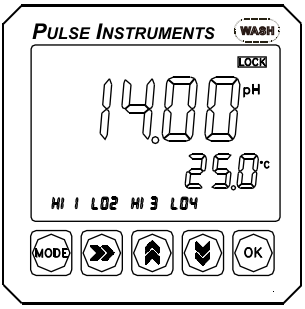
PULSE INSTRUMENTS



AP210
Instruction Manual

(800) 462-1926
support@pulseinstrument.com

I. INITIAL INSPECTION and ASSEMBLY

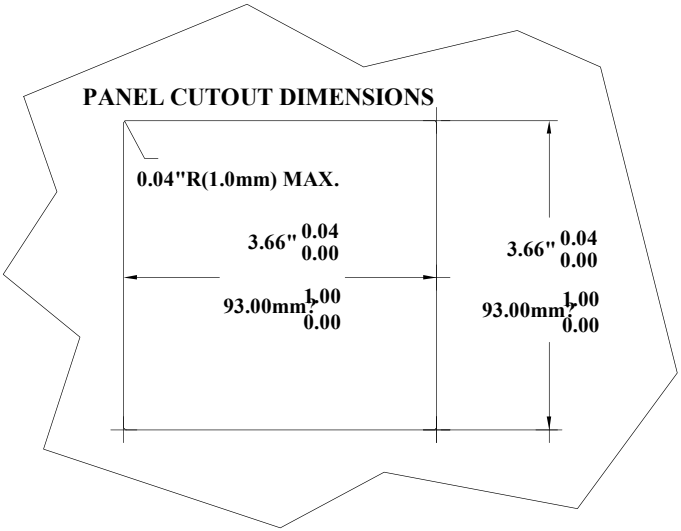
Carefully unpack the instrument and accessories. Inspect for damages made in shipment. If any damage is found, notify your Cole-Parmer representative immediately. All packing materials should be saved until satisfactory operation is confirmed.

MOUNTING PROCEDURE

1. Make a cutout on any panel, with a thickness of 1/16 in. (1.5 mm) to 3/8 in. (9.5mm).

2. Remove the mounting assembly from the controller and insert the controller into the cutout.

3. Replace the mounting bracket assembly onto the controller and secure the controller to the mounting panel.



Warning:

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Cleaning the instrument:

1. Be sure to remove the power before attempting to clean the meter.

2. Use a lint free cloth and clean water or neutral detergent.

3. Wipe the outer surface of the instrument only.

4. Wipe-dry the instrument before powering again.

II. GENERAL INTRODUCTION

The Pulse Instruments model AP210 (pH/ORP and Temperature) controller is a rugged microprocessor based instrument assembled in a watertight ¼ DIN case, designed for use in laboratories and process control applications.

The system simultaneously displays pH or ORP, Temperature and relay status in one large LCD screen.

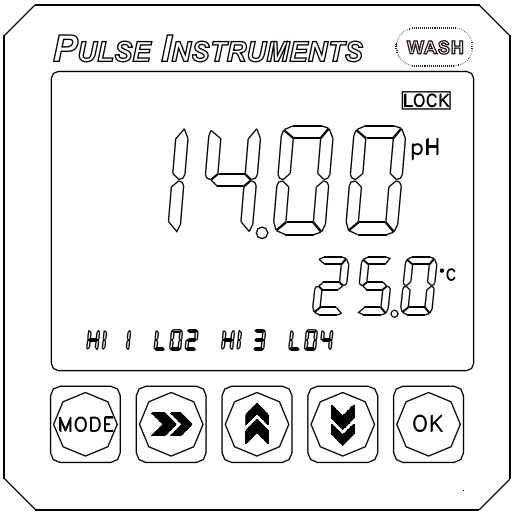
The model AP210 microprocessor per forms a self-diagnostic routine every time you turn on the unit providing you with basic information on the stability of the instrument.

The model AP210 is equipped with 4 control relays and one wash relay. All control relays are programmable and hysteresis driven. The system also has an isolated 4-20mA analog output, offset and span configurable for the pH or ORP display.

The model AP210 comes with a RS485 in terface that can easily let the user log all data (from multiple model AP210 or other Pulse Instruments Models with RS485) with an IBM©PC/AT compatible computer. For advanced users, the model AP210 may also be (PC) remotely controlled from main display mode to all calibration/setting modes.

III. USING THE PULSE INSTRUMENTS AP210

A. FRONT PANEL



1. The [**MODE**] key.

1a. In **MAIN** display mode this key will switch the display from pH, ORP absolute mV, ORP relative mV, CAL and back to pH display again.

1b. In the **PASSWORD CHECK** mode, pressing the [**MODE**] key for two seconds will by pass the **PASSWORD CHECK** and ***just*** let the user continue. Just press the [**OK**] key to view all control settings but the user will not be able to change any setting.

1c. After entering “CAL “mode, pressing the [MODE] key for two seconds will leave the control setting and return the user to the MAIN display mode.

2. The [▶] **RIGHT** key.

2a. In **CALibration** mode where the user can change the settings and the setting is in decade number format, pressing this key will select the next digit.

2b. In pH Buffer I Calibration (STAND) if the user wants to skip electrode calibration, pressing this key will skip pH calibration but will still display the last calibration’s EFFICIENCY for about four seconds before continuing to 4mA setting.

2c. In pH Buffer II Calibration (SLOPE) if the user wants to skip calibration, pressing this key will skip pH slope calibration (single point calibration only) but will still display the electrode ideal EFFICIENCY (100%) for about four seconds before continuing to 4mA setting.

3. The [⮝] **UP** key.

In **CALibration** mode where the user can change the settings, this key will show the next possible option. If in decade number format this key will ***increment*** the digit.

4. The [⮟] **DOWN** key.

4a. In **CALibration** mode where the user can change the settings, this key will show the next possible option. If in decade number format this key will decrement the digit.

4b.During **pH Buffer Calibration**, the user can press this key to repeat the buffer calibration.

5. The [**OK**] key.

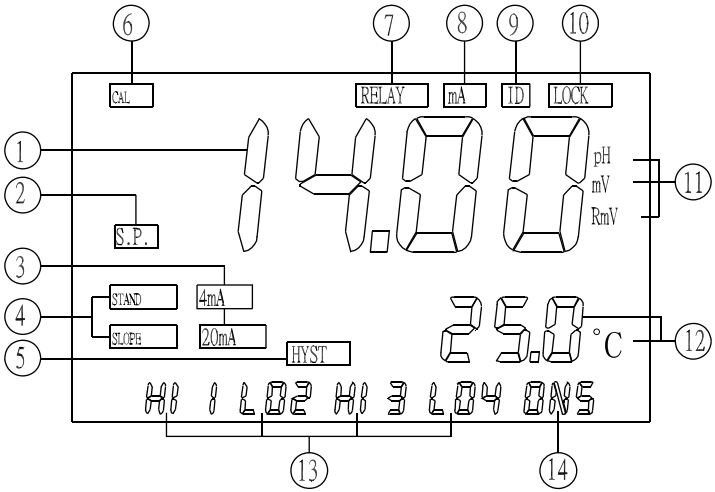
5a. In any mode where the user can change the settings, this key will save the new settings. If no change has been made then pressing this key will just move the user to the next setting.

5b. If the unit is password locked then continue pressing this key will just move the user to view the next setting.

6. The [**WASH**] key.

Pressing this key for about two seconds in any mode and the unit is UNLOCKED will turn ON the WASH relay (Relay 5). If the WASH relay is ON, The WASH relay will turn OFF after the timer setting or the user may press this key to turn it OFF immediately.

B. LCD SCREEN



1. **MAJOR LCD DISPLAY**

2. **S.P.** annunciator– Set Point, this will turn ON while changing /viewing the **RELAY 1- RELAY 4** settings.

3. **4mA** & **20mA** annunciators – the respective annunciator will turn ON while in the 4 mA or 20 mA setting mode.

4. **STAND** & **SLOPE** annunciators – the respective annunciator will BLINK before Buffer 1 or Buffer 2 calibration. The respective annunciator will stay ON while BUFFER 1 or BUFFER 2 is being calibrated.

5. **HYST** annunciator **– HYSTERESIS**, this annunciator will turn ON while changing/viewing the **RELAY 1- RELAY 4** settings. This annunciator indicates that the value at the **MINOR LCD DISPLAY** is the hysteresis value.

6. **CAL** annunciator – this annunciator will turn ON if the user is not in **MAIN** display mode.

7. **RELAY** annunciator – this annunciator will turn ON if the user is in **RELAY1 – RELAY4** settings.

8. **mA** annunciator – this annunciator will turn ON if the user is in **4mA** or **20mA** setting.

9. **ID** annunciator – this annunciator will turn ON if the user is in ID (RS485 address) setting.

10. **LOCK** annunciator – this annunciator will turn ON if the unit PASSWORD LOCKED.

11. **pH, mV, RmV** annunciators – this annunciators will indicate the unit of **MAJOR LCD DISPLAY**.

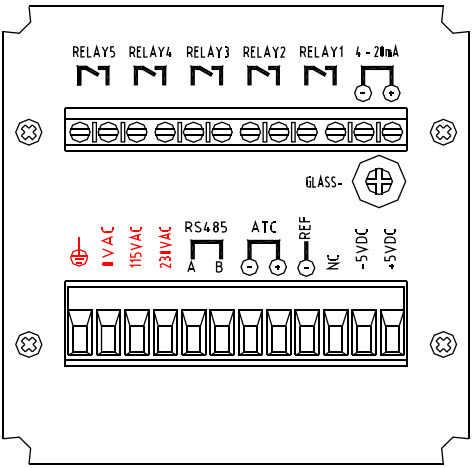
12. **LCD MINOR DISPLAY**

In MAIN mode, the temperature will be displayed here with the centigrade unit (℃).
In CALibration mode at Relay1-Relay4 settings, the hysteresis value will be displayed here without any unit.

13. **HI?/LO?** annunciators – **HI?** or **LO?** indicates relay action and relay number. (“?“ mark is the relay number.)

14. **ON5** annunciator – this annunciator will turn ON if the user turns ON the WASH relay.

C. REAR CONNECTORS



Before connecting the probes, relays, analog output, RS485 and power cord be sure that you are inserting to the right terminal as shown above. Remember that the unit is ON once the user plugs in the power cord to an AC power supply.

1. Connect the AC line to the rear of the instrument. The model pH/ORP 500 can be used with 115 or 230VAC 50/60 Hz. Power consumption is 6 watts. Make sure the **EARTH** connector is connected to the earth lead of the AC power line.

2. Connect the proper load to the output relays. Make sure that the load does not exceed the relay rating, 5 Amp at 115VAC and 2.5 Amp at 230 VAC.

3. Set the proper load to the 4-20mA-output connector. Make sure that the load impedance is less than 500 Ohms.

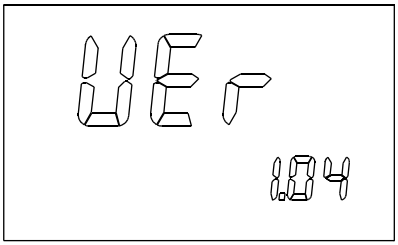
4. A +5VDC and -5VDC (max 20mA for each) output to provide excitation voltage for pH/ORP pre-amplifier only.

CAUTION:

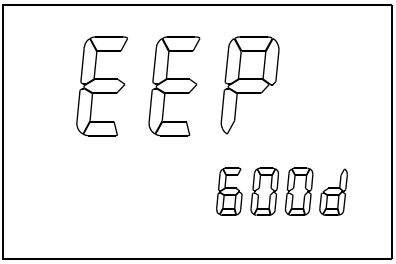
1. MAKE SURE THAT THE POWER IS UNPLUGGED BEFORE WIRING YOUR PROBES, RELAY ETC.

2. MAKE SURE YOU CONNECT THE AC POWER CORD TO THE CORRECT AC TERMINALS. CONNECTING INCORRECTLY MAY DAMAGE THE UNIT PERMANENTLY.

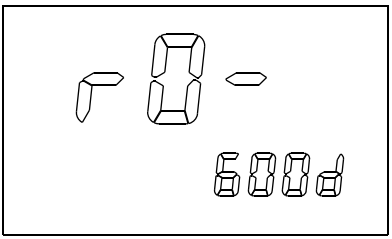
D. TURNING ON/OFF THE INSTRUMENT



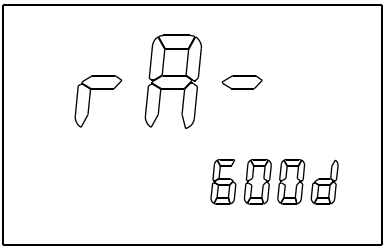
By just plugging the unit to a correct AC voltage the unit will be ready for use. There is no Power key so unplugging or plugging the unit will turn OFF or turn ON the unit respectively.



After the unit is turned on, the unit will display the software version number ("Ver"=Version) then it will perform some basic self-diagnostics ("EEP"= EEPROM Check, "RO-" = ROM Check & "RA-" = RAM Check) and will display "GOOd" or "bAd".



If you received any "bAd" messages turn OFF the unit and turn it ON again. (See **VIII. ERROR DISPLAYS AND TROUBLESHOOTING**).



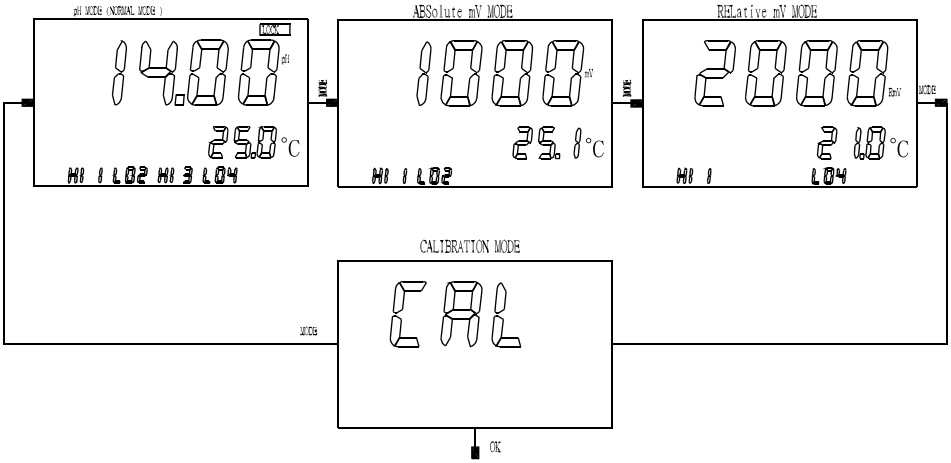
If the message persists then you might need to call your distributor. (See **XI. WARRANTY**).

After the self-diagnostic is complete the temperature will be displayed on the lowest part of the screen and you are ready to make pH/ORP/Temperature calibration or measurements. Just immerse the probes half way to the liquid. If possible do not allow the probes to touch any solid object in the solution.

There should be no air bubbles around the probes either. Shaking or moving the probes vigorously before recording any measurement will dislodge any bubbles formed in the probes.

IV. MODEL AP210

A. MAIN DISPLAY MODE



Turning ON the unit will always display **MAIN** display mode.

This instrument is designed to provide 4 distinct measurements:

1. **Temperature** - current temperature of the solution, which is always displayed.

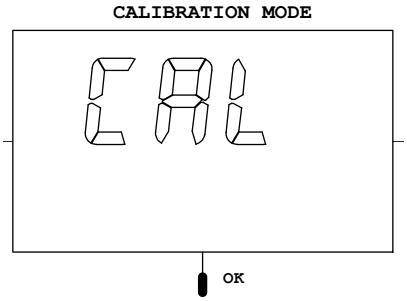
2. **pH** - the degree of acidity or alkalinity of the solution (with automatic temperature compensation).

3. **ORP-mV** - a measurement of absolute ORP mV.

4. **ORP-RmV** - a measurement of relative ORP mV. The **OFFSET** value at the **ORP CALIBRATION** page will be added to the ORP absolute value to display the ORP relative value.

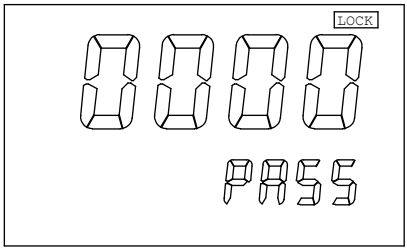
Pressing [**MODE**] in MAIN display mode will cycle the display from the four modes above.

B. CALIBRATION/SETTING MODE



Pressing the [**OK**] key at the CAL mode will bring-up the PASSWORD CHECK display if the unit is LOCKED. If the unit is not locked, the unit will skip the PASSWORD CHECK screen and go directly to CALIBRATION SELECT screen.

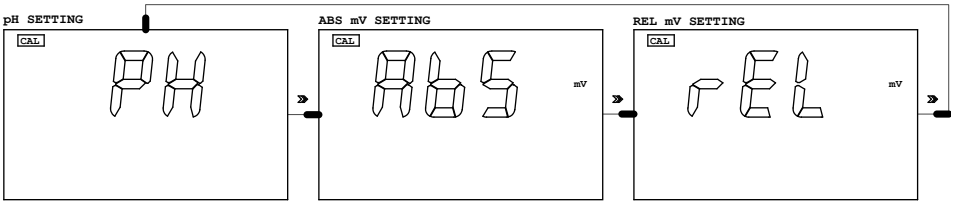
a. **PASSWORD CHECK** screen.



You will only see this screen if the unit is LOCKED. To change any settings or calibration you need to unlock the system to remove the "**LOCK**" message. You can use [▲], [▼], [▶] or [**OK**] keys to enter the correct 4-digit number on the number input. The relays and analog out will be **FROZEN** (control relays and current output will not be updated even if the input is changing). The user can opt to view all the screens of **CALIBRATION/SETTING mode** even if the system is LOCKED, by just pressing the **[MODE]** key for about two seconds on this screen. If the unit is LOCKED when going to **CALIBRATION /SETTING mode**, viewing the settings will not affect the function of the relays and the current output.

CAUTION: If the unit is **UNLOCKED** then every time the user enters the **Calibration/Setting mode** the relays and analog out will be **FROZEN** (control relays and current output will not be updated even if the input is changing).

b. **CALIBRATION/ SETTING SELECT** screen

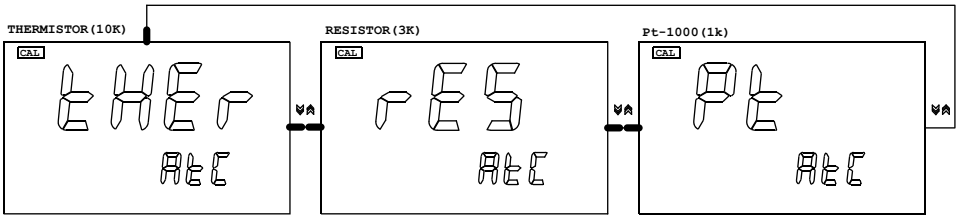


This screen will let the user select only one (pH, ABS. mV or REL. mV) mode that will control the relay1 - relay4 and mA output. This screen will always default to the last CALIBRATION/ SETTING SELECT you chose, so for most application you don't need to change this selection once you decide what reading to use. If you need to change the CALIBRATION/ SETTING SELECT, press the [▶] **RIGHT** key to choose your active reading then press [OK] to save your new selection and the unit will display the Temperature probe select screen. If the unit is LOCKED the user will not be able to change the setting here.

1. *ACTIVE* ***"pH"***

If the user selected "AbS" or "rEL" please see the next section "2. ACTIVE "**ABS**"" (At page 19) or "3. ACTIVE "**REL**"" (At page 21) respectively.

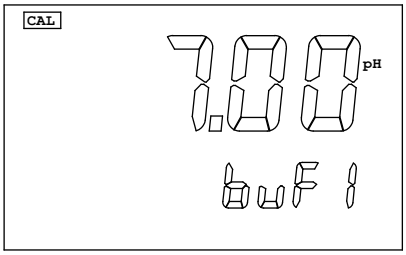
i. **TEMPERATURE PROBE SELECT screen**



This screen will let the user select what temperature probe (10KΩ thermistor, Balco 3KΩ resistor or RTD pt-1000) the user will use. This screen will always default to the last temperature probe the user selected. For most application the user will only use one kind of temperature probe so the user don't need to change this selection once you select the correct temperature probe. If the user needs to change the temperature probe type, press the [⮝] or [⮟] keys to choose your temperature probe then press [**OK**] to save your new selection.

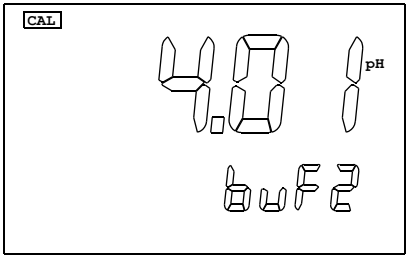
The next two steps are for pH buffer select.

ii. **pH BUFFER I (STAND) SELECT screen**



This screen selects the buffer for standardization calibration. The user can select "7.00pH" or "6.86pH". Press [⮝] or [⮟] keys to select the buffer then the [**OK**] key to save your selection.

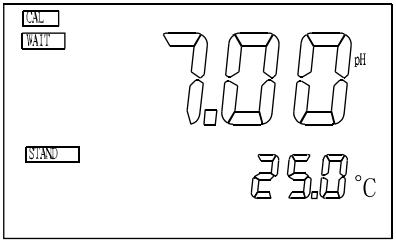
iii. **pH BUFFER II SELECT screen**



This screen selects the buffer for slope calibration. The user can select “1.68pH”, “4.00pH”, “4.01pH”, “9.18pH”, “10.01pH” or “12.46pH”. Press the [▲] or [▼] keys to select the buffer then the [**OK**] key to save your selection.

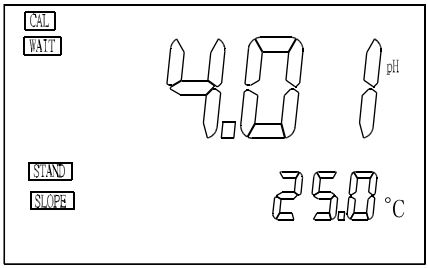
The next two steps are for actual pH electrode calibration.

iv. STAND CALIBRATION screen



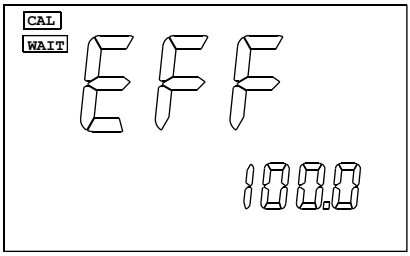
This is the actual pH calibration. The initial display will be the chosen buffer for **pH BUFFER I SELECT.** The **“STAND**” annunciator will blink indicating the unit is waiting for the user to start the calibration. Put the cleaned electrode and temperature probe in buffer I. Press the [**OK**] key will start the calibration. For Detailed instructions please see **Step-by-Step pH Calibration (step 7)** on the next page**.**

v. SLOPE CALIBRATION screen



After finishing the Buffer I calibration the unit will move to this screen. The initial display will be the chosen buffer for **pH BUFFER II SELECT.** The “**SLOPE**” annunciator will blink indicating that the unit is waiting for the user to continue the calibration. Put the cleaned electrode and temperature probe in buffer II. Pressing the [**OK**] key will start the calibration. For detailed instructions please see **Step-by-Step pH Calibration** on the next page.

vi. EFFICIENCY INFORMATION screen



This screen will display the efficiency of the pH electrode from its last calibration. This screen is for user information only and will automatically change to the 4mA setting after 4 seconds.
The equation of Efficiency is:

Efficiency = (new slope/ ideal slope) x 100%.

We recommend that you use a new electrode, if the electrode efficiency is lower than 80%.

Step by Step pH calibration

1. From the MAIN display mode, press the [**MODE**] key to go to "CAL" screen then press [**OK**].

2. If the unit is LOCKED, remove the LOCK display first.

3. Select "pH" at the **CALIBRATION/ SELECT** screen. This will also set the RELAYS and ANALOG OUT to be controlled by the pH reading.

4. Select the correct temperature probe at TEMPERATURE PROBE SELECT screen.

5. Select the correct buffer at **pH BUFFER I SELECT** screen.

6. Select the correct buffer at **pH BUFFER II SELECT** screen.

7. Clean the pH electrode and temperature probe with de-ionized or distilled water.

8. Place the pH electrode and Temperature probe into buffer 1.

9. Press the [**OK**] key to start the **STAND** ardization calibration. A "**WAIT**" message will blink indicating that the instrument is waiting for a stable reading. The display will be locked to the buffer value corresponding to the temperature of buffer 1 (See chapter **IX. pH Buffers**). When a stable reading is reached, the unit will blink a "**SAVE**" message at MINOR LCD display.

10. Press the [**OK**] key to save the STAND calibration and prepare to do a SLOPE calibration **OR** press the [▼] key to *recalibrate* buffer 1 and see step 9. If "**OVEr**"(OVER) or "**Undr**"(UNDER) (See chapter **VIII. ERROR DISPLAYS AND TROUBLESHOOTING**) is displayed or a blinking "**SAVE**" does not show after more than few minutes then something is wrong with your buffer 1 or electrode. Be sure your buffer 1 is correct or change a new electrode and repeat from step 7.

11. Clean the pH electrode and temperature probe with the de-ionized/distilled water.

12. Place the pH electrode and Temperature probe into buffer 2.

13. Press the [**OK**] key to start the **SLOPE** calibration. A "**WAIT**" message will blink indicating that the instrument is waiting for a stable reading. The display will be locked to the buffer value corresponding to the temperature of buffer 2 (See chapter **IX. pH Buffers**). When a stable reading is reached, the unit will blink a "**SAVE**" message at the MINOR LCD display.

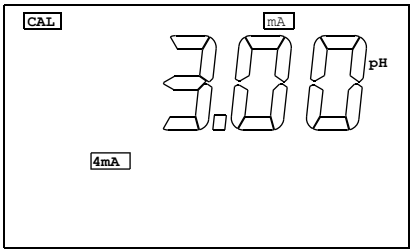
14. Press the [**OK**] key to save the SLOPE calibration **OR** press the [▼] key to recalibrate buffer 2 and see step 13.

If "**OVEr**" (OVER) or "**Undr**" (UNDER) (See chapter **VIII. ERROR DISPLAYS AND TROUBLESHOOTING**) is displayed or a blinking "**SAVE**" does not show after more than few minutes then something is wrong with your buffer 2 or electrode. Be sure your buffer 2 is correct or change a new electrode and repeat from step.

15. Set-up your mA OUT and CONTROL RELAY settings.

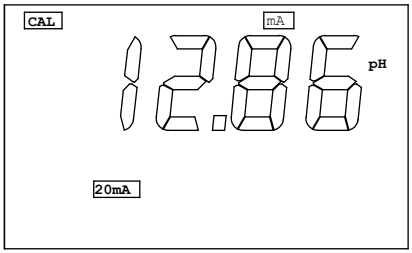
16. The unit is ready for measurement and control.

vii. 4mA SETTING screen



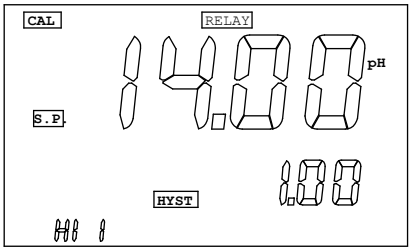
This screen will let the user change the 4 mA value. The user can use [▲], [▼], [▶] or [**OK**] keys to input new 4mA value. This value is used for scaling the 4-20mA **ANALOG OUTPUT.** (For detailed explanation see chapter **VI**. **4-20 mA OUTPUT**.)

viii. 20 mA SETTING screen



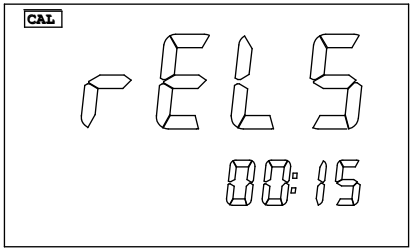
This screen will let the user change the 20 mA value. The user can use [▲], [▼], [▶] or [**OK**] keys to input new 20mA value. This value is used for scaling the 4-20mA **ANALOG OUTPUT.** (For detailed explanation see chapter **VI**. **4-20 mA OUTPUT**.)

ix. RELAY-1, RELAY-2, RELAY-3, RELAY-4 SETTING



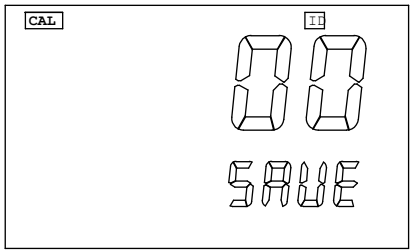
This screen is essentially the same for the four relays. Take note of the blinking character as there are 3 values to input for each relay. The user can use [▲], [▼] , [▶]or [**OK**] keys to input the **SET-POINT** then the **HYSTERISIS** and finally the **RELAY ACTION**. (See **V. CONTROLLING THE RELAYS** .)

x. RELAY 5 (WASH) ON TIME SETTING



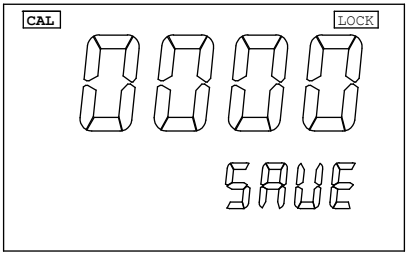
This screen set the ON TIME delay in **MINUTES**:**SECONDS** for the **RELAY 5.** The user can use [▲], [▼], [▶] or [OK] keys to input the new ON time. You can only turn-ON the WASH relay if the unit is UNLOCKED.

xi. ID (RS485 ADDRESS) SETTING



This screen selects the unique ID/ address for the unit. Your RS485 communication program must also use this same ID to communicate with this unit. The user can use [▲], [▼], [▶] or [OK] keys to input the new ID/address.

xii. PASSWORD SETTING



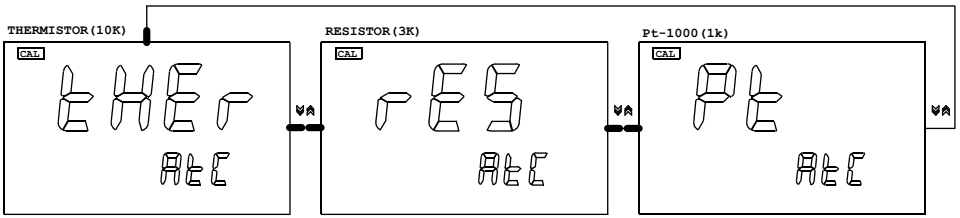
This screen selects the password number for this unit. The user can use [▲], [▼] or [▶] keys to input the new password. Pressing the [**OK**] key will save the password number and LOCKS the unit. You will not be able change any setting or turn-on the wash relay unless a correct 4-digit number is selected in the **PASSWORD CHECK** screen.

CAUTION: The user is responsible in remembering their password number otherwise you would not be able to calibrate or change the settings.

*2. ACTIVE **"ABS mV"***

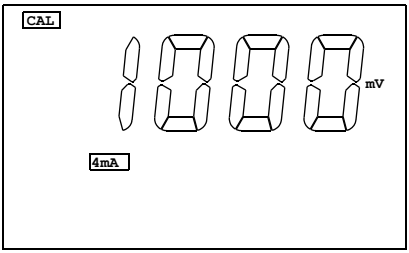
If the user selected "**pH**", please see the previous section **1.** ACTIVE **"pH"**(at page 13). If the user selected "**REL**", please see the next section **3.** ACTIVE **"REL"** (at page 21)**.**

i. TEMPERATURE PROBE SELECT screen



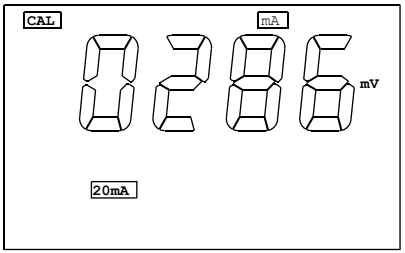
This screen will let the user select what temperature probe (10KΩ thermistor, Balco 3KΩ resistor or RTD pt-1000) the user will use. This screen will always default to the last temperature probe the user selected. For most application the user will only use one kind of temperature probe so the user don't need to change this selection once you select the correct temperature probe. If the user needs to change the temperature probe type, press the [▲] or [▼] keys to choose your temperature probe then press [**OK**] to save your new selection.

ii. 4mA SETTING screen



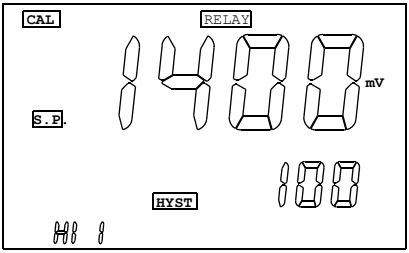
This screen will let the user change the 4 mA value. The user can use [⮝], [⮟], [▶] or [**OK**] keys to input new 4mA value. This value is used for scaling the 4-20mA **ANALOG OUTPUT.** (For detailed explanation see chapter **VI**. **4-20 mA OUTPUT**.)

iii. 20 mA SETTING screen



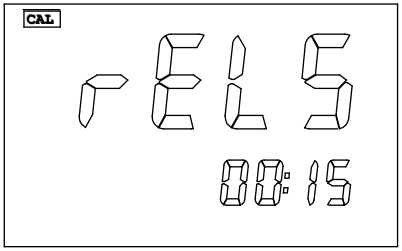
This screen will let the user change the 20 mA value. The user can use [⮝], [⮟], [▶] or [**OK**] keys to input new 20mA value. This value is used for scaling the 4-20mA **ANALOG OUTPUT.** (For detailed explanation see chapter **VI**. **4-20 mA OUTPUT**.)

iv. RELAY-1, RELAY-2, RELAY-3, RELAY-4 SETTING



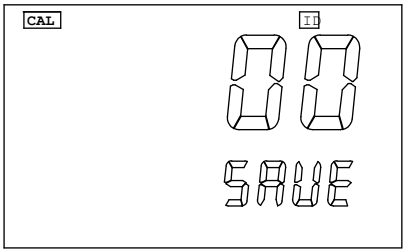
This screen is essentially the same for the four relays. Take note of the blinking character as there are 3 values to input for each relay. The user can use [⮝], [⮟], [▶]or [**OK**] keys to input the **SET-POINT** first then the **HYSTERISIS** and finally the **RELAY ACTION**. (See **V. <u>CONTROLLING THE RELAYS</u>** .)

v. RELAY 5 (WASH) ON TIME SETTING



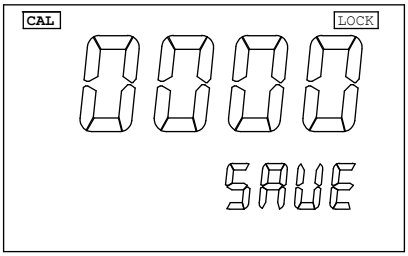
This screen selects the ON TIME delay in **MINUTES**:**SECONDS** for the **RELAY 5.** The user can use [▲], [▼], [▶] or [**OK**] keys to input the new ON time. You can only turn-ON the WASH relay if the unit is UNLOCKED.

vi. ID (RS485 ADDRESS) SETTING



This screen selects the unique ID/address for the unit. Your RS485 communication program must also use this same ID/ address to communicate with this unit. The user can use [▲], [▼], [▶] or [**OK**] keys to input the new ID/address.

vii. PASSWORD SETTING



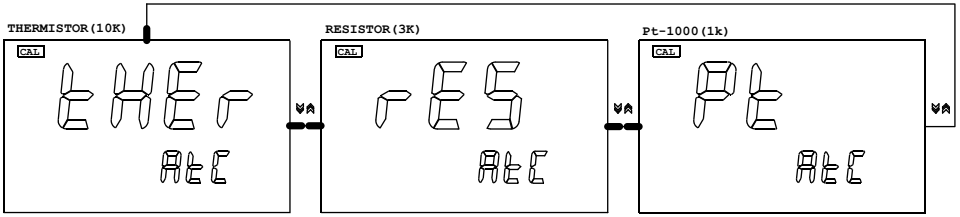
This screen selects the password number for this unit. The user can use [▲], [▼] or [▶] keys to input the new password. Pressing the [**OK**] key will save the password number and LOCKS the unit. You will not be able change any setting or turn-on the wash relay unless a correct 4-digit number is selected in the **PASSWORD CHECK** screen.

CAUTION: The user is responsible in remembering their password number otherwise you would not be able to calibrate or change the settings.

3. *ACTIVE* ***"REL"***

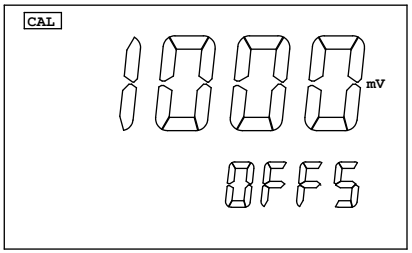
If the user selected "**pH**", please the previous section **1. ACTIVE "pH"** (at page 13). If the user selected "**ABS**", please see the previous section **2. ACTIVE "ABS"** (at page 19)**.**

i. TEMPERATURE PROBE SELECT screen



This screen will let the user select what temperature probe (10KΩ thermistor, Balco 3KΩ resistor or RTD pt-1000) the user will use. This screen will always default to the last temperature probe the user selected. For most application the user will only use one kind of temperature probe so the user don't need to change this selection once you select the correct temperature probe. If the user needs to change the temperature probe type, press the [⩓] or [⩔] keys to choose your temperature probe then press [**OK**] to save your new selection.

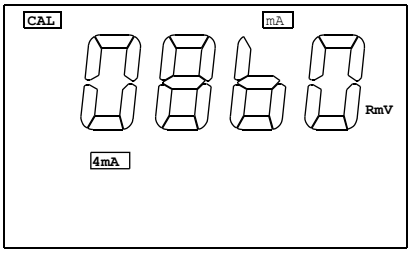
ii. OFFSET SETTING screen



This screen selects the OFFSET for relative ORP. The value here will be subtracted from the absolute ORP reading to display the relative ORP reading. The equation is :

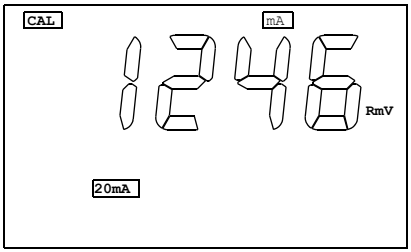
"REL mV" = "ABS mV" – "Offset"

iii. 4mA SETTING screen



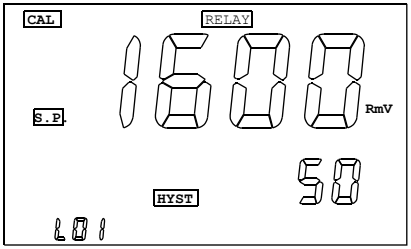
This screen will let the user change the 4 mA value. This value is used for scaling the 4-20mA **ANALOG OUTPUT.**
(See chapter **VI**. **4-20 mA OUTPUT**.)

iv. 20mA SETTING screen



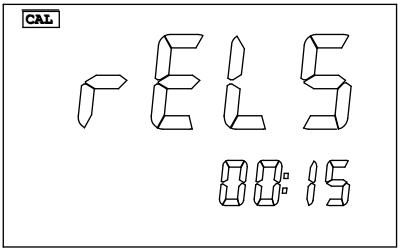
This screen will let the user change the 20 mA value. this value is used for scaling the 4-20mA **ANALOG OUTPUT.**
(See chapter **VI. 4-20 mA** OUTPUT.)

v. RELAY-1, RELAY-2, RELAY-3, RELAY-4 SETTING



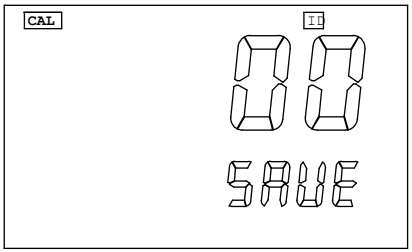
This screen is essentially the same for the four relays. Take note of the blinking character as there are 3 values to input for each relay. The user has to input the **SET-POINT** first then the **HYSTERISIS** and finally the **RELAY ACTION**.
(See chapter **V. CONTROLLING THE RELAYS** .)

vi. RELAY 5 (WASH) ON TIME SETTING



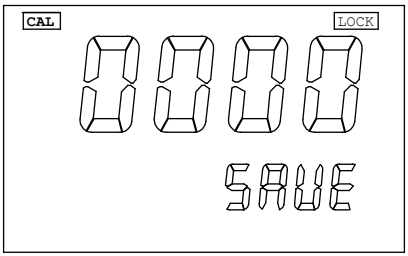
This screen selects the ON TIME delay in **MINUTES**: **SECONDS** for the **RELAY 5.** The user can use [▲], [▼], [▶] or [**OK**] keys to input the new ON time. You can only turn-ON the WASH relay if the unit is UNLOCKED.

vii. ID (RS485 ADDRESS) SETTING



This screen selects the unique ID/address for the unit. Your RS485 communication program must also use this same ID/ address to communicate with this unit.

viii. PASSWORD SETTING



This screen selects the password number for this unit. The user can use [▲], [▼] or [▶] keys to input the new password. Pressing the [**OK**] key will save the password number and LOCKS the unit. You will not be able change any setting or turn-on the wash relay unless a correct 4-digit number is selected in the **PASSWORD CHECK** screen.

***CAUTION**: The user is responsible in remembering their password number otherwise you would no be able to calibrate or change the settings.*

V. CONTROLLING THE RELAYS

A. ISOLATION VOLTAGE

The maximum isolation voltage of the relay output contacts is 1500 VDC. The voltage differential between the relay output contacts and the load should not exceed 1500 VDC.

B. OUTPUT LOAD

The current through the relay output contacts should not exceed 5 Amp at 115 VAC and 2.5 Amp at 230 VAC in order not to cause permanent damage to the relay contacts. This rating is **specified for resistive loads only.**

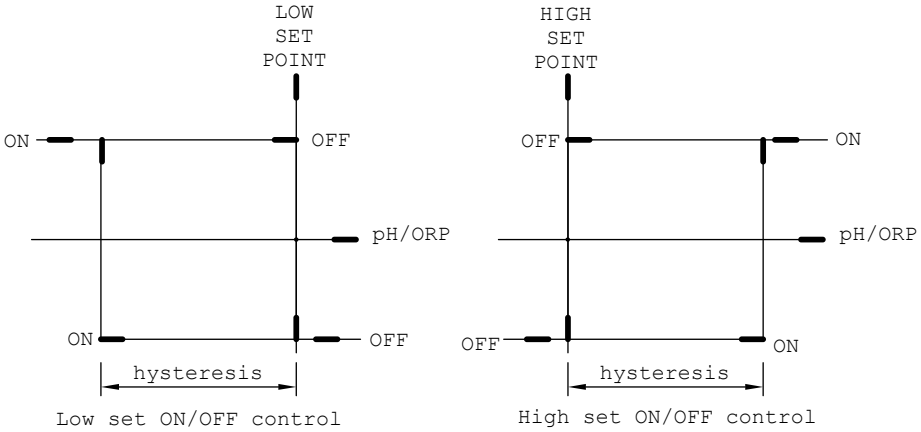
C. RELAY ACTION, RELAY SETPOINT & HYSTERESIS VALUE

Relay Action	Effective RELAY-**ON** Set Point	Effective RELAY-**OFF** Set Point
HIGH	S.P.	S.P. – (H.V)
LOW	S.P	S.P. +(H.V.)

S.P. = Relay Set point H.V.= Hysteresis value (Dead Band)

If the relay action is set to **HI**GH, the relay will turn **ON** at (SET POINT), and will turn **OFF** at (SET POINT-HYSTERISIS).
If the relay action is set to **LO**W, the relay will turn **ON** at (SET POINT), and will turn **OFF** at (SET POINT + HYSTERISIS).

There are four Independent relays the user can bind to pH, ABSOLUTE mV or RELATIVE mV mode. The user can ***only*** bind the four relays to one reading mode at a time. The user can change this anytime by changing option at the **CALIBRATION/ SETTING SELECT** screen.



The figure above shows how the relays react to user set point, hysteresis and reading.

Note:

1. The ideal set point range for **pH** is 0.00 to 16.00 pH.

2. The ideal set point range for **ABS** mV is –2500 to 2500 mV.

3. The ideal set point range of for **REL** mV is -6499 to 6499 mV.

VI. 4 - 20 mA OUTPUT

A. ISOLATION VOLTAGE

The maximum isolation voltage of the 4-20 mA output is 500 VDC. The voltage differential between the 4-20 mA output and the load should not exceed 500 VDC.

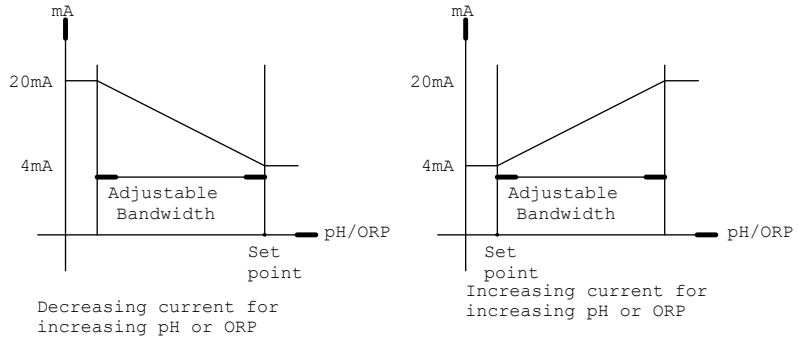
B. OUTPUT LOAD

The maximum load is 500 . Output current inaccuracies may occur for load impedance in excess 500 .

C. LINEAR ANALOG OUPUT

The analog output will produce a linear analog output. The user can only bind the ANALOG OUTPUT to one reading at a time. The user can change this anytime by changing option at the **CALIBRATION/ SETTING SELECT** screen.

The analog output will be restricted on the 4 mA setting, 20 mA setting and the current bound display.



The above figure shows the relationship between Reading, U_{4mA} & U_{20mA}.

The analog output is based on the following equation:

$mA_{(output)} = 4mA+(16mA)*(D – U_{4ma}) / (U_{20ma}- U_{4mA})$

Where:

$mA_{(output)}$ = analog output
D = current bound display
U_{4mA} = user setting for 4 mA for current bound display
U_{20mA} = user setting for 20 mA for current bound display

Note:

1. The ideal range of U_{4mA} and U_{20mA} for **pH** is 0.00 to 16.00 pH.

2. The ideal range of U_{4mA} and U_{20mA} for **ABS mV** is -2500 to 2500 mV.

3. The ideal range of U_{4mA} and U_{20mA} for **REL mV** is -6499 to 6499 mV.

4. The absolute difference of U4mA and U20mA for pH, ABS mV & REL mV must be greater or equal to 0.20 pH, 20 mV, 20 RmV respectively.

VII. RS485 INTERFACE OPERATION

A. INTRODUCTION

This section assumes you are familiar with the basics of computer programming, data communication, the RS485 interface and possess a copy of any programming language software capable of interfacing with a RS485 card or a RS232-RS485 converter (third party vendor) module.

A demo program for Windows (XP, 7) is included in the accompanying disk.

B. PREPARING THE METER

This meter comes equipped with a 2-wire RS485 interface. Just connect each terminal to the respective RS485 terminal on your PC. (If the DEMO program is not working, try reversing the connections of the terminals.) After you have connected the meter (or multiple meters with unique ID number) correctly and turned on both the meter(s) and the computer, you are now ready to program a simple routine to read data from the instrument.

VIII. ERROR DISPLAYS AND TROUBLESHOOTING

MAJOR LCD display	**MINOR LCD display**	**DISPLAY unit**	**Possible cause(s) [Action(s)]**
"OVEr"	"OVEr"	pH	a. Temperature > 120.0°C. [Bring buffer/solution to a lower temperature.] [Replace temperature probe.] b. No temperature sensor. [Use a temperature probe.]
"OVEr"	"Undr"	pH	Temperature < -10.0°C. [Bring buffer/solution to a higher temperature.]

MAJOR LCD display	MINOR LCD display	DISPLAY unit	Possible cause(s) [Action(s)]
"OVEr"	-10.0~ 120.0°C	pH	pH>16.00 . [Recalibrate.]
"OVEr"	0.0 ~ 60.0°C	pH-Cal	pH>16.00. [Use a new buffer solution.] [Replace the electrode.]
"OVEr"	0.0 ~ 60.0°C	a.pH-Cal-STAND buffer 7.00pH b.pH-Cal-STAND buffer 6.86 pH c. pH-Cal-SLOPE	a. Offset>100mV b. Offset>108.3mV c. Slope>ideal mV by 30% [Use a new buffer solution.] [Replace electrode.]
"Undr"	-10.0~ 120.0°C	pH	pH<-2.00 [Recalibrate.]
"Undr"	0.0 ~ 60.0°C	a.pH-Cal-STAND buffer 7.00pH b.pH-Cal-STAND buffer 6.86 pH c.pH-Cal-SLOPE	a. Offset <-100mV b.Offset < -91.7 mV c. Slope<ideal slope by 30% [Use a new buffer solution.] [Replace electrode.]
"OVEr"	don't care	ORP (ABS or REL)	a. ORP ABS display > +2500 mV [Bring solution to a lower ORP reading]
"Undr"	don't care	ORP (ABS or REL)	a. ORP ABS display < -2500 mV [Bring solution to a higher ORP reading]
don't care	"OVEr"		a. Temperature > 120.0°C. [Bring solution to a lower temperature.] [Replace temperature probe.] b. No temperature sensor. [Use a temperature probe.]
don't care	"Undr"		Temperature < -10.0°C. [Bring buffer/solution to a higher temperature.]

“EEP”	“bAd”	During power-on	Unit has failed its EEPROM test. [Turn instrument OFF and back to ON again.] [Return for service. (see Warranty)]
“rO-“	“bAd”	During power-on	Unit has failed its ROM test. [Turn instrument OFF and back to ON again.] [Return for service. (see Warranty)]
“rA-“	“bAd”	During power-on	Unit has failed its RAM test. [Turn instrument OFF and back to ON again.] [Return for service. (see Warranty)]

IX. pH BUFFERS

The temperature characteristics of pH calibration buffers pH1.68, pH4.00, pH4.01, pH6.86, pH7.00, pH9.18, pH10.01 & pH12.46 are stored inside the instrument. The buffers used to calibrate the instrument must exhibit the same temperature characteristics as the stored values.

TABLE 1.

°C	1.68	4.00	6.86	9.18	4.01	7.00	10.01	12.46
0	1.67	4.01	6.98	9.46	4.01	7.11	10.32	13.42
5	1.67	4.00	6.95	9.39	4.01	7.08	10.25	13.21
10	1.67	4.00	6.92	9.33	4.00	7.06	10.18	13.01
15	1.67	4.00	6.90	9.28	4.00	7.03	10.12	12.80
20	1.68	4.00	6.88	9.23	4.00	7.01	10.06	12.64
25	**1.68**	**4.00**	**6.86**	**9.18**	**4.01**	**7.00**	**10.01**	**12.46**
30	1.68	4.01	6.85	9.14	4.01	6.98	9.97	12.30
35	1.69	4.02	6.84	9.10	4.02	6.98	9.93	12.13
40	1.69	4.03	6.84	9.07	4.03	6.97	9.89	11.99
45	1.70	4.04	6.83	9.04	4.04	6.97	9.86	11.84
50	1.71	4.06	6.83	9.02	4.06	6.97	9.83	11.71
55	1.72	4.07	6.83	8.99	4.08	6.97	9.80	11.57
60	1.72	4.09	6.84	8.97	4.10	6.98	9.78	11.45

Note: The actual reading of the instrument can differ from the values shown by ±0.01 pH.

X. SPECIFICATIONS

Mode	Range	Resolution	Accuracy
pH	-2.00 to 16.00 pH	0.01 pH	±0.1% of rdg ± 1 LSD
ORP Absolute mV	-2500 to 2500 mV	1 mV	±0.1% of rdg± 1 LSD
ORP Relative mV	-6499 to 6499 mV	1 mV	±0.1% of rdg± 1 LSD
Temperature	-10.0 to 120.0 °C	0.1 °C	±0.1 °C ± 1 LSD

pH

Recognized pH buffers pH6.86, pH7.00 & pH1.68, pH4.00, pH4.01,pH9.18, pH10.01, pH12.46
pH Temperature compensation Auto -10.0°C to 120.0 °C
pH Buffer Temperature range 0.0°C to 60.0 °C
pH Electrode Offset recognition 100 mV at pH 7.00
+108.3 mV/-91.7 mV at pH 6.86
pH Electrode Slope recognition 30% at pH 1.68, 4.00, 4.01, 9.18,10.01 & 12.46
Input impedance $>10^{12}$
Calibration end point sensing Yes

Temperature

Temperature sensor (User selectable) Thermistor :10.00k at 25 °C,
Resistor : Balco 3K at 25 °C
RTD : pt-1000,α=0.00385

4-20 mA Output

Current output range 4 to 20 mA (isolated)
Current output scale user programmable
Maximum load 500
Accuracy ± 0.02mA
Isolation voltage 500VDC

Controller

Control type (five) ON/OFF control

Relay output (Resistive load only)	5A at 115VAC or 2.5A at 220VAC

GENERAL

Keys	Audio feedback in all keys
Security protect	4-digit password
Communication	RS485
Power:	115VAC or 230VAC 50/60Hz
Ambient Temperature range	0.0 to 50.0 °C
Display(pH/ORP :Temp.)	16mm : 8.5mm high LCD
Case	IPT65, ¼ DIN case, depth 148mm
Weight	940 g

XI. WARRANTY

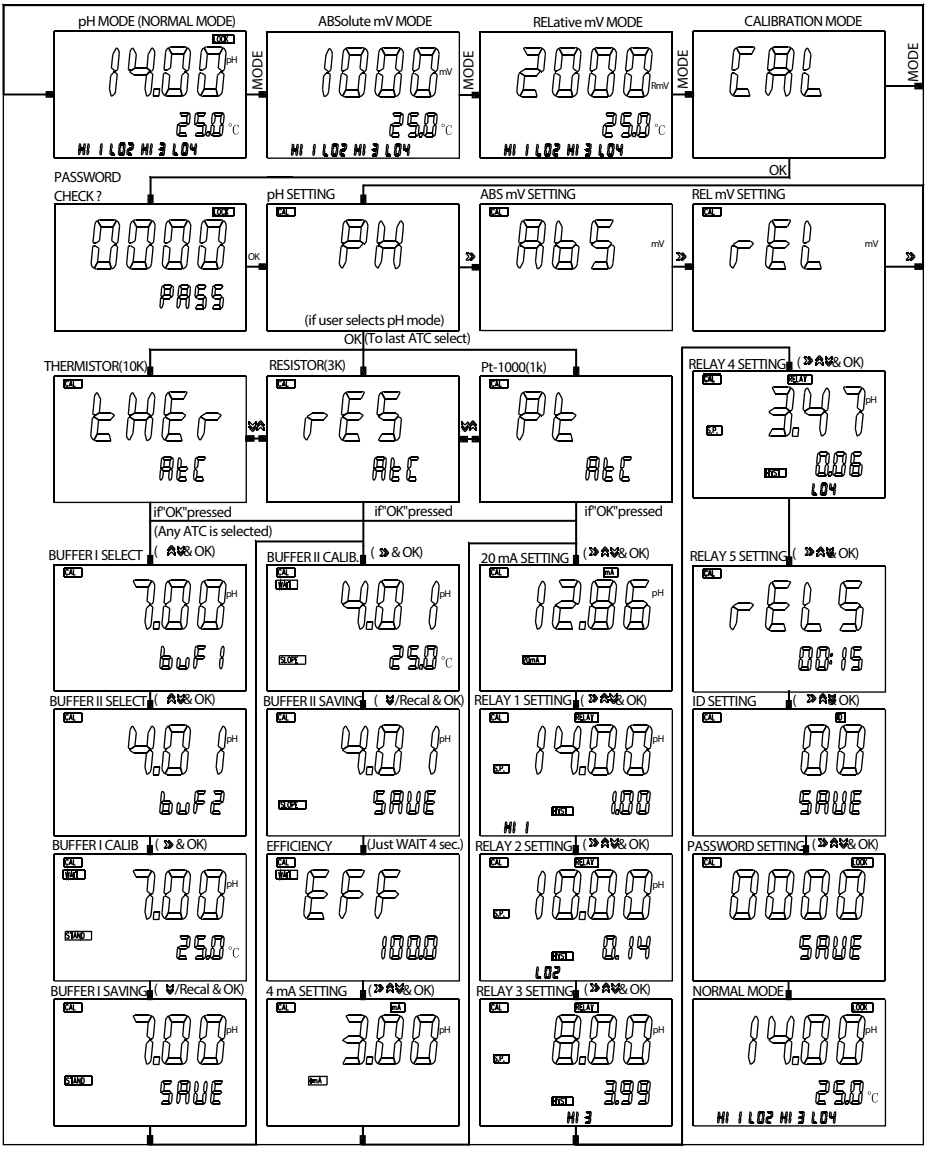
Pulse Instruments' controllers have a 1-year warranty on electronic components and a 1-year warranty on mechanical parts and electrodes. See Statement of Limited Warranty in front of manual for details.

XII. RETURN OF ITEMS

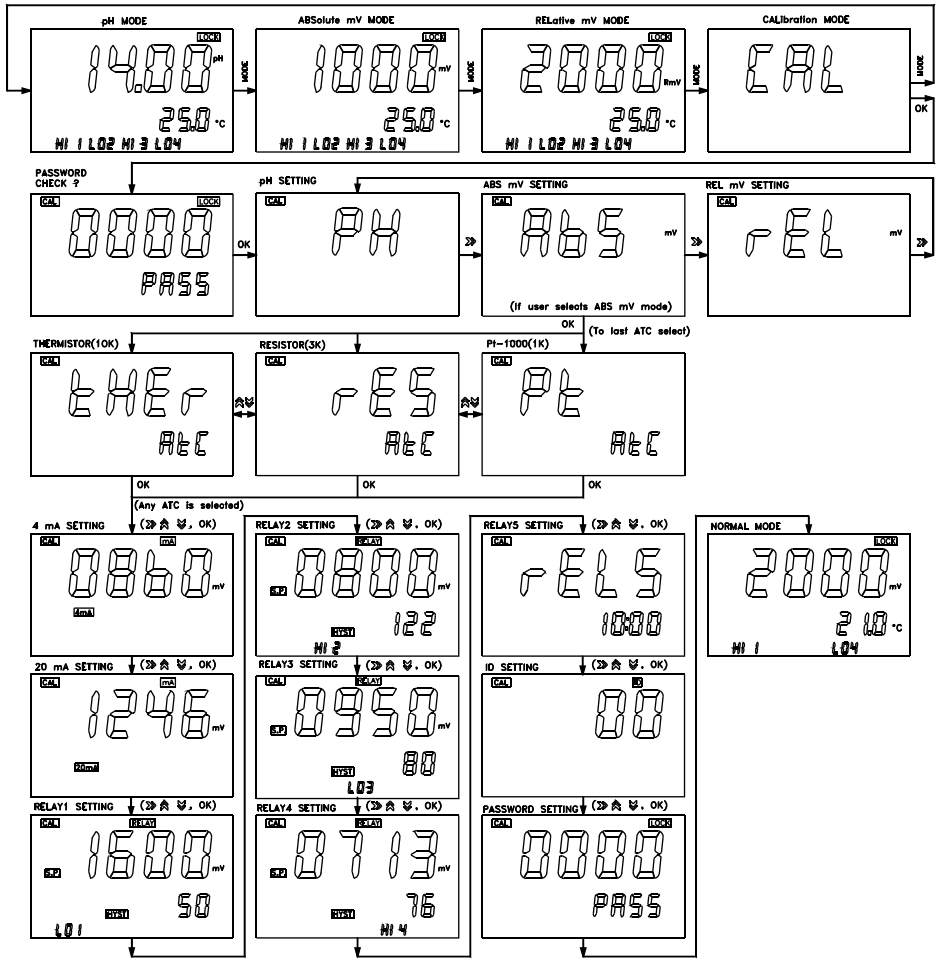
Pulse controllers are supported by a worldwide network of authorized master distributors. Contact Pulse Instruments for troubleshooting support, replacement parts, and service. If a controller is not functioning properly, circuit boards may be available for exchange after the problem has been isolated. Pulse Instruments will provide a Return Material Authorization (RMA) number for any products being returned to the factory for repair. Repairs are generally completed in less than one week. Repairs that are returned to the factory by next-day-air freight will receive priority service. Out-of-warranty repairs are charged on a time and material basis.

XIII. KEYBOARD FLOWCHARTS

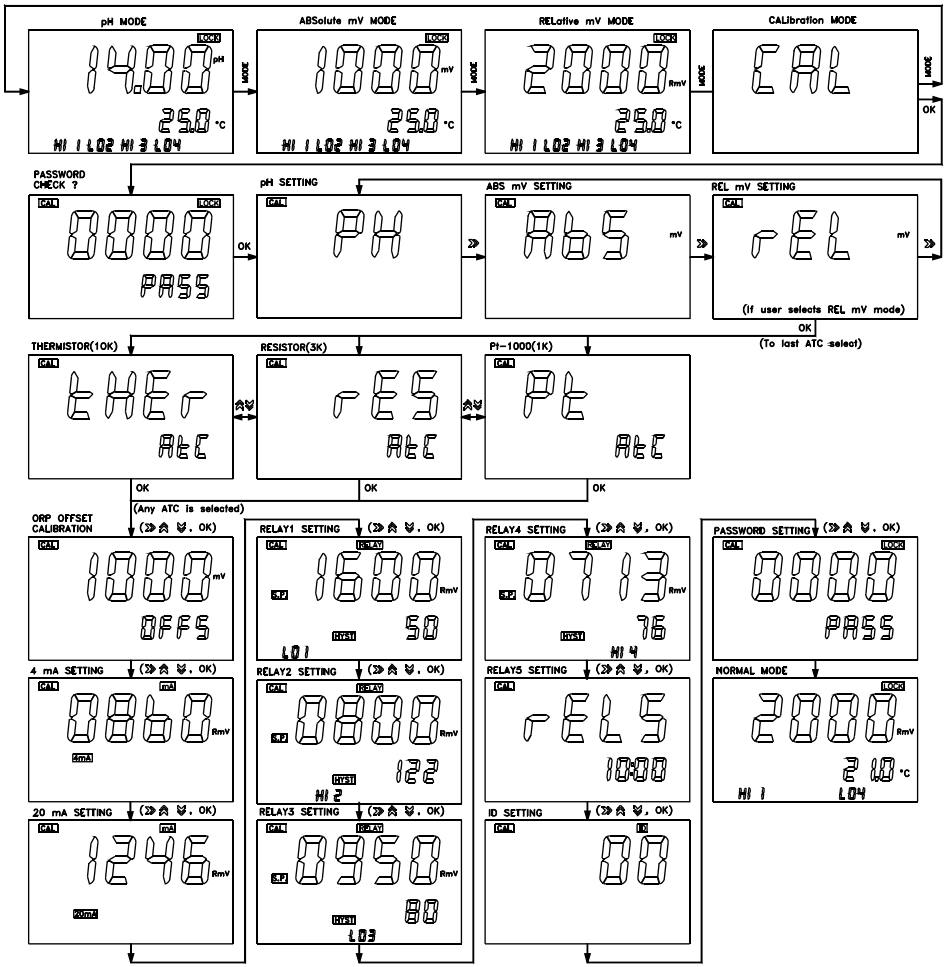
A. pH MODE



B. ABS mV MODE


pH MODE
ABSolute mV MODE
RELative mV MODE
CALibration MODE
MODE
OK
PASSWORD CHECK ?
pH SETTING
ABS mV SETTING
REL mV SETTING
(If user selects ABS mV mode)
(To last ATC select)
THERMISTOR(10K)
RESISTOR(3K)
Pt-1000(1K)
(Any ATC is selected)
4 mA SETTING
20 mA SETTING
RELAY1 SETTING
RELAY2 SETTING
RELAY3 SETTING
RELAY4 SETTING
RELAY5 SETTING
ID SETTING
PASSWORD SETTING
NORMAL MODE

C. REL mV MODE


pH MODE
ABSolute mV MODE
RELative mV MODE
CALibration MODE
MODE
OK
PASSWORD CHECK ?
pH SETTING
ABS mV SETTING
REL mV SETTING
(If user selects REL mV mode)
(To last ATC select)
THERMISTOR(10K)
RESISTOR(3K)
PT-1000(1K)
(Any ATC is selected)
ORP OFFSET CALIBRATION
RELAY1 SETTING
RELAY4 SETTING
PASSWORD SETTING
4 mA SETTING
RELAY2 SETTING
RELAY5 SETTING
NORMAL MODE
20 mA SETTING
RELAY3 SETTING
ID SETTING

AP210 Controller Relay Settings

pH Settings				
Relay	Name	Set Point	Force Direction	DeadBand
Relay 1	Acid	7.0 pH	High 1	0.1
Relay 2	Low Alarm	5.5 pH	Low 2	0.1
Relay 3	High Alarm	8.5 pH	High 3	0.1
Relay 4	Not Used	0.0 pH	Low 4	0

ORP Settings				
Relay	Name	Set Point	Force Direction	DeadBand
Relay 1	Chlorine	700 mV	Low 1	0.5
Relay 2	Low Alarm	500 mV	Low 2	0.5
Relay 3	High Alarm	900 mV	High 3	0.5
Relay 4	Not Used	0 mV	Low 4	0

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