PT: pH - Temperature

Technical

Safety

Safety

+/-1VDC maximum on field wiring terminals.
24 VDC maximum on internal card surfaces.

1. Installation

1.1 PT Services

The **PT**, pH-Temperature driver measures a pH sensor and a temperature using a platinum RTD.

The driver can be jumper configured to measure either 100 ohm or 1000 ohm RTDs. The controller detects the location of the RTD selection jumper on power up and auto-configures.

Up to three '**PT**' drivers may be installed in an M7 controller and up to seven '**PT**' drivers in an M14 controller.

Although most installations will use the **PT** driver temperature input to thermally compensate the pH input, the pH and temperature inputs of the **PT** driver may be also used independently to control pumps and solenoids.

1.2 Temperature Compensation of pH

Cooling Tower Applications

The amount of pH variation with temperature increases as the pH increases above pH 7 or decreases below pH 7. Cooling towers operating around pH 8 and over a narrow temperature range are seldom temperature compensated. The pH error due to temperature in cooling towers is nominally 0.1pH which does not justify the cost and complexity of pH temperature compensation.

Process Applications

Temperature changes the mV/pH response of the pH sensor. The following table shows how the response of the pH sensor varies with temperature and the error that temperature compensation of pH corrects.

The 8pH column is included to demonstrate the minimal effect temperature has in the 50-90F typical cooling tower application range.

Temperature	millivolts/pH	mV@ 4pH pH error	mV @ 7pH pH error	mV @ 8pH pH error	mV @ 10pH pH error
0C or 32F	-54.2	162.6mV 0.25pH	0mV 0pH	-54.2mV 0.08pH	-162.6mV 0.25pH
25C or 77F	-59.16	177.5mV	0mV	-59.2mV	-177.5mV
100C or 212F	-74.04	222.12 0.79pH	0mV 0pH	-74.04mV 0.25pH	-222.12 0.79pH

The mV/pH value is the controller pH sensor **GAIN**.
The controller's default pH sensor 25C **GAIN** is 0.017, nominally 1 / 59.16 mV/pH

When the pH sensor **Compensation** is set to **Temperature**, the controller adjusts the pH sensor **GAIN** based on the value measured at the selected Temperature sensor.

1.3 Controller Services

The controller provides services to calibrate the RTD temperature and to warn you of wiring & operational problems. The controller limits the range of temperatures that can be used for pH temperature compensation to limit operating problems on a defective or mis-calibrated RTD sensor.

1. Temperature compensation of pH can only be applied to pH sensors connected to pH input cards. 4-20mA inputs representing pH cannot be thermally compensated since these sensors are usually compensated at the pH to 4-20mA converter.

2. Compensating temperatures are only applied in the range of 0-100C, 0-212F. Out of range temperatures are not used for compensation. No thermal compensation of pH occurs.
   Set the **HIGH** & **LOW** alarms on the compensating thermal sensor to detect this fault.

3. Any temperature sensor, including the RTD sensor connected to the PT Driver card may be used to temperature compensate a pH sensor.

4. RTD calibration is limited to +/-20 degrees before a calibration error occurs. The warning may be overridden by the user.

5. The default RTD is 0.00385 ohm/ohm/C where the default GAIN = 1/0.00385 = 259.74. If you are using and RTD with a response other than 0.00385, use **SENSOR / CONFIGURE** to set the correct **GAIN**.

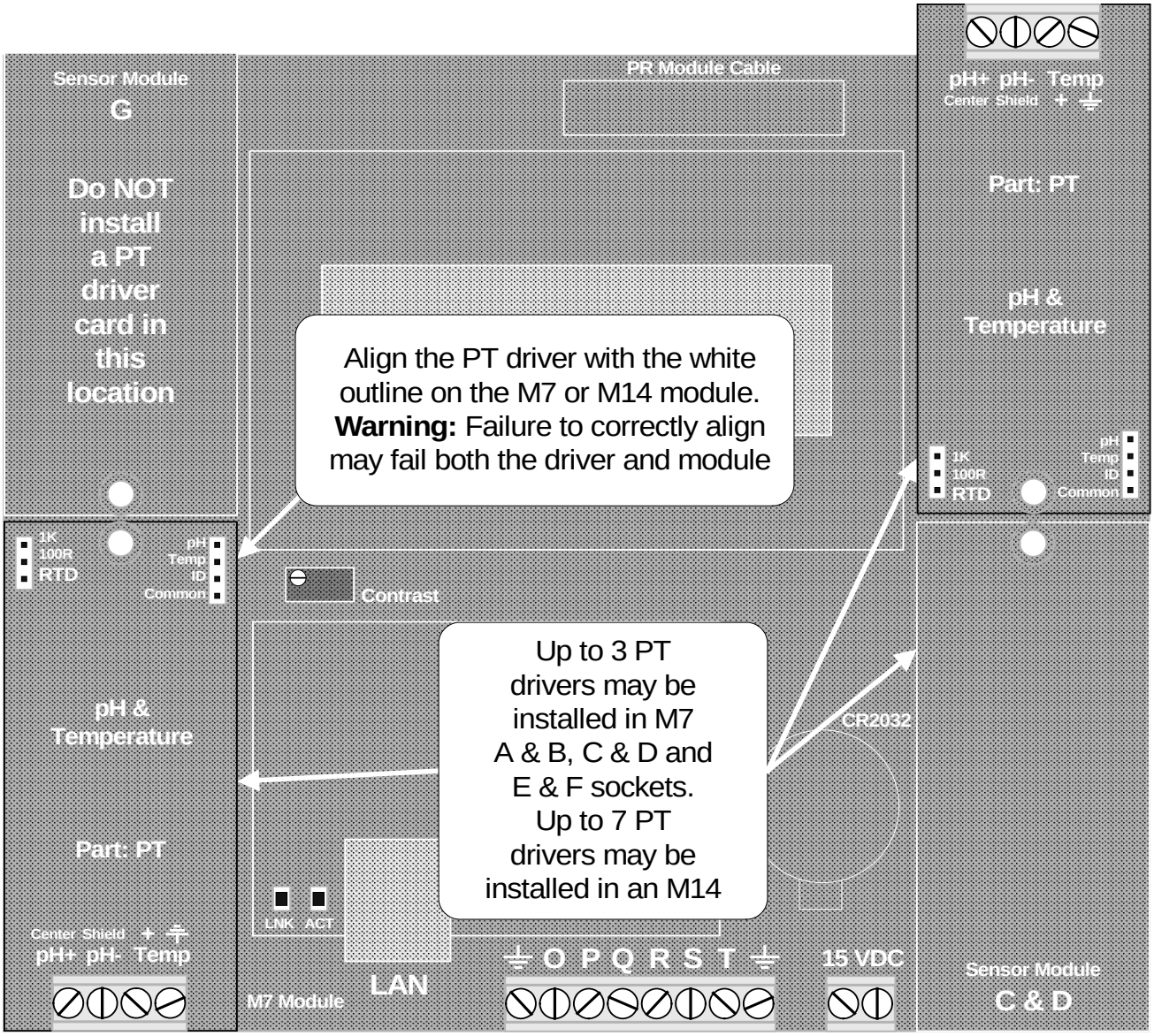
6. Disconnected RDT sensors will display –50C or –50F. When the controller measures an RTD voltage of less than 1000mV, it sets the RTD temperature to –50C or -50F.

7. When you select **SYSTEM / CONFIGURE / Metric Units**, the controller displays RTD temperatures in degrees C independent of the user set units for temperature.

8. Temperature compensation of a pH sensor can also be configured and monitored using the keypad and controller LCD display

1.4 Driver Card Installation

1. Enable both of the analog inputs at the driver socket location.
2. Turn OFF the controller AC power
3. **PT** drivers may be installed in any of the seven M14 controller slots and in any of the M7 slots with the exception of '**G**'.
4. Connect the pH and RTD sensors to the driver field wiring terminals.
5. Set the **PT** driver jumper to match the pH sensor RTD value, either 100 ohms or 1000 ohms. If you don't know the RTD value, measure the resistance between the two AWG24 sensor temperature wires.
6. Turn ON the controller after installing the **PT** Driver and the controller will auto-configure, displaying the installed sensor or sensors on the LCD display and browser.

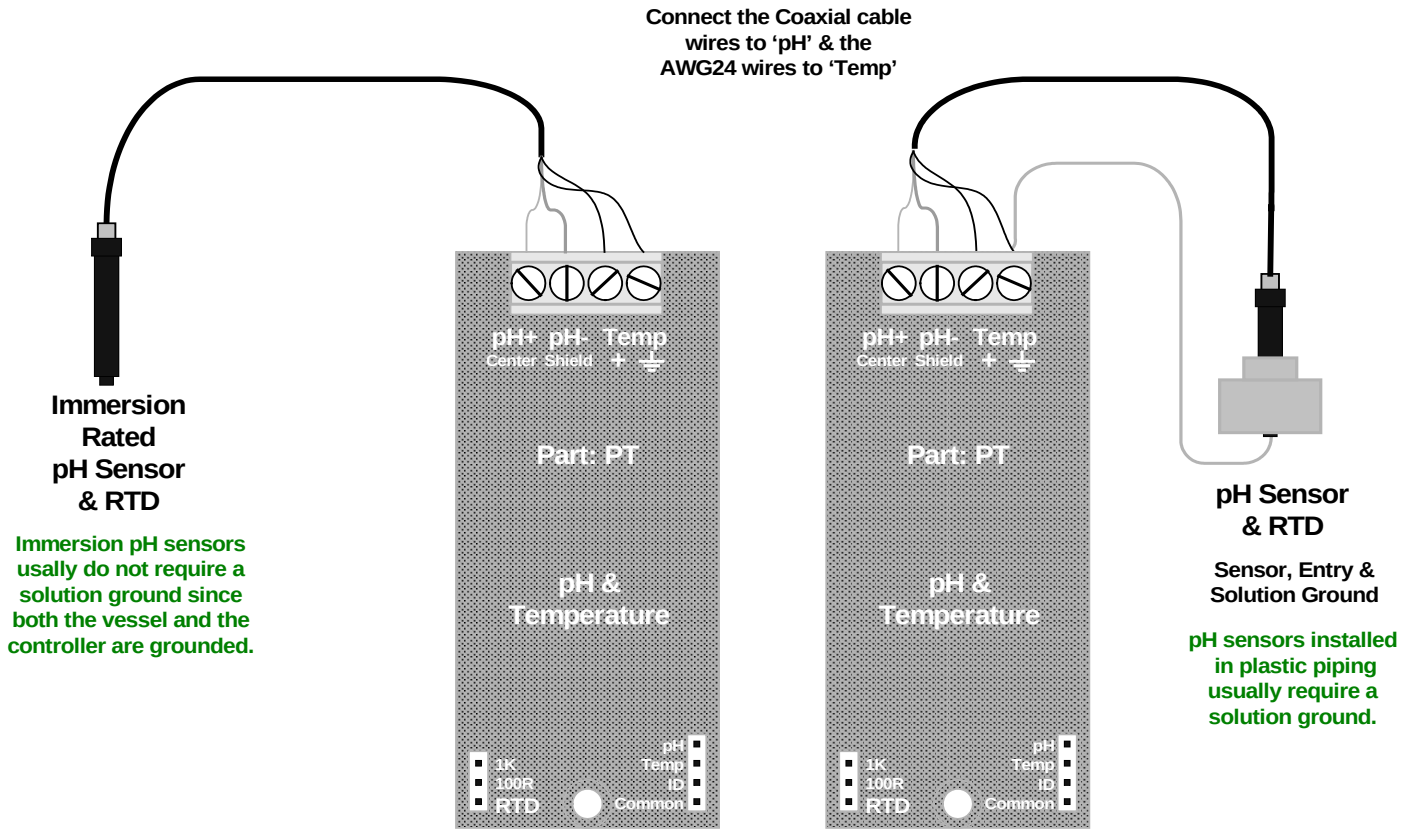


Note: The text on the bottom, left PT driver card has been altered to make it readable.
This text will be inverted in an actual controller.

1.5 pH Sensor Part Numbers

Aquatrac immersion rated pH sensor part numbers A261107, A261108 and A261109 include a thermal compensation RTD,
Generally, any pH sensor with a single coaxial cable and a 2 wire 100 ohm or 1000 ohm RTD may be used with the PT drivers.

1.6 Sensor Wiring



At temperatures below 75F / 25C, higher internal pH impedance limits a pH sensor's cabling to nominally 25ft or 10m.
At temperatures above 100F /40C in conductive process streams, pH sensor cabling may be extended to typically 50ft, 20m without using a sensor amplifier.

Do not install pH sensor cabling in the same conduit as AC power cabling.

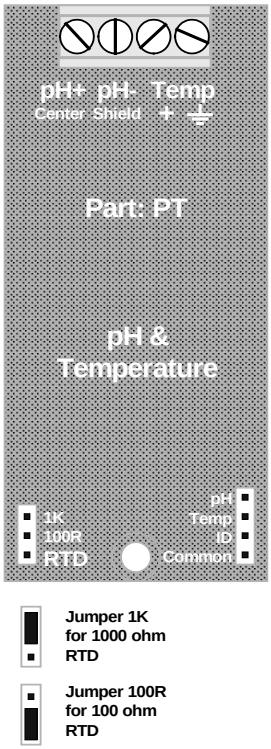
pH sensor cabling may share a common conduit with other sensors, water meter and contact set cabling.
Solution grounds are single conductor AWG18-22 / 0.25-0.75 mm^2.

Warning:
Turn OFF the controller before connecting or disconnecting pH sensors & selecting RTD.

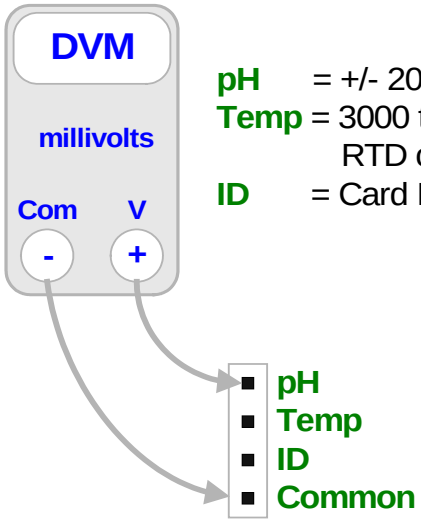
2. Configuration - Operation

2.1 RTD Selection

Changing the Selected RTD Set:
Turn controller OFF before changing the RTD selection jumper.
Controllers check the RTD selection jumper on power up, auto-configuring the temperature measurement.



2.2 Driver Test Header



pH = +/- 200mV, Sensor millivolts
Temp = 3000 to 4000mV
RTD current + RTD drive
ID = Card ID Level, 1850mV

3.0 Diagnostics

3.1 pH Input

Parameter	LCD Display	Browser	Value : Use
Sensor Location		OK	A: Installation slot. LCD displays slot letter on screen.
Input Card Type	OK	OK	pH Sensor: verifies driver card type
Current State	OK	OK	Operational / Alarmed:
Displayed Value	OK	OK	8.12 pH: Current measured pH, display user set units, 'pH' default. Displayed with user set resolution
Period Maximum		OK	8.15 pH: Data from current log interval. Used to assess controls.
Period Minimum		OK	8.05 pH:
Period Average		OK	8.10 pH:
Sample Size		OK	122: Samples in Period Max. Min. & Average
Current Period		OK	18 minutes: Elapsed time in current log period
Log Period		OK	15 minutes: User set log period 5 to 1440 minutes
Compensation	OK	OK	None or Thermal Compen.
Measured Level	OK	OK	62.3 mV: Raw sensor level in mV, before Gain & Offset after ID Level correction.
Gain Multiplier	OK	OK	0.0170: User set Gain
Default Gain	OK	OK	0.0170: Factory default Gain, 59mV/pH Gain selected by Input Card ID
Offset Adjust	OK	OK	7.2361: Offset. Calibration adjusts Offset. Displayed Value = Measured Level x Gain Multiplier + Offset Adjust
Default Offset	OK	OK	7.0000: Factory default Offset. Offset selected by Input Card ID
Input Card ID	OK	OK	1854 mV: PT driver Design level = 1850 mV. **Note:** The ID level identifies this pH input as a PT driver. pH-ORP driver only cards have lower Input Card IDs

Sensor Type	Default Gain	Calibration Offset Span	Default Offset
PH	0.017	6 – 8	7

Calibration: A calculated offset outside of the Calibration Offset Span requires a user selected Override to complete calibration.

Driver Verification Test:
Connect a pH sensor, center conductor to pH+ and shield to pH-. Immerse sensor into pH10 buffer and connect a solution ground wire with an exposed wire end immersed in the buffer.
Measured Level = +170mV +/-25mV

3.2 Temperature Input

Parameter	LCD Display	Browser	Value : Use
Sensor Location		OK	B: Installation slot. LCD displays slot letter on screen.
Input Card Type	OK	OK	100 ohm RTD OR 1000 ohm RTD : verifies driver card type
Current State	OK	OK	Operational / Alarmed:
Displayed Value	OK	OK	128F: Current measured temperature, display user set units, 'F' OR 'C" if 'Metric' selected default. Displayed with user set resolution
Period Maximum		OK	132 F: Data from current log interval. Used to assess controls.
Period Minimum		OK	126 F:
Period Average		OK	129 F:
Sample Size		OK	186: Samples in Period Max. Min. & Average
Current Period		OK	38 minutes: Elapsed time in current log period
Log Period		OK	60 minutes: User set log period 5 to 1440 minutes, Default 60
Compensation	OK	OK	None. **Note:** Do not apply any type of Compensation to a thermal sensor use to compensate a pH sensor
Measured Level	OK	OK	3126 mV: Raw sensor level in mV, before Gain & Offset after ID Level correction.
Gain Multiplier	OK	OK	259.74: User set Gain. Do not change this value unless you have changed the RTD type.
Default Gain	OK	OK	259.74: Factory default Gain, = 1/ 0.00385 ohm / ohm /c
Offset Adjust	OK	OK	-4.012: Offset. Calibration adjusts Offset. Displayed Value = (Measured Level x Gain Multiplier & RTD to temperature conversion) + Offset Adjust
Default Offset	OK	OK	0.0000: Factory default Offset. Offset selected by Input Card ID
Input Card ID	OK	OK	100 ohm RTD = 43 mV RTD drive measurement level 1000 ohm RTD = 327 mV

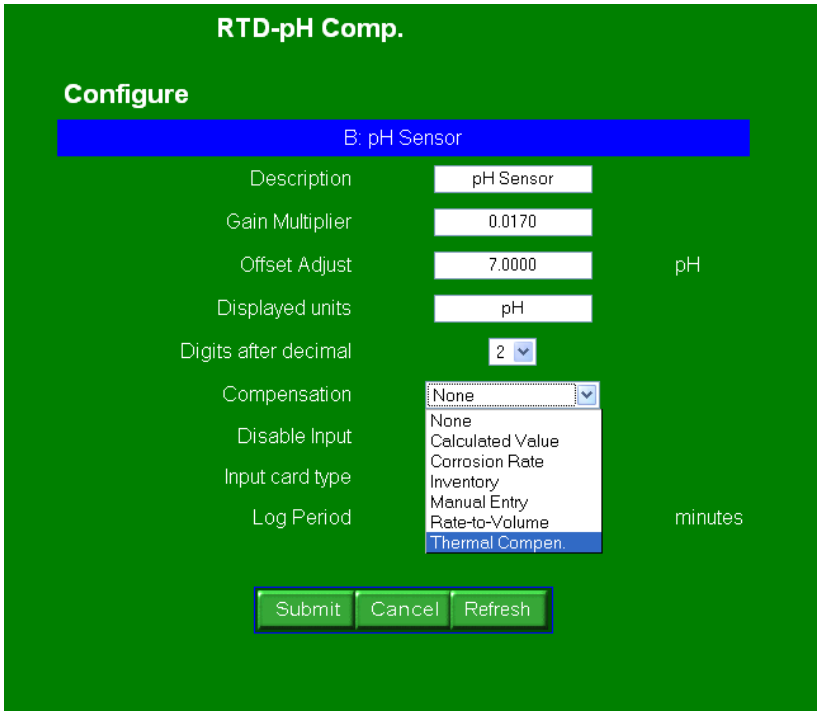
Sensor Type	Default Gain	Calibration Offset Span	Default Offset
RTD	259.74	+20 to -20	0

Calibration: A calculated offset outside of the Calibration Offset Span requires a user selected Override to complete calibration.

4.0 Browser pH Thermal Compensation Set-up

Select **Sensor / Configure** for the pH sensor that you wish to Temperature Compensate.

Pull down the **Compensation** selection list & select **Thermal Compensation** & **Submit**

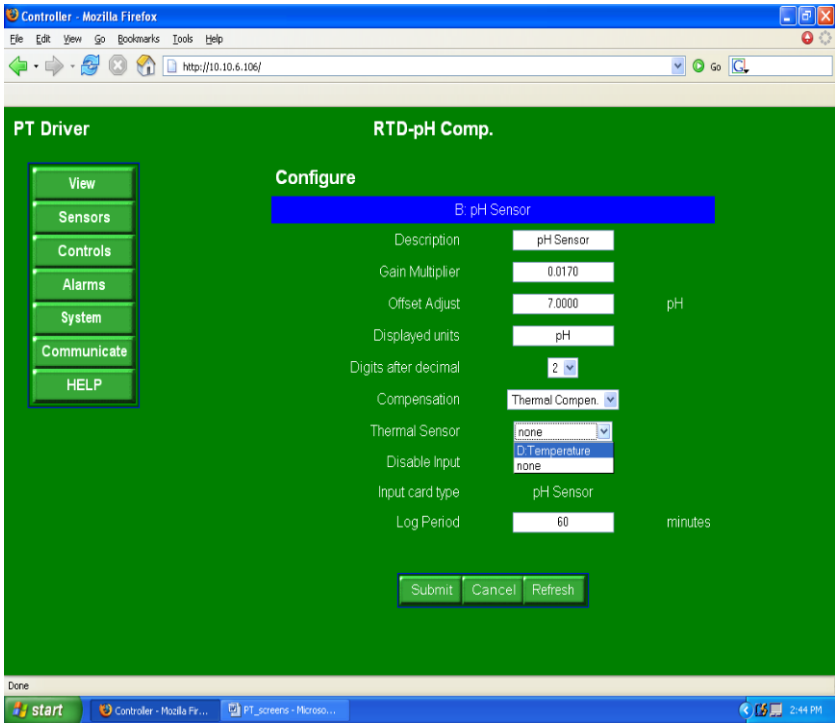


Select the **Thermal Sensor** that you wish to use for pH Temperature Compensation.

The pull down list will display all of the installed thermal sensors.

The RTD sensor is always the next letter after the pH sensor connected to the PT driver card.

For Example: A PT driver card installed at location **C-D** will have the pH sensor at input '**C**' and the RTD at input '**D**'.

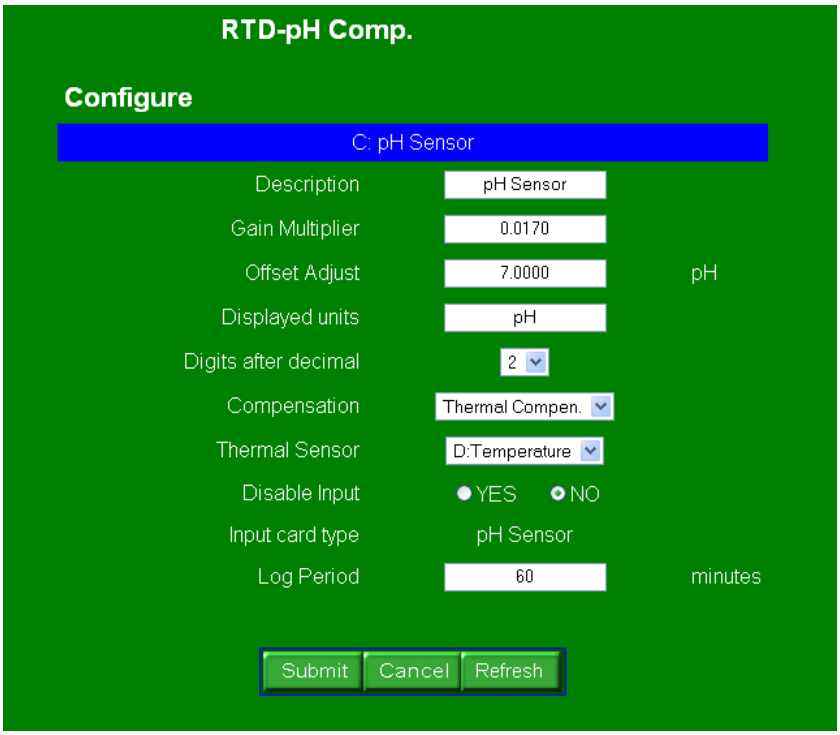


4.0 Browser pH Thermal Compensation Set-up continued

Sensor '**C**' is now temperature compensated by the thermal sensor located at input '**D**'.

Do not modify the factory default **Gain Multiplier**. This value is adjusted by the controller to provide pH temperature compensation

Offset Adjust will vary as you single point calibrate the pH sensor, typically between 6.0 and 8.0.



5.0 Specifications

Function		Notes
Input Range	0-14 pH 100 ohm or 1000 ohm Platinum RTD.	Defaults to 0.00385 ohm/ohm/C RTD, Resistive Thermal Device
Resolution	pH: 0.01 pH Temperature: 0.1C or 0.05F	User controls pH and temperature displayed resolution from 0 to 3 digits after the decimal point.
Accuracy	+/- 0.05F/C +/- 0.02pH	Requires installed solution ground for non-immersion pH sensors.
pH Input Impedance	> 500 MOhm	Fully differential. 20M ohm power OFF input resistance

Notes:

1. Accuracy stated after sensor calibration.