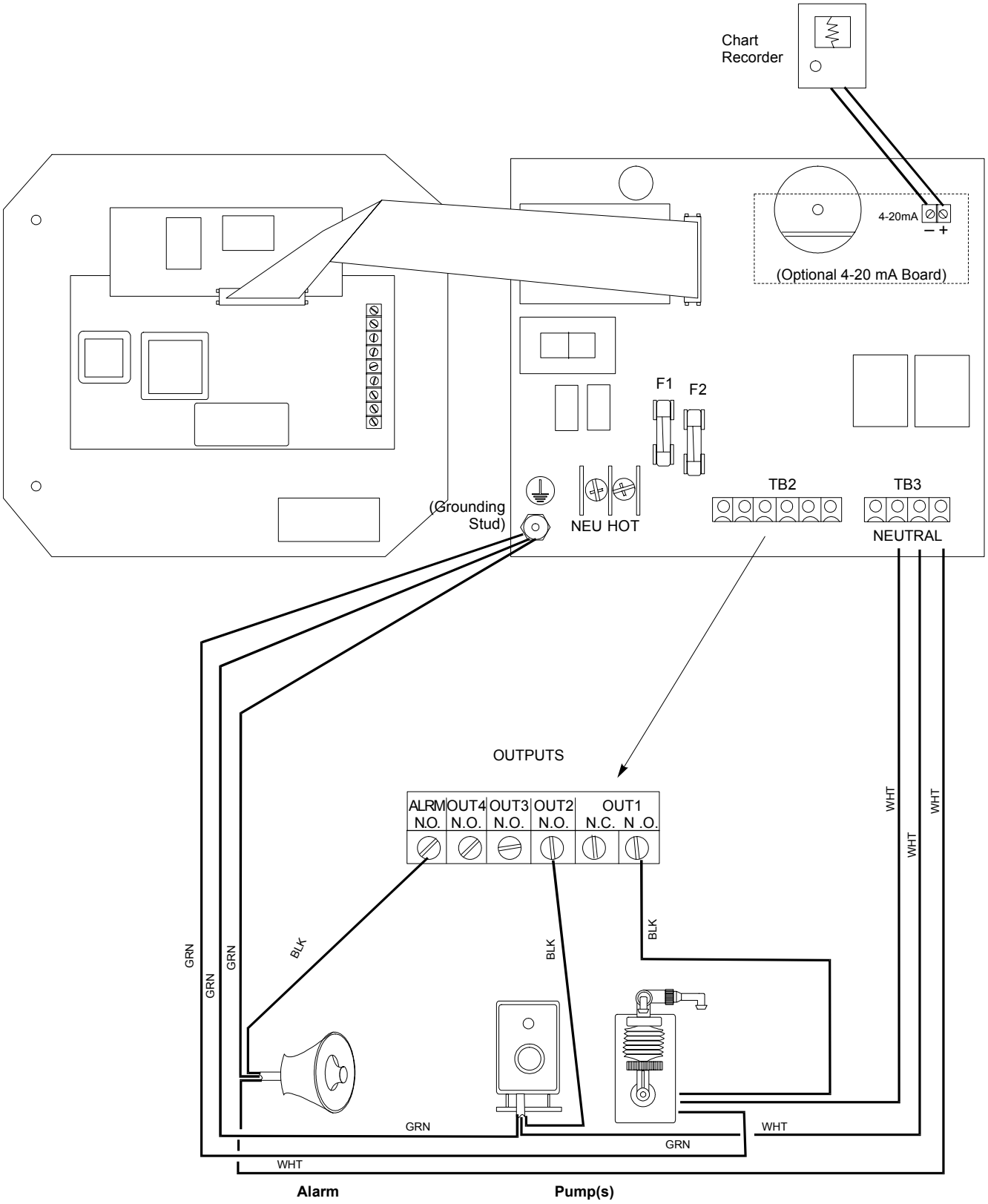


Figure 4 Outputs (for power relay board 190873)

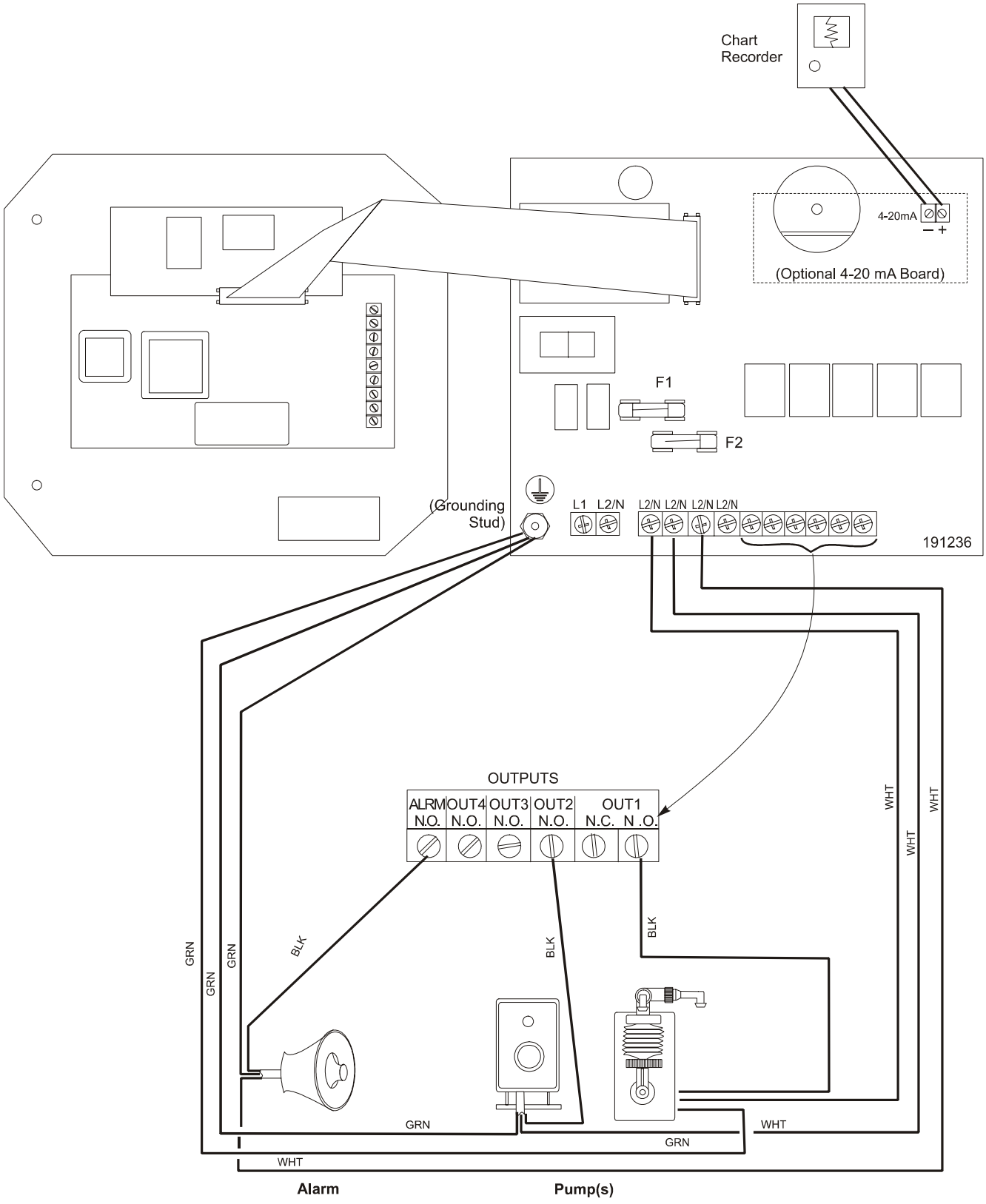


Figure 4a Outputs (for power relay board 191236)

pH ELECTRODE WIRING WITH EXTERNAL PREAMPLIFIER

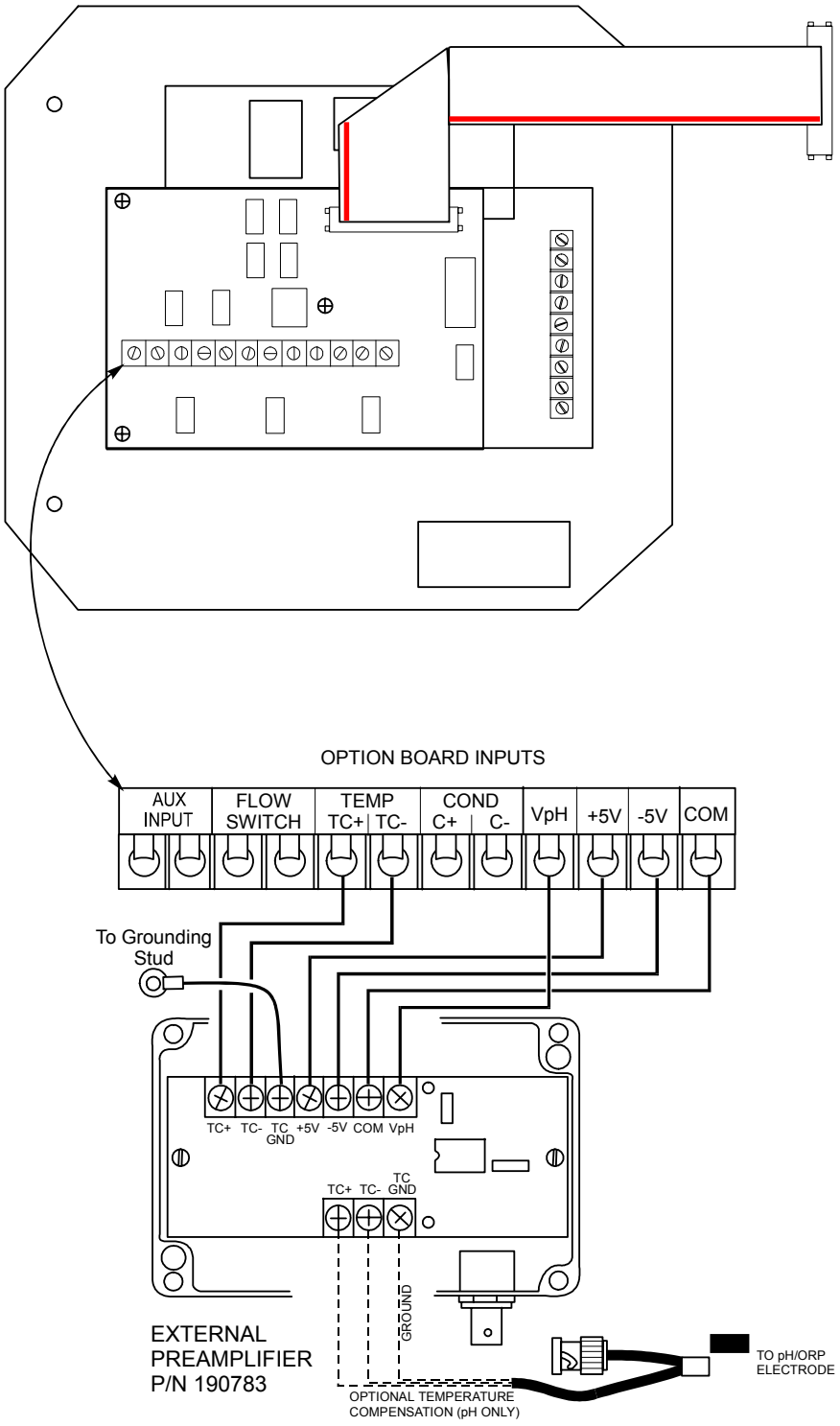


Figure 5 Option Board Inputs

ELECTRODE WIRING WITH WEL STYLE ELECTRODE & HOUSING

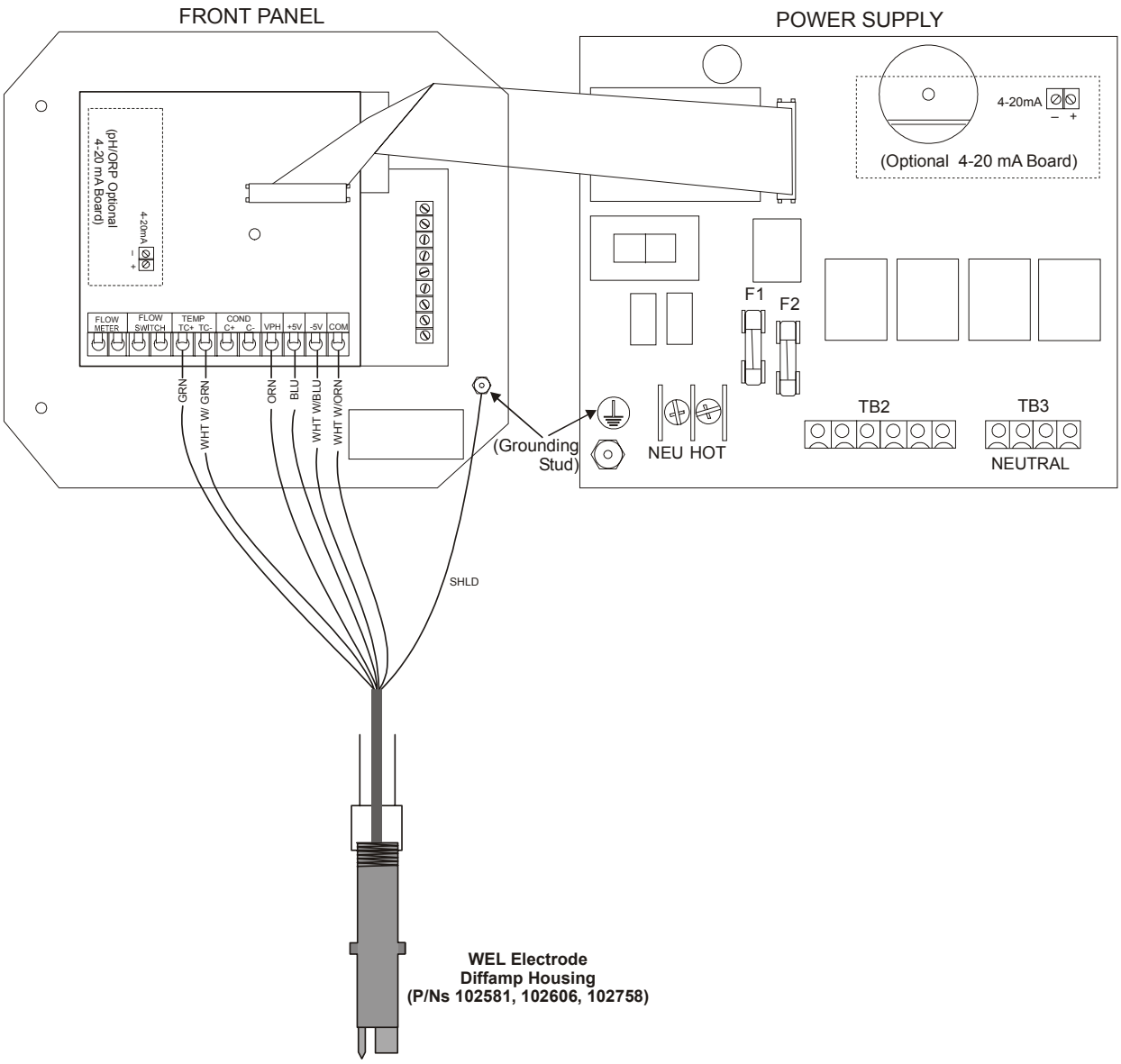


Figure 6
Electrode Wiring (for power relay board 190873)

ELECTRODE WIRING WITH WEL STYLE ELECTRODE & HOUSING

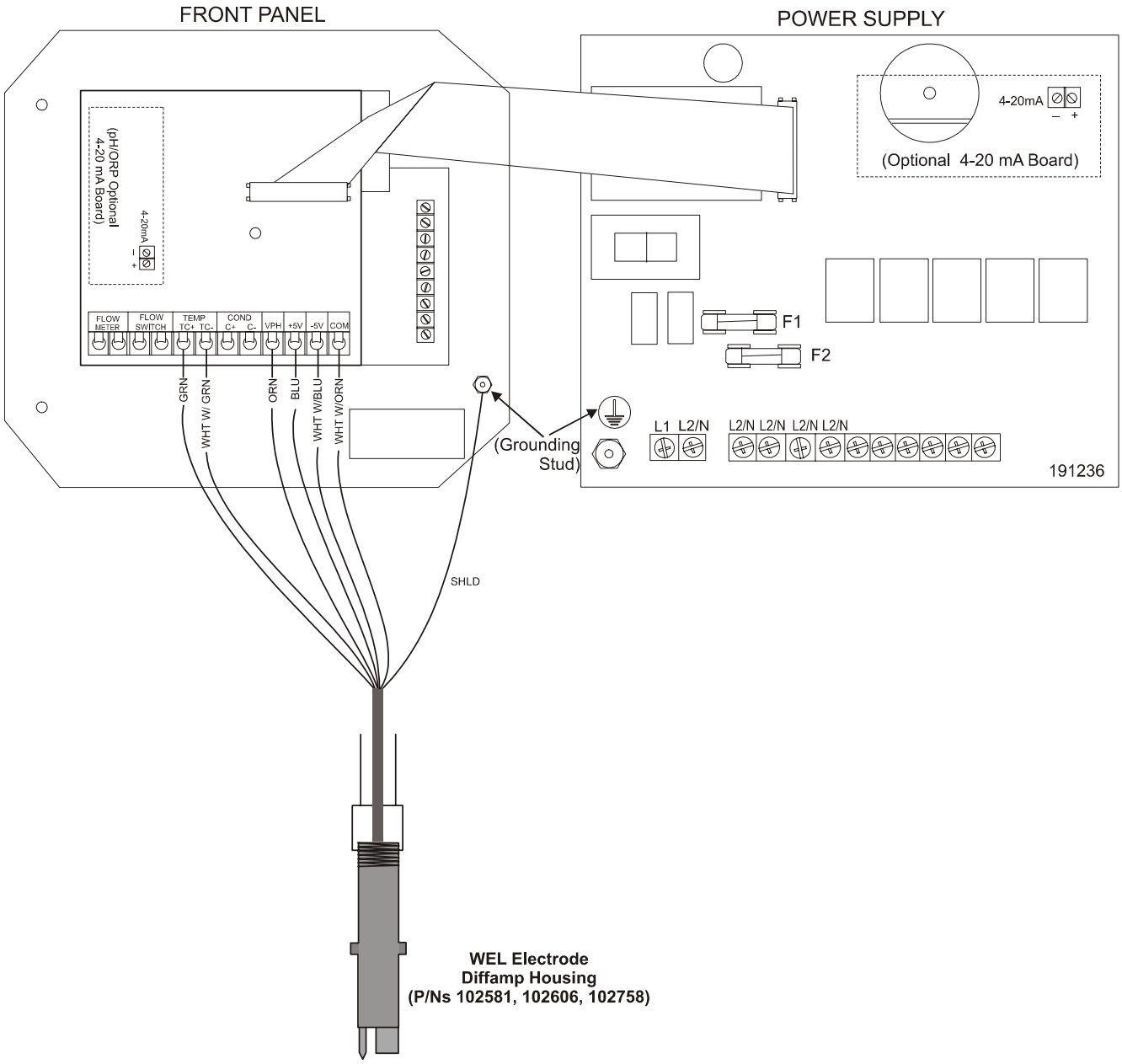
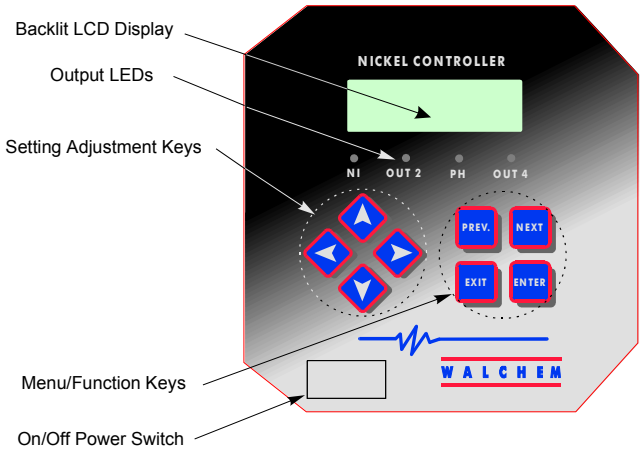


Figure 6a
Electrode Wiring (for power relay board 191236)

4.0 Function Overview

4.1 Front Panel



Front Panel

4.2 Display

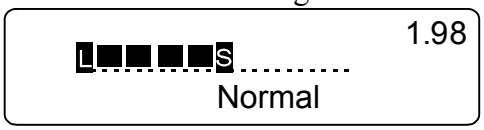
A summary screen is displayed while the WNI controller is on. This display shows a bar graph of the nickel concentration relative to the set point, a digital display of the nickel concentration, and the current operating conditions.

Towards the center of the bar graph is an (S), which represents the set point. For each 1% rise above the set point a vertical line appears to the right of the (S). For each 1% drop below the set point a vertical bar appears to the left of the (S). There are small breaks in the bars at each 5%. If high or low alarm limits are reached, then either an (H) or (L) will appear.

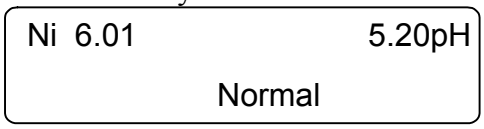
If you have the pH option board installed, the bar graph of nickel concentration relative to set point is not shown. In its place will be the pH reading as shown below.

The operating conditions which may be displayed on the bottom line of the display are: Control Delay 30 (number counts down), Sensor Error, pH Sensor Error, Temp Error, Light Bulb Out, No Sample, Plate Out, Manual Output*, Interlock, Output Disabled*, Pump OverRun, pH Pump OverRun, High/Low Alarm, Turnover Limit, Calibration Time, Outputs On* and Normal*.

* These status messages do not activate the diagnostic alarm relay.



Summary Display

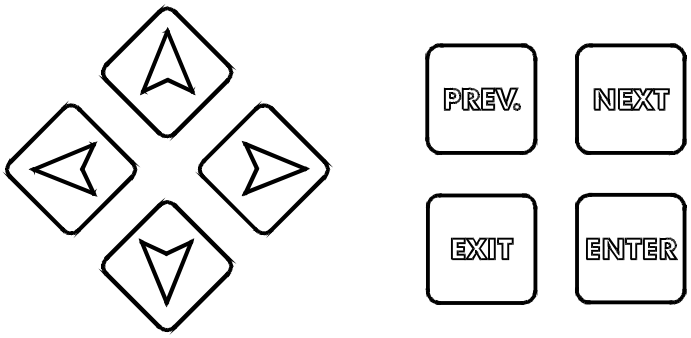


Summary Display w/pH Option Board

4.3 Keypad

The keypad consists of 4 directional arrows and 4 function keys. The arrow keys are used to move the adjustment cursor and change settings, while the function keys are used to enter values, and navigate the various menu screens. The function keys are **ENTER, EXIT**, **NEXT** and **PREV** (previous). **NEXT** and **PREV** scroll through the various menu choices. **ENTER** is used to enter a menu and to enter a value. **EXIT** is used to back up one menu level. If you are at the main menu level, **EXIT** will return you to the summary screen.

To change a value or option in a submenu, the left/right arrow keys move the cursor left and right to each digit or option that can be changed. The up/down arrows will change numeric values up or down, or scroll through option choices. Press **ENTER** only when you have finished making ALL of the changes for that menu screen.



Keypad

4.4 Access Code

The WNI series controller is shipped with the access code disabled. If you wish to enable it, see Section 5.10 for operation. With the access code enabled, any user can view parameter settings, but not change them. Note that this provides protection only against casual tampering. Use a lock on the cover latch if you need more protection.

4.5 Startup

Initial Startup

Once the controller has been wall mounted, the plumbing to the sensor(s) completed, and replenishment pumps connected, the controller is ready for start up. For the first start up, you may choose to disconnect the replenishment pumps until you have changed the set points to fit your application. See below if this is not possible.

Turn on the power switch located on the front panel of the controller. The display will briefly show the model of the controller, and then revert to the top level screen which shows the Nickel (and optionally the pH) as well as any status messages. The status message will be “Control Delay” which gives you 30 seconds to turn off any control outputs prior to changing the set points to fit your application.

If you don't want the replenishment pumps to start pumping, you may press **ENTER**, then press **NEXT** until "OUT 1" is shown on the bottom line of the display. Press **ENTER**, then **PREV** to view the "Hand Off Auto" menu. Use the left arrow key to move the cursor to "Off". Press **EXIT**, then **NEXT** to get to the "OUT 2" menu and repeat the process for each control output. The Main Menu diagram and Output 1 Menu diagram on the following pages will help you navigate the various screens.

If you turn the power to the controller OFF, at the next power-up all outputs will revert back to automatic mode, where they will activate based upon the programmed set points.

Move to the "OUT 1" menu and change the set point, dead band and time limit to your desired values. Refer to Section 5.4. If you want to keep track of the volume of nickel pumped, or track metal turnovers, this is also set in the "OUT 1" menu in the "TOTAL 1" menu.

If you have the pH input option, then the set points are found in the "pH (Output 3)" menu. Refer to section 5.6.

Outputs 2 and 4 are intended for the addition of chemicals (such as hypophosphite or borohydride) in proportion to the nickel addition, so the only set points found in these menus are related to totalizing the chemical additions.

If you have the pH input option, move to the "pH Input" menu to calibrate the pH electrode. Refer to Section 5.3.

Move to the "Sensor" menu to change the units of measure and perform a "New Sensor Setup" (2 point calibration) of the nickel sensor. Refer to Section 5.2.

Alarm limits and setting the time are done in those respective menus.

If you have an optional 4-20 mA output card, you will see a menu for scaling the output signal to fit your application. Refer to Section 5.9.

To return to the "Summary" screen, you may press **EXIT** until it is displayed, or you may wait 10 minutes and the display will revert to it automatically.

Normal Startup

Startup is a simple process once your set points are in memory. Simply check your supply of chemicals, turn on the controller, calibrate the sensor(s) if necessary and it will start controlling.

4.6 Shutdown

To shut the WNI controller down, simply turn off the power switch. Programming remains in memory.

5.0 Operation

These units control continuously while power is applied. Programming is accomplished via the local keypad and display.

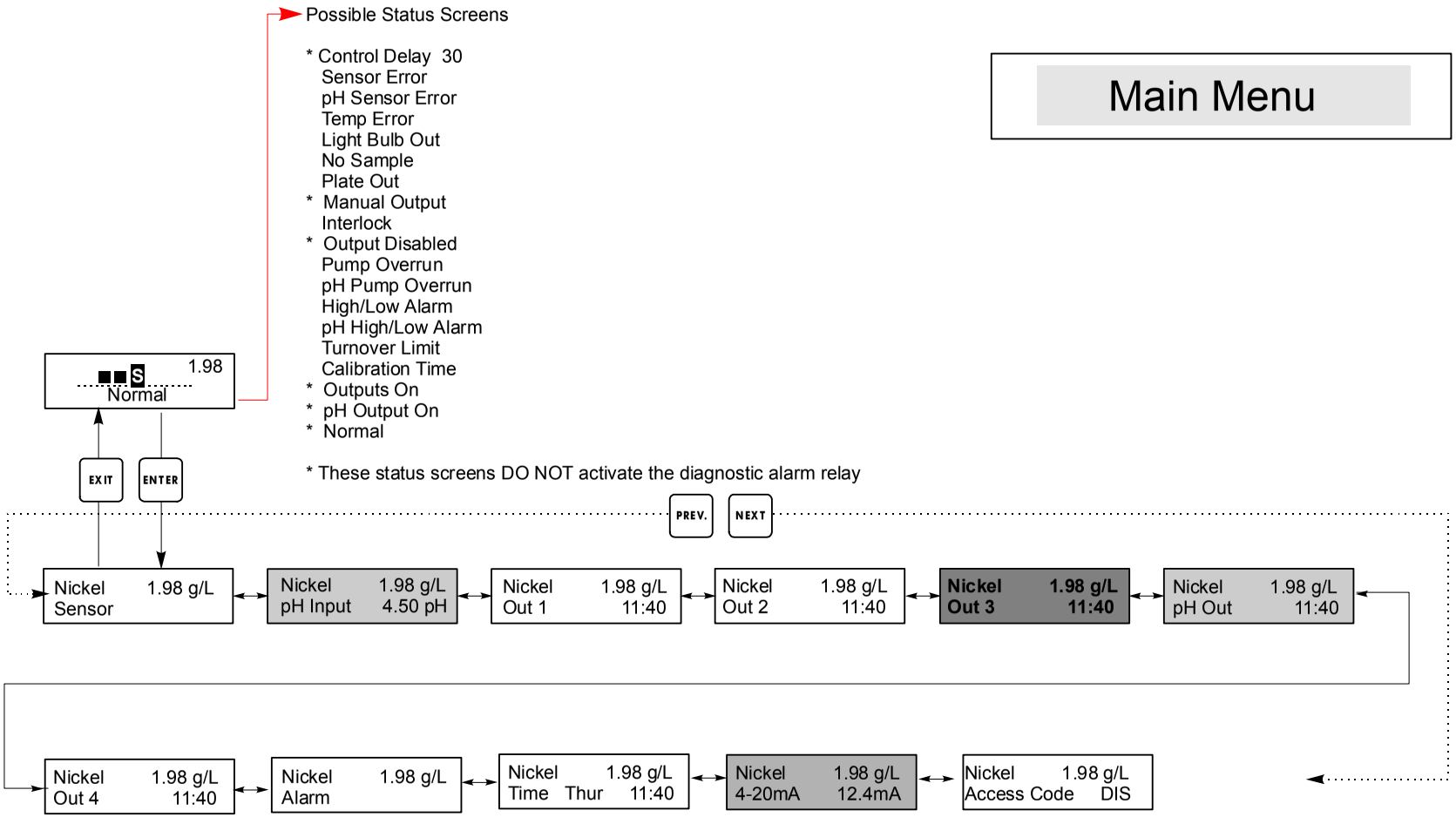
To view the top level menu, press any key. The menu structure is grouped by inputs and outputs. Each input has its own setup menu for calibration and unit of measure selection as needed. Each output has its own setup menu including set points, timer values, direction of control, etc as needed. After 10 minutes of inactivity in the menu, the display will return to the summary screen. Keep in mind that even while browsing through the menus, the unit is still controlling.

5.1 Main Menu

The exact configuration of your WNI controller determines which menus are available as you scroll through the settings. Certain menus are only available if you select certain options. All settings are grouped under the following main menu items:

Sensor
pH Input (Only if unit has pH option circuit board installed)
Out 1
Out 2
pH(Out 3) (Only if unit has pH option circuit board installed)
Out 4
Alarm
Time
4-20 mA (Only if 4-20 mA option circuit board is installed)
Access Code

Main Menu



Legend

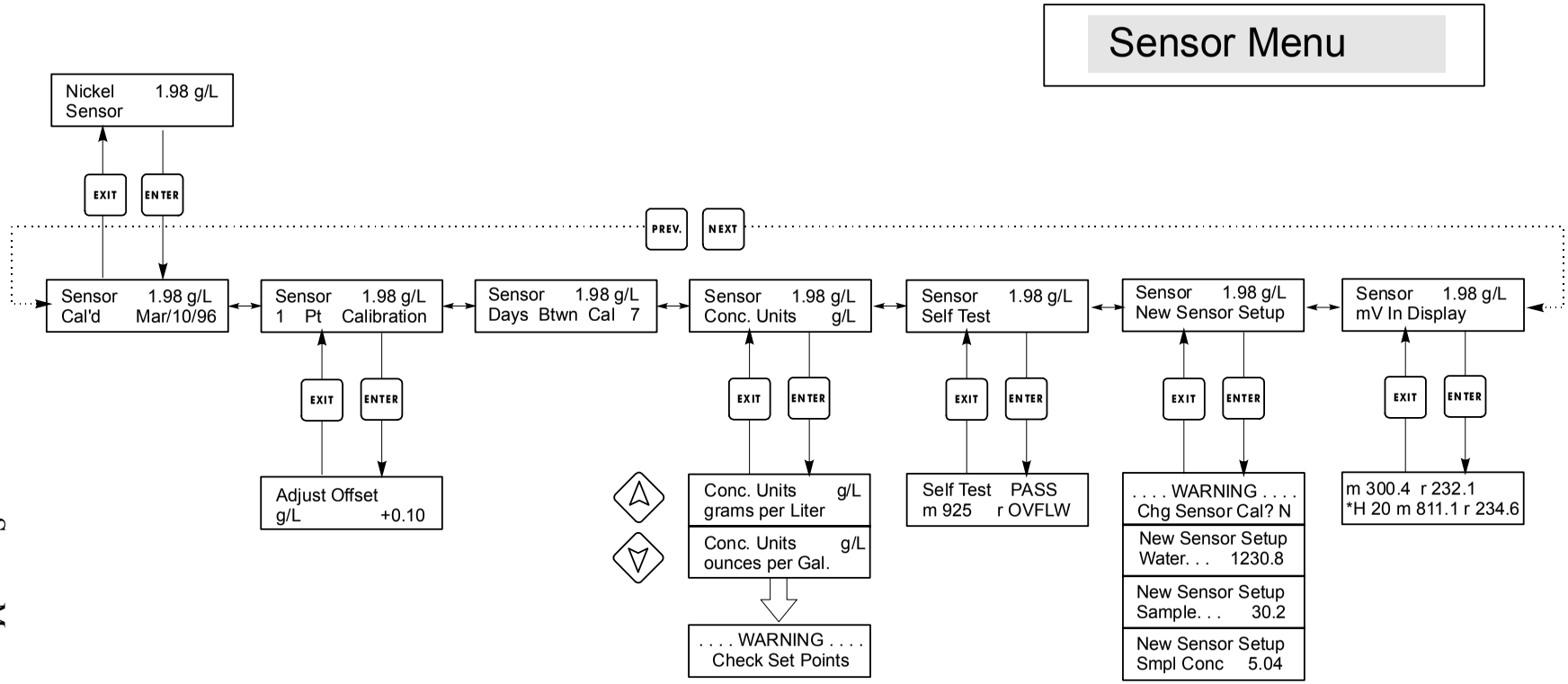
pH Input & Output menus are only present if pH option board is installed.

4-20mA menu is only present if 4-20mA option is installed.

Menu is only present if no pH option board is installed.

Operation

Press Enter key to enter menu or submenu.
Press Exit key to exit menu.
After 10 minutes of inactivity the controller will automatically return to the summary screen.



Operation

Press Enter key to enter menu.
Press Exit key to exit menu.
Blinking fields may be edited with the adjust arrows.
Press Enter when modification is complete to return to Main Menu Level.

5.2 Sensor Menu

The sensor menu provides the following settings: Calibration History (informational only), 1-Point Calibration, Days Between Calibration, Units of Measure, and New Sensor Setup. Each is discussed in detail below. Refer to the Sensor Menu chart.

Note: *If you are programming the unit for the first time, scroll to the Conc. Units menu, and set the units of measure. Then set the rest of the menus.*

Cal'd

Displays the date of the last sensor calibration.

1 Pt Calibration

Press **ENTER** to perform a 1 point calibration of the nickel sensor. This calibration is best performed at normal operating temperature and when there is a typical load of work in the bath. This is to calibrate out the effect of gas evolution in the bath under typical operating conditions.

Have solution flowing through the flow-through sensor. Take a sample of the solution and note the concentration displayed by the WNI controller. Carefully perform the normal laboratory analysis of the nickel concentration. Calculate the offset by subtracting the displayed value from the lab results. If the lab analysis is significantly different, adjust the offset in the 1 point calibration menu, using the arrow keys to change the value and the +/- sign. If the controller's display is higher than the lab analysis, the offset should be negative.

Days Btwn Cal

Use the arrow keys to set the number of days that you would like to go by before recalibrating the sensor. The controller will prompt you to recalibrate when that time has expired. Setting this to zero will disable the calibration reminder.

Conc. Units

Press **ENTER** to change the units of measure. Use the Up and Down arrows to toggle between grams per liter and ounces per gallon, then press **ENTER** to make your selection. The controller will warn you to check your set points, since all set point values will stay the same even though the units of measure may have changed. Press **ENTER** again to clear the warning message from the display.

Self Test

This feature is a diagnostic tool which can help isolate a problem between the sensor and controller. Before initiating the self test, the sensor MUST be disconnected from the controller in order to function properly. When **ENTER** is pressed the controller disables the sensor inputs and injects 2 test signals, simulating a properly functioning sensor. The controller will display "PASS" or "FAIL" along with a live mV reading. If "PASS" is displayed then it indicates the controller is functioning properly and the problem is likely to be with the sensor. See the troubleshooting section for further details. If "FAIL" is indicated, the controller is defective. Consult your factory representative for service options.

New Sensor Setup

THIS MENU IS SHOULD BE USED UPON INITIAL INSTALLATION, WHEN THE SENSOR IS REPLACED AND WHEN THE CHEMISTRY CONTROLLED HAS BEEN CHANGED. OTHERWISE, USE THE 1 POINT CALIBRATION.

Press ENTER to set up a new sensor. First you see a warning message: "WARNING Chg sensor cal? N" This acts as a safety precaution for those who may only be "browsing" through the menus. If you enter the New Sensor Setup menu, you may easily, inadvertently, change the calibration of the sensor. If you continue with the following procedures, you must recalibrate the new sensor. To continue, use the up arrow key to change the "N" to a "Y", and press **ENTER**.

Water....xxxx.x
Circulate water through the flow through sensor. When the number on the display is stable, press ENTER.

Sample....xxxx.x
Circulate the bath at a known concentration. No work should be going through the bath so that the concentration remains constant. Ideally the bath should be at the typical operating nickel concentration and temperature. When the number on the display is stable, press ENTER.

Smpl Conc
Use the arrow keys to change the displayed number to the actual concentration of the bath in the same concentration units as already selected, then press ENTER.

mV in Display

This display is only for diagnostic purposes. The top line shows 2 live voltage readings from the sensor in millivolts. The bottom line shows the stored values for each sensor signal from the most recent New Sensor Set Up calibration - specifically, the signal values measured with water.

5.3 pH Input Menu (Only appears if pH option board is installed)

The pH input menu provides the following: 1-Point Calibration, 2-Point Calibration, Temperature, pH millivolts and Self Test. Each is discussed in detail below. Refer to the pH Input Menu chart.

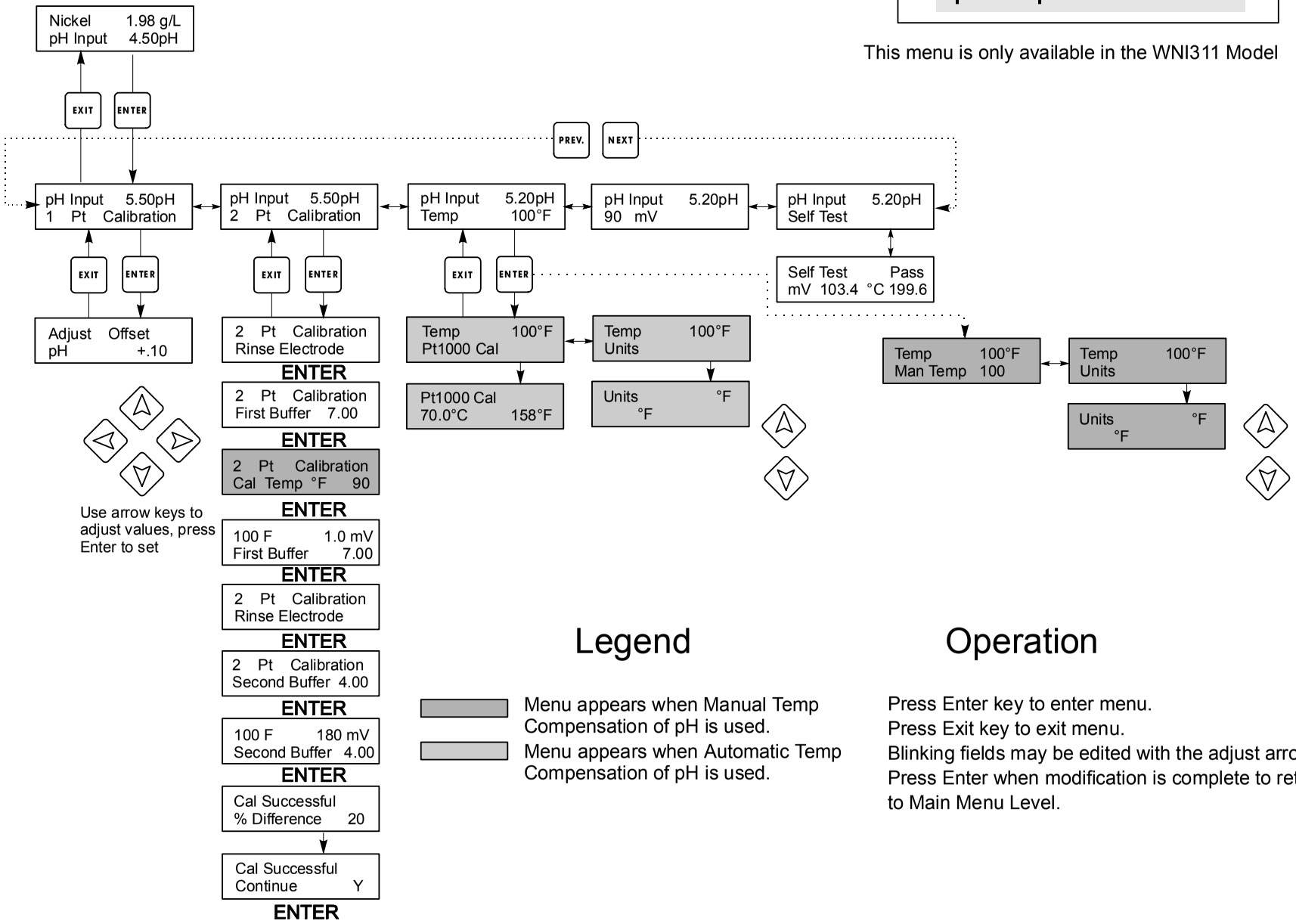
2 Pt Calibration

Press **ENTER** to perform a two-point calibration of the electrode.

Rinse Electrode
Remove the electrode from the process solution and rinse it off. Press ENTER to go to the next step.

pH Input Menu

This menu is only available in the WNI311 Model



Legend

Menu appears when Manual Temp Compensation of pH is used.

Menu appears when Automatic Temp Compensation of pH is used.

Operation

Press Enter key to enter menu.
Press Exit key to exit menu.
Blinking fields may be edited with the adjust arrows.
Press Enter when modification is complete to return to Main Menu Level.

First Buffer
This is a prompt to place the electrode in the first buffer solution. This buffer may be any value that you desire. The display will automatically change to:

1st Buffer 7.00
Use the arrow keys to change the pH value to match that of your first buffer solution, press **ENTER** to continue.

Cal Temp °F/C 90 (Only appears if using manual temperature compensation)
This menu allows you to enter the temperature of the buffers being used for calibration and will result in a more accurate calibration.

Use the arrow keys to adjust the display to match the temperature of the buffer solutions that you will be using to calibrate the pH electrode. Press **ENTER** to go on to the next step.

The controller will display the mV output of the electrode. This value will flash until it has stabilized. When it has stabilized, the display will go on to the next step. If the mV reading does not stabilize sufficiently, you may manually advance to the next step by pressing **ENTER.**

Rinse Electrode
Remove the electrode from the first buffer solution and rinse it off with water to prevent contamination of your second buffer. Press **ENTER** when finished.

Second Buffer
Place the electrode in the second buffer solution. The display will automatically change to:

2nd Buffer 4.00
Use the arrow keys to change the pH value to match that of your second buffer solution. Do not use the same value as the first! Press **ENTER** to continue.

The controller will display the mV output of the electrode. This value will flash until it has stabilized. When it has stabilized, the display will go on to the next step. If the mV reading does not stabilize sufficiently, you may manually advance to the next step by pressing **ENTER.**

% Difference
At the end of the calibration procedure, the display will then tell you whether the calibration was successful or failed, and also the % difference from the theoretical electrode response.

A new, unused electrode should start out with a % difference of 2% or less. If the electrode has been installed, or stored for long periods of time, this will be higher. The controller will fail an electrode if the slope is more than 80% different than the theoretical slope. This message is an excellent indicator of electrode wear and expected life.

Refer to the troubleshooting section for help if the display reads Cal Failure.

Continue Y
This display gives you time to reinstall the electrode in its process location. Press **ENTER** when ready to resume control.

1 Pt Calibration

Press **ENTER** to perform a one-point calibration of the electrode.

Adjust
This menu allows a quick and simple calibration of the electrode by entering an offset in pH units without taking the unit offline to perform a calibration with buffers.

Adjust the desired offset value using the left/right and up/down arrow keys and pressing **ENTER**. Be sure to change the plus/minus sign for adjustment in the appropriate direction.

For example, if an independent laboratory measurement has indicated that the pH displayed by the WNI controller is 0.1 pH units low, a plus 0.1 pH unit offset would be entered.

The maximum adjustment range is ±0.99 pH units. If more adjustment is needed, it is a sign that the electrode has aged and a two point calibration should be performed. If the electrode fails the 2 point calibration, it should be replaced.

Remember, a two point calibration will always be more accurate than a one point calibration.

Temp

Man Temp F 100 (Only appears when no temperature sensor is connected)
Enter the expected process temperature at the pH electrode by using the arrow keys and press **ENTER**.

Pt1000/Pt100 Cal (Only appears if a Pt1000 or Pt100 temperature sensor is detected when the controller is powered on)
Press **ENTER** to calibrate to a more precisely known temperature if necessary. Use the Up or Down arrow keys to adjust the reading and press **ENTER** to accept the change. Press **EXIT** to exit the calibration.

Units
You may choose to display temperature units in C or F. Press ENTER and the Up or Down arrow keys to change units.

90 mV

This menu displays the raw pH millivolt signal and is useful for diagnostic purposes only.

Self Test

This feature is a diagnostic tool which can help isolate problems between the pH electrode and the controller. Press **ENTER** to initiate a self test on the controller. When initiated, the controller ignores the sensor and injects signals through the input channels which simulates the pH electrode and temperature element signals. These signals are shown on the bottom line of the display. An indication of Pass or Fail is shown on the top right portion of the display. See the Troubleshooting Section for details. Press **EXIT** to leave the self test mode.

5.4 Output 1 Menu

The Out 1 menu is used to set the control set point, and to configure the timer/totalizer to keep track of replenishment in the desired way. This menu provides the following settings: Total 1, Set Point, Dead Band, Time Limit, Interlock, and HOA.

The top level menu status line may display the following messages: Off, Intrlck, Overrun, or a time. "Off" indicates that the output is off. "Intrlck" indicates that the output would be on but is not because of a signal from a flow switch or level switch is stopping control. "Overrun" indicates that the output has been on for longer than the maximum time programmed by the user. The time shows how long the output has been on.

Total 1

Press **ENTER** to program the timer/totalizer functions.

Reset Total Y/N
Use the arrow keys to toggle between Y(Yes) and N(No) to reset the totalizer.

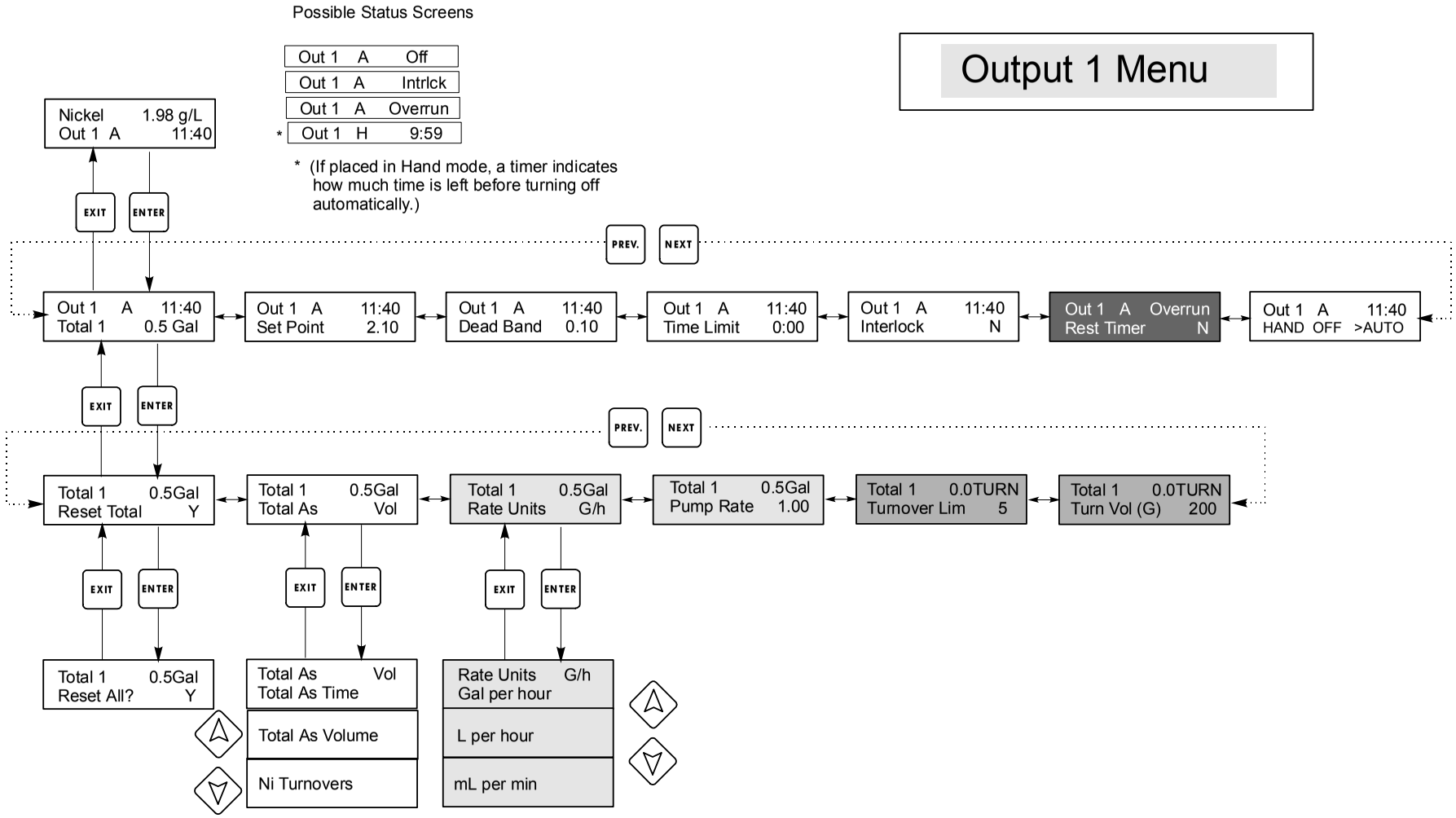
Total As
Press **ENTER**, then use the Up and Down arrows to choose whether to totalize in units of Time, Volume, or Nickel Metal Turnovers.

Turnover Lim.
Only appears if you choose to totalize by metal turnovers. Use the arrow keys to enter the maximum number of turnovers. The controller will prompt you when this number has been exceeded.

Turn Vol(G or L)
Only appears if you choose to totalize by metal turnovers. Enter the number of gallons (G) or liters (L) that equals one metal turnover. The unit of measure displayed correlates with that of the rate units selected in the next menu.

Rate Units
Only appears if you choose to totalize by volume or metal turnovers. Press ENTER, then use the arrow keys to toggle between Gallons per Hour, mL per minute or Liters per hour. These units of measure will be used to enter the rate at which the replenishment pump adds chemicals.

Output 1 Menu



Legend

Menu appears when a pump overrun condition occurs

Menu appears when Total As Volume or Total as Nickel Turnovers is selected

Menu appears when Total As Nickel Turnovers is selected

Operation

Press Enter key to enter menu.
Press Exit key to exit menu.
Blinking fields may be edited with the adjust arrows.
Press Enter when modification is complete to return to Main Menu Level.

Pump Rate
Only appears if you choose to totalize by volume or metal turnovers. Use the arrow keys to set the flow rate of the replenishment pump.

Set Point

Use the arrow keys to adjust the display to read the desired set point value. Press **ENTER** to accept the change.

Dead Band

Use the arrow keys to set the desired dead band, then press **ENTER**. If the set point is 6.00 g/L, and the dead band is 0.05 g/L, then the relay will close at 5.99 g/L and open 0.05 g/L away from 6.00 g/L (6.05 g/L). The deadband should be set to a value 1/4 that of the desired control band. For example, if the desired control band is ± 0.2 g/L, the deadband should be 0.10 g/L.

Time Limit

Use the arrow keys to set the time limit for the output to be active, then press **ENTER**. Since all outputs are turned on at the same time for control purposes, the time limit set applies to outputs 2, 3 and 4 also. If the pH option board is installed, however, the third output becomes pH and does have an independent time limit option. If it is set for "0:00", no limit will be imposed and the output could stay on forever.

Interlock

Use the Up and Down arrows to toggle between Y(Yes) and N(No). Choosing Y means that the output will deactivate depending on the state of the device attached to the controller. If the device is open, the interlock condition exists and control is stopped. For example, if the sensor is installed in a recirculating pipe line, a flow switch that is closed if flow is sufficient and open if flow is insufficient may be installed in the line, so that if flow past the sensor stops, the controller will not pump in chemicals based on a stagnant sample.

An interlock condition disables all outputs.

Reset Timer

This menu appears when the programmed time limit has elapsed, creating a pump overrun condition. Use this menu to reset the timer. This applies to all outputs.

HOA

Use the Left and Right arrows to move between Hand, Off and Auto (H O A). In Hand (Manual) mode, the output will be turned on immediately for a maximum of 10 minutes. In the Off mode, the output will be turned off indefinitely unless power to the controller is cycled off and back on, which puts all outputs back into Auto mode. In the Auto mode, the output turns on and off in response to changes in the process value relative to the set point. The letter inside the block on the status screen indicates which mode the output is in.

5.5 Output 2, 3, and 4 Menus

The Out 2, 3 and 4 menus are separate from each other but operate in exactly the same way. Each menu provides Total and HOA settings. These additional outputs are activated simultaneously with output 1 and are provided to be able to add other bath components in proportion to the nickel, and display independent replenishment totals.

If the pH option is installed, output 3 will be operated separately from the others, based on the pH reading relative to the pH setpoint.

The top level menu status line may display the following messages: Off, Intrlck, Timeout, or a time. "Off" indicates that the output is off. "Intrlck" indicates that the output would be on but is not because of a signal from a flow switch or level switch is stopping control. "Overrun" indicates that the output has been on for longer than the maximum time programmed by the user. The time shows that the output is on, and has been for that amount of time.

Total 2, 3 or 4

This menu works the same as Total 1 described for Out 1 in section 5.4.

HOA

Use the Left and Right arrows to move between Hand, Off and Auto (H O A). In Hand (Manual) mode, the output will be turned on immediately for a maximum of 10 minutes. In the Off mode, the output will be turned off indefinitely unless power is cycled off and back on, which puts all outputs into Auto mode. In the Auto mode, the output turns on and off in response to changes in the process value relative to the set point. The letter inside the block on the status screen indicates which mode the output is in.

5.6 pH (Output 3) Menu

(Only appears if the pH option circuit board is installed)

This menu is used to set the pH output set points. This menu provides the following settings: Set Point, Dead Band, Time Limit, Control Direction and HOA.

The top level menu status line may display the following messages: Off, Intrlck, Overrun, or a time. "Off" indicates that the output is off. "Intrlck" indicates that the output would be on but is not because of a signal from a flow switch or level switch is stopping control. "Overrun" indicates that the output has been on for longer than the maximum time programmed by the user. The time shows that the output is on, and has been for that amount of time.

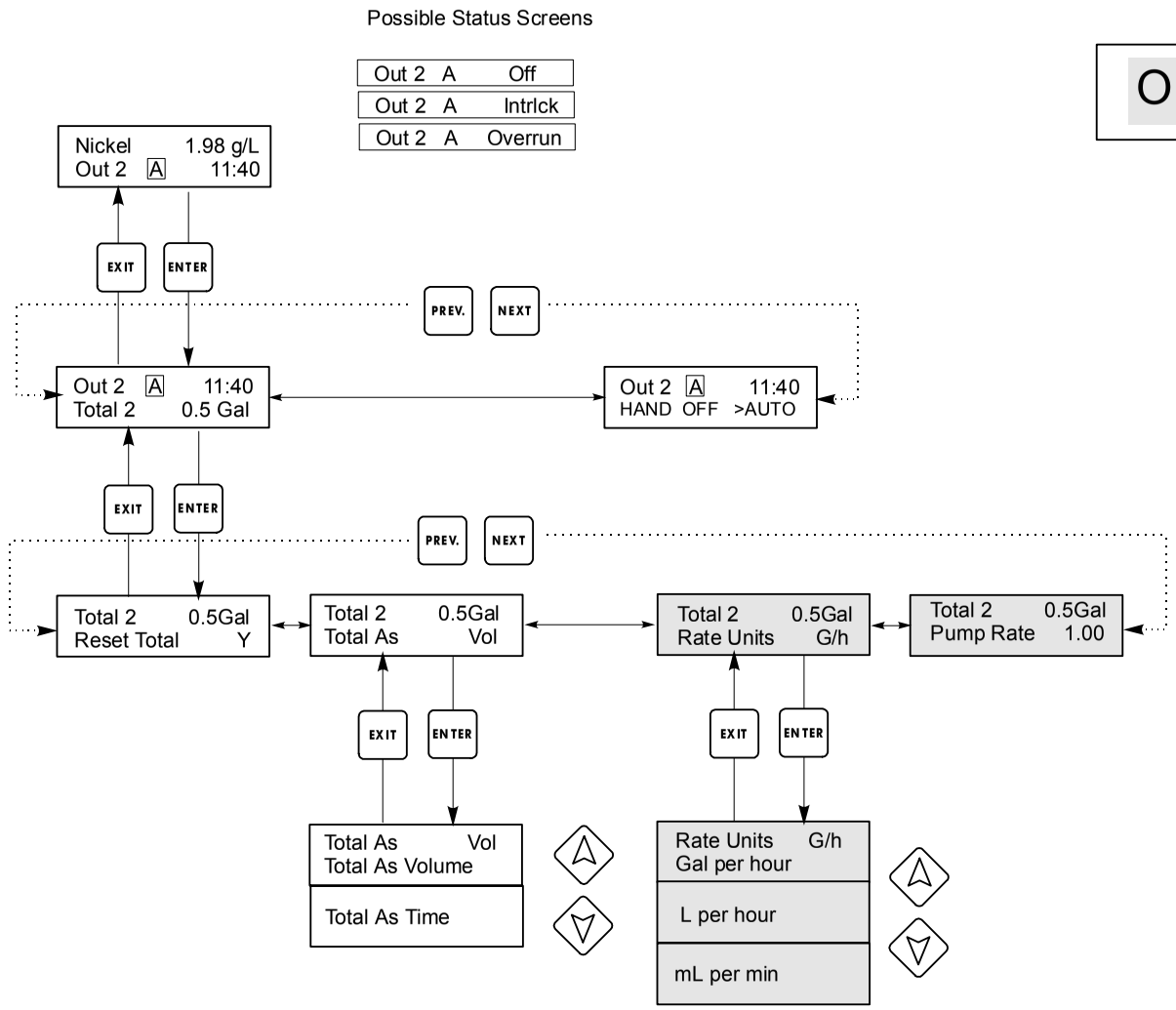
Total 3

This menu works the same as Total 1 described for Out 1 in section 5.4.

Set Point

Use the arrow keys to adjust the display to read the desired set point value. Press **ENTER** to accept the change.

Output 2, 3 & 4 Menus



Legend

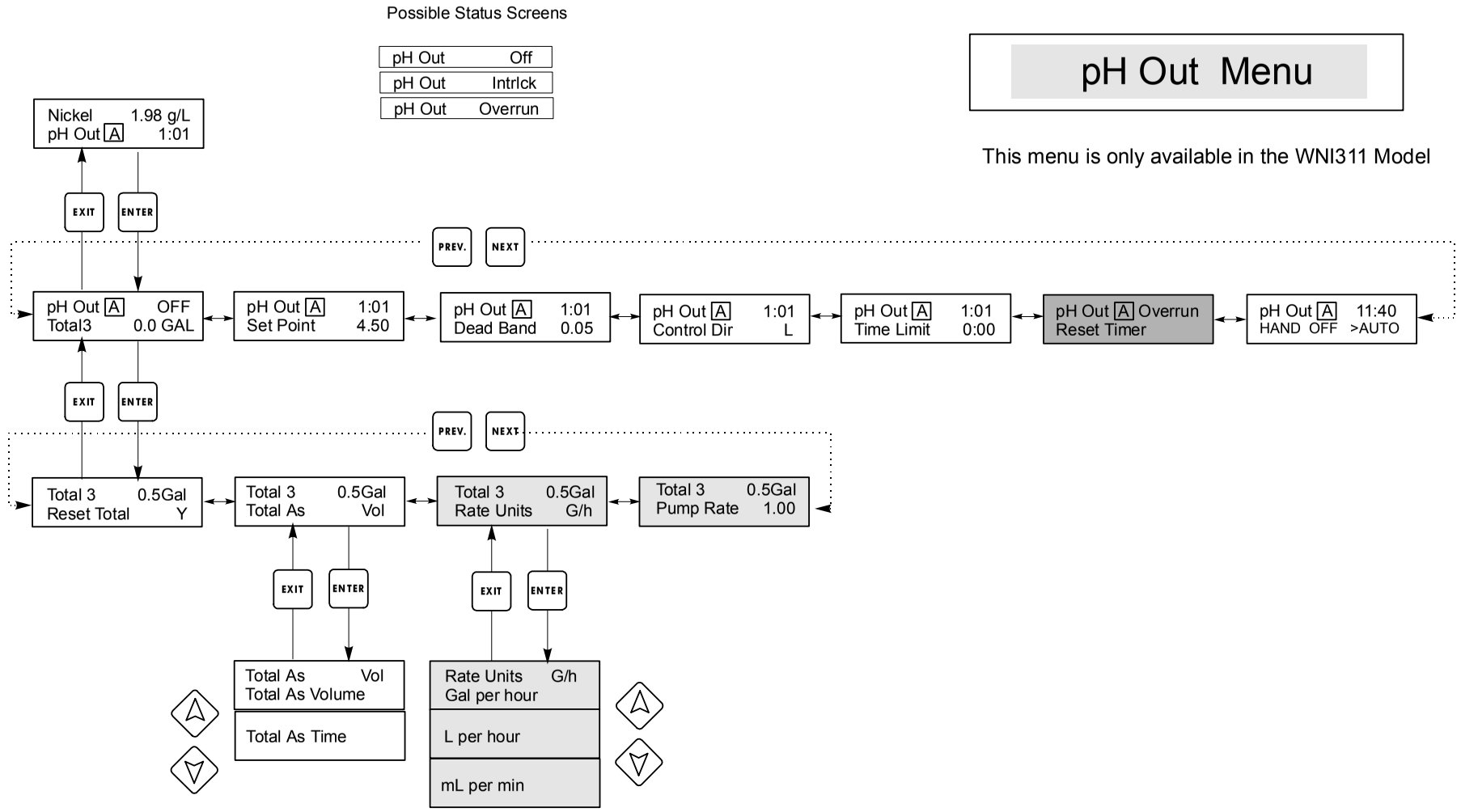
Menu appears when Total As Volume is selected

Operation

Press Enter key to enter menu.
Press Exit key to exit menu.
Blinking fields may be edited with the adjust arrows.
Press Enter when modification is complete to return to Main Menu Level.

pH Out Menu

This menu is only available in the WNI311 Model



Legend

Menu appears only when a pump overrun condition occurs

Menu appears when Total as Volume is selected.

Operation

Press Enter key to enter menu.
Press Exit key to exit menu.
Blinking fields may be edited with the adjust arrows.
Press Enter when modification is complete to return to Main Menu Level.

Dead Band

Use the arrow keys to set the desired dead band, then press **ENTER**. If the set point is pH 4.50, and the dead band is 0.05 pH units, then the relay will close at 4.5 pH and open 0.05 pH away from 4.5 pH (4.55 pH).

Time Limit

Use the arrow keys to set the time limit for the output to be active, then press **ENTER**. If it is set for "0:00", no limit will be imposed, and the output could stay on forever.

Control Direction

Press **ENTER** to change the direction of control. A low set point will respond to a drop in pH by adding an alkaline replenisher. Use the Up and Down arrows to change the direction of control if necessary.

Reset Timer

This menu appears when the programmed time limit has elapsed, creating a pump overrun condition. Use this menu to reset the timer.

HOA

Use the Left and Right arrows to move between Hand, Off and Auto (H O A). In Hand (Manual) mode, the output will be turned on immediately for a maximum of 10 minutes. In the Off mode, the output will be turned off indefinitely. In the Auto mode, the output turns on and off in response to changes in the process value relative to the set point. The letter inside the block on the status screen indicates which mode the output is in.

5.7 Time Menu

The time menu is used to set the date and time that the controller uses to schedule calibration prompts. There is only one menu selection: Set Clock.

Set Clock

Press **ENTER** to set the clock. Use the arrow keys to change the year, date, and month, then press **ENTER**. Use the arrow keys again to set the day of the week and the time. Use military time (for example, 1:00 PM is 13:00). Press **ENTER** to return to the top level clock menu.

5.8 Alarm Menu

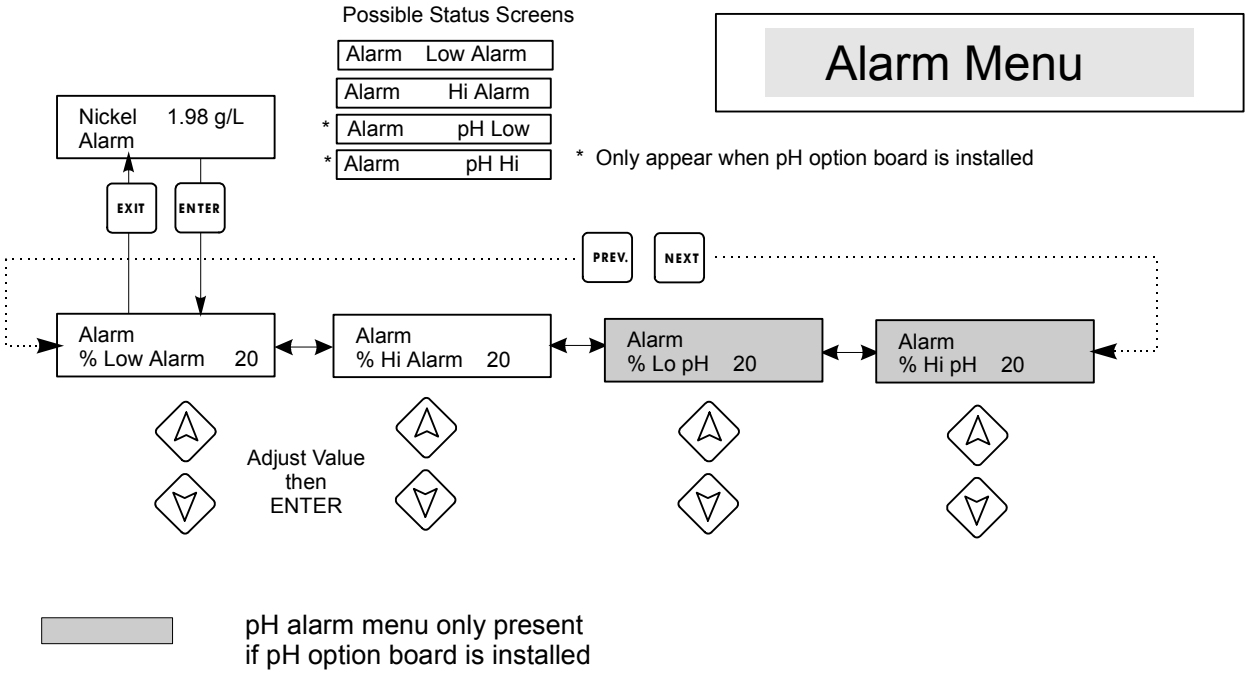
This menu is used to set the high and low nickel concentration alarm points and optional pH alarms. Press **ENTER** to adjust the alarm set points.

% Low Alarm

Use the arrow keys to change the % below the set point nickel concentration (or pH) that will trigger a low alarm. Percent range is 0 to 50%. Alarm can be disabled if 0 is entered.

% High Alarm

As above for the high alarm set point.



Alarm Menu

5.9 4-20 mA Menu (Optional)

This menu will only appear if the optional 4-20 mA output board is installed. It is used to scale the 4-20 mA output to a corresponding nickel or pH range. It contains the following menu selections: Measure, 4 mA Point, 20 mA Point, and Calibrate.

Measure

This menu allows the user to change the 4-20 mA output to correspond to nickel concentration or pH.

4 mA Pt

Use the arrow keys to enter the nickel concentration or pH value that you want to correspond to a 4 mA output from the controller.

20 mA Pt

Use the arrow keys to enter the nickel concentration or pH value that you want to correspond to a 20 mA output from the controller.

Calibrate

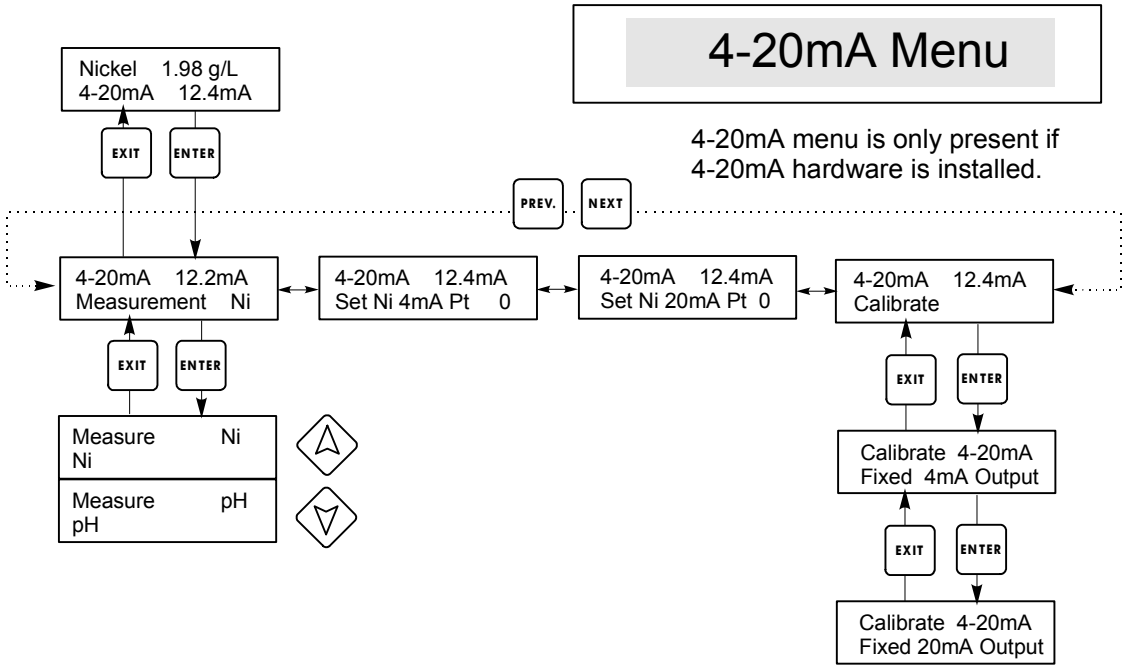
This menu, in conjunction with an ammeter, is used to calibrate the mA output. Press ENTER to start the calibration.

Fixed 4 mA Out

The controller will output 4.00 mA. Adjust the chart recorder or data logger per its instruction so that the process value displayed is what is expected for a 4.00 mA input.

Fixed 20 mA Out

As above, except that the controller will output 20.00 mA.
The design of the 4-20 mA output is such that it should never need calibration. If the mA signal is not what it should be, call the factory for service.



5.10 Access Code Menu

This menu determines whether the access code feature of the controller is enabled or disabled and allows you to customize the access code to your own value. The access code controls whether or not you are allowed to change the parameters in the controller. With the access code disabled, any user may change any parameter. With the access code enabled, any user can view any parameter, but cannot change them.

Once an attempt is made to change a parameter, the display will prompt the user to enter the access code. If the correct code is entered, the parameter can be changed. (If the cursor is blinking, a change will be allowed; if the number or words are not blinking, they can't be changed). Once the correct access code has been entered, it will remain valid until there is a period of 10 minutes without a key being pressed.

Possible status screens are: Access Code REQ, Access Code OK, and Access Code DIS.

The first indicates that the access code is required to alter settings. The second indicates that the access code is required and has been entered correctly, and the last indicates that the access code has been disabled.

Enable Y/N

Use the arrow keys to select Y(Yes) or N(No) and press **ENTER** to enable or disable the access code. If the code was enabled, you must enter the access code in order to disable it.

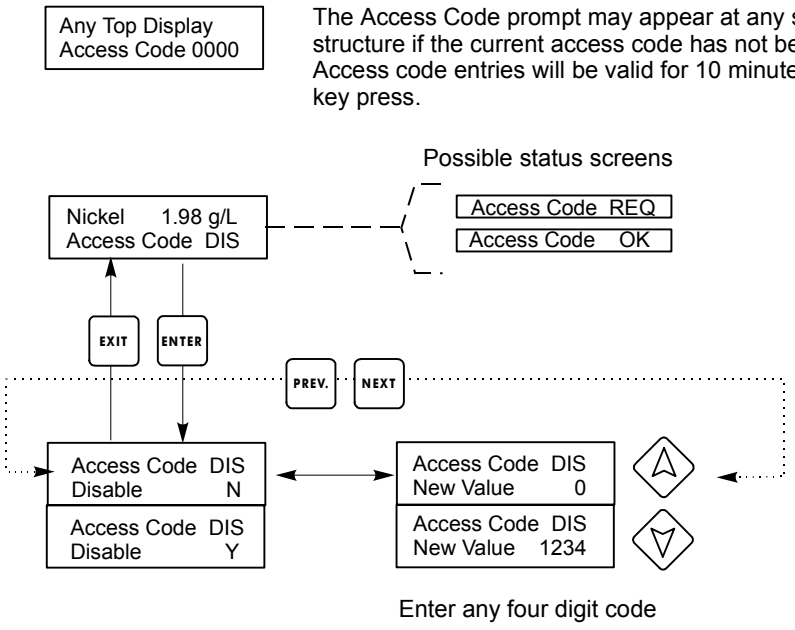
New Value

Press **ENTER** to display the current access code value and use the arrow keys to change it to any value between 0 and 9999. If the access code has been enabled, you will be prompted to enter the current access code before being allowed to change it.

The factory default access code is 1995.

If you change the access code and can't remember it, follow this procedure:
1. Turn off the power to the controller.
2. Wait 10 seconds.
3. Press and hold the Up and Down arrow keys while turning on the power.
4. Read the access code on the display.
5. Release the arrow keys and the code will disappear.

Access Code Menu



Access Code Menu

6.0 Maintenance

The WNI control module itself needs very little maintenance. Clean the outside of the controller enclosure with a damp cloth. Do not spray down the controller unless the enclosure door is closed and latched. "Pigtails" should be protected from spray or washdown. Check the cords and cables for damage.

6.1 Nickel Sensor Maintenance

The most important maintenance item for the sensor is to keep the optical paths clean of plate-out or other coatings. In flow through electroless nickel applications, the sensor should be resistant to plate out because the sample has been cooled. However, if some plate out does occur in the sample lines or the sensor, etch it as you would the tank.

Avoid any mechanical cleaning of the optical surfaces to avoid scratching them. Chemical cleaning is preferred over mechanical cleaning methods. Plate-out should be removed using nitric acid.

Field repairs should not be attempted. Call your factory representative in order to arrange for factory service. Expedited service is available at no additional cost.

NOTE: TO PREVENT CALIBRATION SHIFTS DUE TO CONDENSATION FORMING ON THE GLASS SAMPLE TUBE INSIDE THE SENSOR ENCLOSURE, DO NOT REMOVE THE SENSOR'S COVER FOR ANY REASON!

6.2 Electrode Maintenance

The pH electrode requires periodic cleaning and calibration. These electrodes are like batteries and their voltage outputs will change with time even if they are not being used. After installation, the rate of change increases, and factors such as temperature, extremes of pH, abrasion and chemical attack will increase the required frequency of calibration. If the process solution contains oils, scale or other solids, the electrode surfaces will tend to coat, its response time will slow down and cleaning will be required.

The frequency of cleaning and calibrating will vary greatly depending upon the application, the factors listed above, as well as the accuracy of control you require. The best way to determine the optimum number of days between calibrations is to remove the electrode from the process periodically (daily in dirty or hot applications) and check its accuracy in a buffer solution. If using manual temperature compensation, remember to change the temperature from that of the process to that of the buffer. If the accuracy of the reading is within your required tolerances, and the speed of response is good, reinstall the electrode in the process. If not, clean the electrode and perform a two point calibration.

The method of cleaning the electrode will depend upon the coating, as well as the materials of construction of the electrode. Do not use a solvent that will attack the electrode! Care must be taken to avoid scratching the pH electrode's glass, as this will shorten its life.

Oily coatings should be removed with a mild detergent or isopropyl alcohol. Soft coatings can be removed using a soft cloth or soft toothbrush.

A two point calibration should always be performed after cleaning the electrode.

Because the electrode signal is so sensitive, the condition of the cable and connectors between the electrode, preamplifier and controller is critical. Make sure that all electrical connections stay clean and dry. Never splice the cable prior to preamplification. Replace the cable if there is any sign of damage.

6.3 Replacing the Fuses

CAUTION: Disconnect power to the controller before opening front panel!

Locate the fuses on the circuit board at the back of the controller enclosure. (See figure 3.) Gently remove the old fuse from its retaining clip and discard. Press the new fuse into the clip, secure the front panel of the controller and return power to the unit.

The F1 fuse protects the electronics from spikes on the power input. The F2 fuse protects the electronics from excessive power consumption by devices connected to the relays.

Warning: Use of non-approved fuses can affect product safety approvals. Fuse ratings depend on controller power rating. Specifications are shown below. To insure product safety certifications are maintained, it is recommended that a Walchem fuse is used.

Controller Rating	F1	Walchem PN	F2	Walchem PN
120 VAC	5X20mm, 0.125A, 250V	102369	5X20mm,10A,125V	102432
240 VAC	5X20mm, 0.063A, 250V	103363	5X20mm, 5A, 250V	102370

7.0 Troubleshooting

CAUTION: Disconnect power to the controller before opening front panel!

Troubleshooting and repair of a malfunctioning controller should only be attempted by qualified personnel using caution to ensure safety and limit unnecessary further damage. Contact the factory.

7.1 Nickel Error Messages

HIGH ALARM

The summary screen will display an H at the right side of the bar graph if the nickel concentration rises above the high alarm set point.

Possible Cause	Corrective Action
1. Overshooting set point	Reduce replenishment pump rate. Increase flow through sensor. Place replenishment line closer to sensor.
2. Pump siphoning	Check all valves. Re-route tubing.
3. Output 1 in HAND mode	Go to H O A menu and put in AUTO mode.

LOW ALARM

The summary screen will display an "L" at the left side of the bar graph if the nickel concentration drops below the low alarm set point.

Possible Cause	Corrective Action
1. Pump not working.	Repair pump.
2. No replenishment.	Refill chemical supply.
3. Output 1 in OFF mode	Go to H O A menu and put in AUTO mode.

NO SAMPLE

No sample will be displayed if the measurement signals indicate excess air in the sample. Perform a self test to verify that the control module passes, which indicates that the problem is with the sensor (see section 5.2). If the control module fails the self test, return it for repair.

Possible Cause	Corrective Action
1. Sample pump failure.	Repair sample pump
2. Leak in or blockage of sample line.	Repair sample line
3. Partial plate out of sensor.	Etch sensor.
4. Excess air in line.	Check vertical mounting of sensor

LIGHT BULB OUT

This message indicates that the measurement signals have disappeared. Perform a self test to verify that the control module passes, which indicates that the problem is with the sensor (see section 5.2). If the control module fails the self test, return it for repair.

Possible Cause	**Corrective Action**
1. Light bulb failure	Return sensor for repair
2. Severe plate out	Etch sensor
3. Sensor disconnected	Reconnect sensor

PLATE OUT

This message is displayed when signal levels have been reduced considerably due to plate out. Perform a self test to verify that the control module passes, which indicates that the problem is with the sensor (see section 5.2). If the control module fails the self test, return it for repair.

Possible Cause	**Corrective Action**
1. Plate out of sensor	Etch sensor

SENSOR ERROR

Caused by the measurement signals being outside the normal range, such as a negative concentration reading. Perform a self test to verify that the control module passes, which indicates that the problem is with the sensor (see section 5.2). If the control module fails the self test, return it for repair.

Possible Cause	**Corrective Action**
1. Condensation inside sensor	Allow to dry out thoroughly
2. Faulty new sensor set-up	Repeat new sensor set-up with clean water
3. Sensor disconnected	Reconnect sensor

CALIBRATION TIME

The controller will display this prompt based upon the setting of the "Days between cal" menu in the Sensor menu group and the time of the last calibration. It may be cleared by performing a 1 point calibration of the sensor. If this feature is not desired, setting "Days between cal" to 0 will disable it.

TURNOVER LIMIT

This prompt is displayed if the output 1 totalizer has calculated a replenishment volume that exceeds the number of turnovers set in the "turnover limit" menu.

PUMP OVERRUN

This display appears if the pump output has been on longer than the time limit set in the "Time Limit" menu. It could be caused by a pump failure, lack of replenishment chemical, the time limit being set too low, or a failure of the pump to respond.

INTERLOCK

This error message is displayed if the signal from a flow or level switch is open, and the "Interlock Y/N" menu is set for "Y". Restore flow or level. The switch may be tested by measuring ohms when the switch should be closed (it should be very low, not infinite). The input may be tested by shorting the two terminals (interlock message should disappear).

CHECK SET POINTS

This is a normal display if you have changed the units of measure of the nickel concentration. This serves as a reminder that the controller does not convert the numerical value of the set points; for example, if the set point was 7.5 g/L, it will become 7.5 oz/gal, not 1 oz/gal.

PASS

This message is displayed after initiating the SELF TEST feature. This indicates the controller is functioning properly and the problem is likely to be with the sensor. However, the wiring between the controller front panel circuit board and the external sensor connector should be checked for breakage or wear. See diagram in figure 3.

FAIL

This message is displayed after initiating the SELF TEST feature. The controller is probably defective. Consult your factory representative for service options.

7.2 pH Error Messages

pH HIGH ALARM

The summary screen will display pH HIGH ALARM if the pH rises above the high alarm set point.

Possible Cause	**Corrective Action**
1. Overshooting set point.	Reduce replenishment pump rate. Increase flow through sensor. Place replenishment line closer to sensor.
2. Pump siphoning,	Check all valves. Re-route tubing.
3. Output 3 in HAND mode mode.	Go to H O A menu and put in AUTO
4. pH electrode out of calibration.	Calibrate electrode.

pH LOW ALARM

The summary screen will display pH LOW ALARM if the pH drops below the low alarm set point.

Possible Cause	**Corrective Action**
1. Overshooting set point.	Reduce replenishment pump rate. Increase flow through sensor. Place replenishment line closer to sensor.
2. Pump siphoning,	Check all valves. Re-route tubing.
3. Output 3 in HAND mode mode.	Go to H O A menu and put in AUTO

4.	pH electrode out of calibration.	Calibrate electrode.

TEMP ERROR

This error message appears if the signal from the automatic temperature compensation element disappears during operation. It is usually caused by a failure of the platinum RTD, or by a problem with the cabling or connections of the cable.

The PT1000 RTD should read 1000 ohms at 0°C and 3.85 ohms/degree C above zero. At 25°C it should read 1096.25 ohms±1%. The PT100 RTD should read 100 ohms at 0°C and .385 ohms/degree C above zero. A higher reading or open circuit (infinite resistance) may indicate a bad connection. A lower reading may indicate a shorted cable.

Measure the resistance at each connection between the sensor and the controller to determine if the sensor, cabling or connections are faulty.

pH SENSOR ERROR

This error message appears if the pH input signal is outside of the normal range. This usually indicates that the electrode has been disconnected or is faulty. It could appear under normal conditions if the pH is outside of the operating range of 0 to 14 pH.

	Possible Cause	**Corrective Action**
1.	Controller is faulty; fails self test.	Return for repair.
2.	Preamplifier has no power to it.	If battery powered preamp, replace battery. If preamp is powered by the controller, check +5V, -5V terminals vs. COM terminal. Should read +5VDC±5% and –4.6VDC ±5%.
3.	Preamplifier is faulty.	Indicated if ±5VDC power out of spec w/preamp attached, but in spec without preamp attached. Repair or replace preamp.
4.	Electrode is faulty.	Replace electrode.

CAL FAILURE

The controller will fail a two-point or one-point calibration if the voltage output from the electrode is outside certain limits. There are a number of possible causes for this condition:

Possible Cause	**Corrective Action**
1. Contaminated buffer solutions.	Replace buffer solutions.
2. Manual temperature compensation set at process value.	Set to buffer temperature.
3. Defective electrode.	Replace electrode.
4. Defective electrode wiring.	Check all connections, clean and dry. Check power to preamplifier. Use ohmmeter to check for shorts or opens.
5. Defective preamplifier.	Replace preamplifier.
6. Defective controller.	Replace if self-test fails.

8.0 Service Policy

The WNI Series Nickel Controller has a 2-year warranty on electronic components and a 1-year warranty on mechanical parts (keypad, terminal strip and relays).

We stock circuit boards for immediate exchange after we have isolated the cause of the problem.

Factory authorized repairs that are received by next-day-air will be returned within 24 hours. Normal priority for returns is two weeks.

Out of warranty repairs or circuit board exchanges are done on a flat fee basis after the warranty is expired.