

Congratulations !

You have purchased the latest in Handheld, Waterproof pH-mV-Temperature instrumentation. We trust that your new **Aqua-pH** will give you many years of reliable service.

The **Aqua-pH** is a breeze to operate. This manual has been designed to help you get started, and also contains some handy application tips. If at any stage you require assistance, please contact either your local TPS representative or the TPS factory in Brisbane.

The manual is divided into the following sections:

1. **Table of Contents**

Each major section of the handbook is clearly listed. Sub-sections have also been included to enable you to find the information you need at a glance.

2. **Introduction**

The introduction has a diagram and explanation of the display and controls of the **Aqua-pH**. It also contains a full listing of all of the items that you should have received with your **Aqua-pH**. Please take the time to read this section, as it explains some of items that are mentioned in subsequent sections.

3. **Main Section**

The main section of the handbook provides complete details of the **Aqua-pH**, including operating modes, calibration, troubleshooting, specifications, and warranty terms.

4. **Appendices**

Appendices containing background information and application notes are provided at the back of this manual.

**Model Aqua-pH
pH-mV-Temp. Meter**

Version : 2.2

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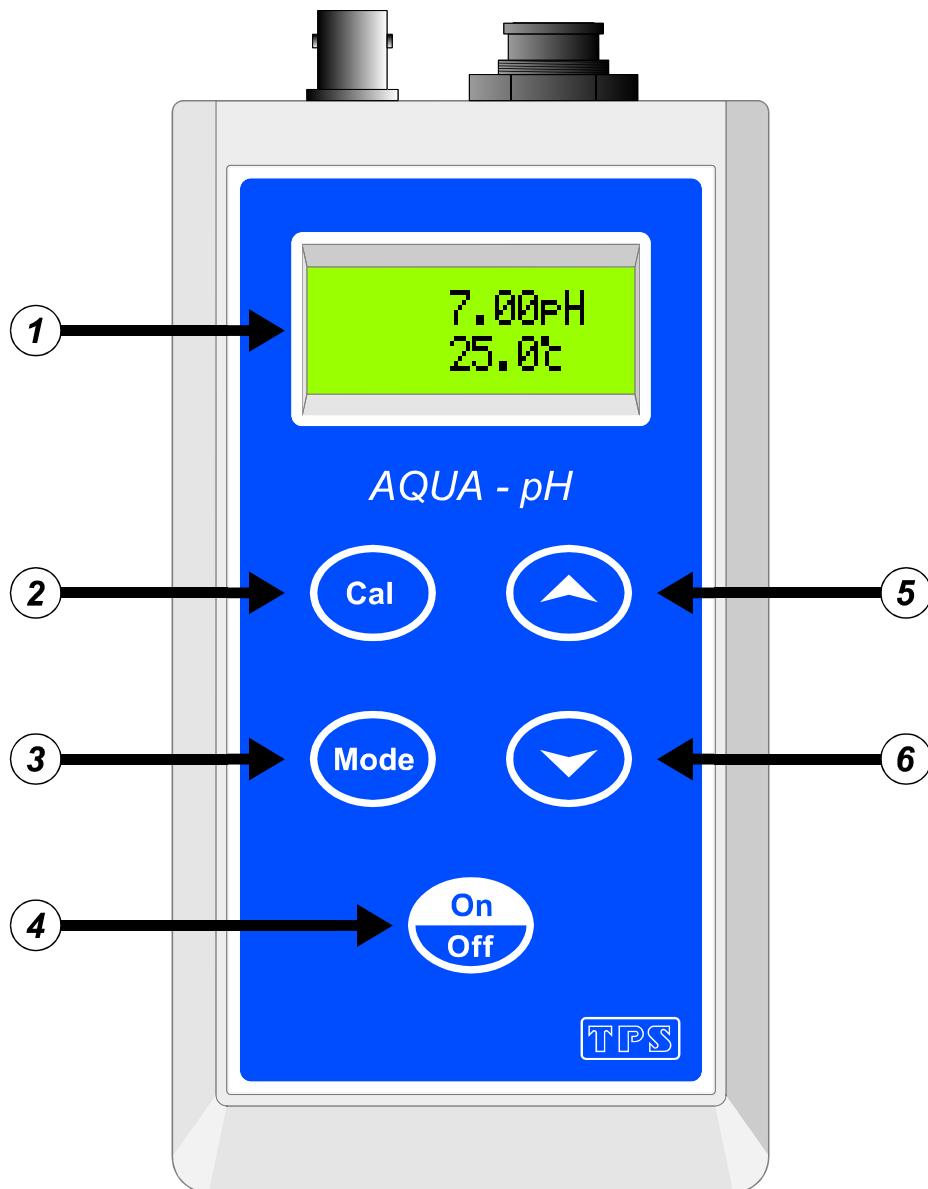
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1. Introduction

1.1 Aqua-pH Display and Controls



① **Display**

24 character alpha-numeric display. Can show any of the following combinations readouts simultaneously (see section 2).

pH + Temperature	Millivolts + Temperature	Temperature only
------------------	--------------------------	------------------

A unique “Large Digit” mode nearly doubles the size of the digits (section 2).

User-friendly prompts and error messages are also provided.

② 

Used to calibrate all parameters. See sections 3 and 5.

Also used to select buffers for automatic buffer recognition. See section 6.

③ 

Used to select pH, mV or Temperature modes. See section 2.

④ 

Switches the **Aqua-pH** on and off.

Hold this key for 3 seconds to invoke Battery Saver mode. See section 7.

⑤  and ⑥ 

These keys toggle the **Aqua-pH** between Large Display mode and Dual Display mode. See section 2.

NOTE: The digits in Large Display mode are made by combining the two rows of the display. This results in a small gap approximately half way up the digits.

1.2 Unpacking Information

Before using your new **Aqua-pH**, please check that the following accessories have been included:

	Part No
1. Aqua-pH pH-mV-Temperature Instrument.....	121112
2. pH Sensor, Porous Teflon Double Junction, 1m	121207
3. Temperature Sensor, Stainless Steel , 1m.....	121247
4. pH7.00 Buffer, 200mL	121387
5. pH4.01 Buffer, 200mL	121381
6. 9V Battery.....	130026
7. Aqua-pH Handbook	130050

Options that may have been ordered with your **Aqua-pH**:

1. Aluminium Carry Case	130057
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1.3 Specifications

	Ranges	Resolution	Accuracy
pH	0 to 14.00 pH	0.01 pH	±0.01 pH
mV	0 to ±1500 mV	1 mV	±1 mV
Temperature	-10.0 to 120.0 °C	0.1 °C	±0.2 °C

Additional pH Specifications

Temperature Compensation.....Automatic, 0 to 50.0 °C
 pH Input Impedance>3 x 10¹² Ω
 pH Asymmetry Range-1.00 to 1.00 pH
 pH Slope Range85.0 to 105.0%
 Auto pH Buffer Recognition.....pH4.01, pH6.86, pH7.00 pH9.18,
 pH10.01


Additional Temperature Specifications



Temperature Sensor Offset Range-10.0°C to +10.0°C

General Specifications



Display.....24 Character alphanumeric LCD,
 with full text prompts and error
 messages.
 Power9V Alkaline Battery for 100+ hours
 operation.
 Battery Saver.....On : Auto switch-off after 5
 minutes
 Off : Continuous use
 Dimensions.....157 x 78 x 35 mm
 MassInstrument only : Approx 200g
 Full Kit : Approx 1.5kg
 EnvironmentTemperature : 0 to 45 °C
 Humidity : 0 to 90 % R.H.


2. Operating Modes



Press the  key to select the desired operating mode. The sequence is shown in the following table...

pH Mode	7.00pH 25.0°C
<p>pH data is shown on the top line and Temperature data is shown on the bottom line.</p> <p>The Temperature reading is shown with an “M” if the Temperature sensor is unplugged and manual Temperature compensation is being used.</p> <p>Select this mode to calibrate pH.</p> <p>Press  or  to toggle between dual readout or large digit readout.</p>	

↓ 

mV Mode	1000mV 25.0°C
<p>mV data is shown on the top line and Temperature data is shown on the bottom line.</p> <p>No Temperature data is shown if the Temperature sensor is unplugged, as manual Temperature compensation is not applicable to mV.</p> <p>Calibration is not available in this mode.</p> <p>Press  or  to toggle between dual readout or large digit readout.</p>	

↓ 

Temperature Mode	25.0°C
<p>Temperature data only is shown on the top line.</p> <p>Select this mode to calibrate Temperature.</p> <p>Press  or  to toggle between regular readout or large digit readout.</p>	

↓ 

Back to pH mode

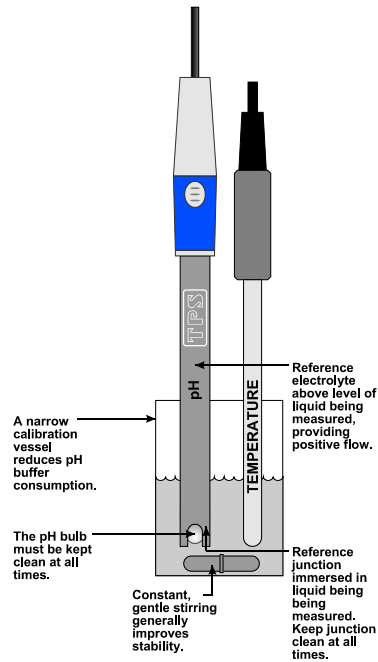
Note: The decimal point is replaced by a “*” if a pH or Temperature calibration has failed (see sections 3 and 5), if the unit is initialised (see section 8), or if the unit has lost its factory calibration (see section 9.1).

3. pH Calibration


A “ * ” in place of the decimal point indicates that the pH readout is not calibrated, or a past calibration has failed. The “ * ” will be removed once a full two-point pH calibration has been successfully performed.

3.1 Calibration


1. Switch the **Aqua-pH** on.
2. Select pH Mode (see section 2).
3. Plug the pH sensor into the BNC socket (this is the metal socket). For automatic temperature compensation, plug the Temperature sensor into the Temperature socket (this is the 6-pin plastic socket). If the Temperature sensor is not connected, then the **Aqua-pH** will use manual temperature compensation.
4. Ensure that temperature has already been calibrated, or manually set (see sections 5.1 and 5.4). NOTE: If the decimal point in the temperature reading is replaced by a “ * “, then the temperature readout is not calibrated.
5. Remove the wetting cap from the pH sensor.
6. Rinse the pH and Temperature sensors in distilled water and blot them dry.
7. Ensure that you are using the buffers which have been selected for automatic buffer recognition. See section 6 for a detailed explanation.
8. Place both sensors into a small sample of pH7.00 (or pH6.86) buffer, so that the bulb and reference junction are both covered. See the diagram over the page.



DO NOT place the sensors directly into the buffer bottle. Discard the used buffer after use.

9. When the reading has stabilised, press and hold the  key for 2 seconds to calibrate. If a 1 point calibration has been performed, a “*“ will not be removed until a full 2 point calibration has been performed.
10. Rinse the pH and Temperature sensors in distilled water and blot them dry.
11. Place both sensors into a small sample of pH4.01, pH9.18 or pH10.01 Buffer, so that the bulb and reference junction are both covered, as per the diagram in step 8. **DO NOT** place the sensors directly into the buffer bottle. Discard the used buffer after use.

pH9.18 and pH10.01 buffers are unstable once the bottles have been opened. Discard immediately after use.

12. When the reading has stabilised, press and hold the  key for 2 seconds to calibrate. The “ * “ will now be replaced by a decimal point, if calibration was successful.
13. The **Aqua-pH** is calibrated for pH and is ready for use in this mode.

3.2 pH Calibration Notes

1. A 1-point calibration should be performed at least weekly. In applications where the sensor junction can become blocked, such as dairy products, mining slurries etc, a 1-point calibration may have to be done daily.
2. A full 2-point calibration should be performed at least monthly. Of course, more frequent calibration will result in greater confidence in results.
3. All calibration information is retained in memory when the **Aqua-pH** is switched off, even when the battery is removed.
4. The **Aqua-pH** displays the value of the pH buffer that it has attempted to recognise at calibration. Ensure that the buffer value displayed corresponds to the buffer that you are using.

3.3 pH Calibration Messages

1. If a 1-point calibration has been successfully performed, the **Aqua-pH** will display the following message, and then display the asymmetry and slope of the sensor. If the meter has not been calibrated at two points at this stage, the slope is set to 100.0%.

1 point 7.00
Cal. OK

then:

Asym= 0.10pH
Slope=100.0%

2. If a 1-point calibration has failed, the **Aqua-pH** will display the following message, then the failed asymmetry value of the sensor.

1 point 7.00
Cal. Failed

then:

Asym= 1.50pH

3. If a 2-point calibration has been successfully performed, the **Aqua-pH** will display the following message, and then the asymmetry and slope of the sensor.

2 point 4.01
Cal. OK

then:

Asym= 0.10pH
Slope= 99.5%

4. If a 2-point calibration has failed, the **Aqua-pH** will display the following message, and then the failed slope value of the sensor.

2 point 4.01
Cal. Failed

then:

Slope= 70.0%


4. Millivolt Calibration

The mV section is factory calibrated. There is no user-calibration facility for this mode.





5. Temperature Calibration

A “ * ” in place of the decimal point indicates that the Temperature readout is not calibrated, or a past calibration has failed. The “ * ” will be removed once Temperature has been successfully calibrated.

5.1 Calibration

1. Switch the **Aqua-pH** on.
2. Select Temperature mode (see section 2).
3. Plug the Temperature sensor into the Temperature socket (this is the 6-pin plastic socket). If the Temperature sensor is not connected, then the **Aqua-pH** will use manual temperature compensation. In this case, refer to section 5.4 for details on setting manual temperature compensation values.
4. Place the sensor into a beaker of room temperature water, alongside a good quality mercury thermometer. Stir the sensor and the thermometer gently to ensure an even temperature throughout the beaker.
5. When the reading has stabilised, press and hold the  key for 2 seconds.
6. The reading from the sensor is now displayed on the top line, and the value you are going to set is on the bottom line. For example...

Enter	25.0°C
Temp	↑ 26.0 ↓

7. Press the  and  keys until the bottom line shows the same temperature as the mercury thermometer.
8. Press the  key to calibrate the temperature readout.
Alternatively, press the  key to abort temperature calibration.

5.2 Calibration Notes

1. Temperature calibration information is stored in memory when the meter is switched off, even if the battery is removed.
2. Temperature does not need to be re-calibrated unless the Temperature sensor is replaced or the meter is initialised.

5.3 Calibration Messages

1. If a temperature calibration has been successfully performed, the **Aqua-pH** will display the offset value of the sensor. For example...

```
Cal. OK  
Offset=1.0°C
```

2. If a temperature calibration has failed, the **Aqua-pH** will display the failed offset value of the sensor.

```
Cal. Failed  
Offset=10.5°C
```

5.4 Manual Temperature Setting



1. Switch the **Aqua-pH** on.
2. Select Temperature mode (see section 2).
3. Manual temperature setting is only available if the Temperature sensor is not connected.
4. Press and hold the Cal key for 2 seconds. The current Manual Temperature Setting is now displayed, for example...

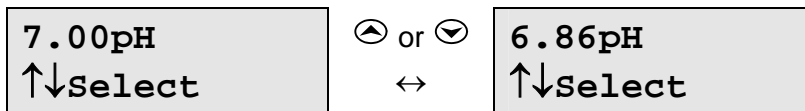
```
Enter Man.  
Temp ↑ 25.0 ↓
```




5. Press the ▲ and ▼ keys until the bottom line shows the temperature which you wish to set. This value should be the same as the temperature of the solution you are measuring.
6. Press the Cal key to set the temperature.

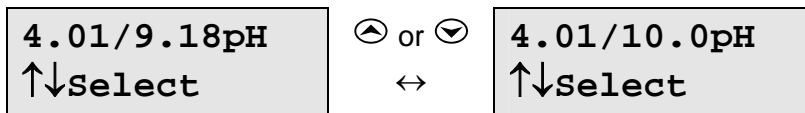
6. Selecting Buffers for Auto Buffer Recognition




The **Aqua-pH** is factory set to automatically recognise pH4.01, pH7.00 and pH9.18 buffers. However, some users may prefer to use pH6.86 instead of pH7.00 and pH10.01 instead of pH9.18. The following procedure describes how to set which of these buffers are automatically recognised at calibration.

1. Switch the meter **OFF**.
2. Press and HOLD the  key while switching the meter back on.
3. Release the  key when the message, "**Buffer 1 Select**" is displayed.
4. The display will now show the currently selected primary buffer, for example...



5. Use the  or  keys to alternate between pH7.00 and pH6.86 buffers.
6. Press the  key to save the primary buffer.
7. After the message, "**Buffer 2 Select**", the display will now show the currently selected secondary pH buffers, for example...




8. Use the  or  keys to alternate between pH9.18 and pH10.01 buffers (the display shows pH10.0 for the latter but this buffer is stored as pH10.01).
9. Press the  key to save the secondary pH buffers.
10. The buffer recognition setting is kept in memory when the meter is switched off, even if the battery is removed.

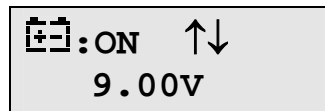
7. Battery



7.1 Battery Saver Function



The **Aqua-pH** is equipped with a battery saver function. If no button has been pressed for five minutes, the unit beeps and flashes the display for 20 seconds, and then shuts off. This function can be disabled for continuous use.

To enable or disable the battery saver function:

1. Switch the **Aqua-pH** on.
2. With the meter already switched on, press and HOLD the  key for 3 seconds.
3. The battery saver menu is now displayed. For example...

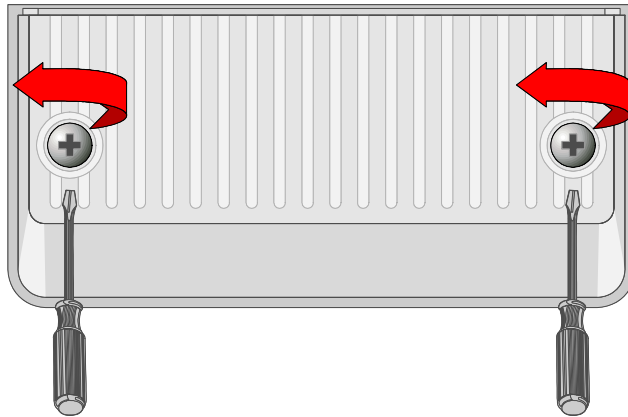


4. In this mode, use the  or  keys to toggle the battery saver function on or off.
 - ON** enables the battery saver function. The unit will turn itself off after 5 minutes.
 - OFF** disables the battery saver function. The unit will not switch itself off.

NOTE: The display also shows the battery volts. This gives the operator an idea of how much battery life is remaining. The  symbol flashes when the battery volts drops below 7.50 volts. At 6.00 volts the meter turns itself off.
5. When you have set the battery saver function to the desired position, press the  key to return to normal measurement mode.

7.2 Changing the Battery

1. Turn the instrument over and locate the 2 battery cover screws on the rear. See the diagram below.




2. Raise the fold out stand (so it is out of the way) and then fully loosen both screws. It is not necessary to pull the screws all the way out. Lift off the battery cover.
3. Replace the battery with a new alkaline 9V battery.
4. Re-fit the battery cover and tighten the screws. **Do not over-tighten.**

8. Initialising the Aqua-pH

If the calibration settings of the **Aqua-pH** exceed the allowable limits, and the unit cannot be re-calibrated, then it may need to be initialised to factory default values. This action may be required if a sensor is replaced.

To initialise the **Aqua-pH**...

1. Switch the **Aqua-pH** off.
2. Press AND HOLD the  key while switching the **Aqua-pH** on.
3. The following messages are now displayed...

Memory & Cal
Reset !



You MUST
Re-Calibrate




TPS AQUA-P
V1.0 S1234

4. The meter then displays pH and Temperature. Note that the decimal points have been replaced with a “ * “, to indicate that the unit requires re-calibration.

9. Troubleshooting

9.1 General Error Messages

Error Message	Possible Causes	Remedy
Factory Cal. Fail See Handbook	The EEPROM chip which contains the factory calibration information has failed.	The unit must be returned to TPS for service.
Memory Failed Calib. Lost Memory Reset ! You MUST Re-Cal.	User calibration settings have been lost or corrupted.	Re-calibrate the instrument. A 2 point calibration is required for pH (section 3) and a 1 point calibration for temperature (section 5).
Meter displays the word OFF , and switches off.	Battery is below 6.00 volts.	Replace the battery.
Meter will not turn on.	Battery is exhausted.	Replace the battery.
Flashing  symbol.	Battery is below 7.50 volts.	Replace the battery soon. Note that the unit will switch itself off when the battery falls below 6.00 volts.

9.2 pH and mV Troubleshooting

Symptom	Possible Causes	Remedy
Unit fails to calibrate, even with new sensor.	Calibration settings outside of allowable limits due to previous failed calibration.	Initialise the unit. See section 8.
1 Point calibration fails (Asymmetry is greater than +/- 1.00 pH).	<ol style="list-style-type: none"> Reference junction blocked. Reference electrolyte contaminated. 	<p>Clean reference junction, as per instructions supplied with the sensor.</p> <p>Flush with distilled water and replace electrolyte.</p>
2 Point calibration fails (Slope is less than 85.0%).	<ol style="list-style-type: none"> Incorrect primary buffer. Glass bulb not clean. Sensor is aged. Connector is damp. Buffers are inaccurate. 	<p>Ensure that you are using the buffers which the Aqua-pH has been set to automatically recognise (See section 6).</p> <p>Clean glass bulb as per instructions supplied with the sensor.</p> <p>Attempt rejuvenation, as per instructions supplied with the sensor. If not successful, replace sensor.</p> <p>Dry in a warm place.</p> <p>Replace buffers.</p>

Continued over the page...

pH and mV Troubleshooting, continued...

Unstable readings.	<ol style="list-style-type: none"> 1. Reference junction blocked. 2. Glass bulb not clean. 3. Bubble in glass bulb. 4. Faulty connection to meter. 5. Reference junction not immersed. 6. KCl crystals around reference junction, inside the electrolyte chamber. 	<p>Clean reference junction, as per instructions supplied with the sensor.</p> <p>Clean glass bulb as per instructions supplied with the sensor.</p> <p>Flick the sensor to remove bubble.</p> <p>Check connectors. Replace if necessary.</p> <p>Ensure that the bulb AND the reference junction are fully immersed.</p> <p>Rinse electrolyte chamber with warm distilled water until dissolved. Replace electrolyte.</p>
Inaccurate readings, even when calibration is successful.	Reference junction blocked.	Clean reference junction, as per instructions supplied with the sensor.
Displays 7.00 for all solutions.	Electrical short in connector.	<ol style="list-style-type: none"> 1. Check connector. Replace if necessary. 2. Replace sensor.
Displays 4-5 pH for all solutions.	Glass bulb or internal stem cracked.	Replace sensor.

9.3 Temperature Troubleshooting

Symptom	Possible Causes	Remedy
Displays "OVR°C" when sensor is plugged in.	<ol style="list-style-type: none"> 1. Faulty sensor. 2. Faulty instrument. 	<p>Fit new sensor, part number 121247.</p> <p>Return instrument to factory for repair.</p>
Temperature inaccurate and cannot be calibrated.	<ol style="list-style-type: none"> 1. Faulty connector. 2. Faulty sensor. 3. Faulty instrument. 	<p>Check the connector and replace if necessary.</p> <p>Fit new sensor, part number 121247.</p> <p>Return instrument to factory for repair.</p>

10. Appendices

10.1 pH Sensor Fundamentals

A combination pH sensor is two sensors in one. The sensing membrane is the round or spear shaped bulb at the tip of the sensor. This produces a voltage that changes with the pH of the solution. This voltage is measured with respect to the second part of the sensor, the reference section. The reference section makes contact with the sample solution using a salt bridge, which is referred to as the reference junction. A saturated solution of KCl is used to make contact with the sample. It is vital that the KCl solution has an adequate flow rate in order to obtain stable, accurate pH measurements.

10.1.1 Asymmetry of a pH Sensor

An "ideal" pH sensor produces 0 mV output at 7.00 pH. In practice, pH sensors generally produce 0 mV output at slightly above or below 7.00 pH. The amount of variance from 7.00 pH is called the asymmetry. Figure 10-1 illustrates how asymmetry is expressed.

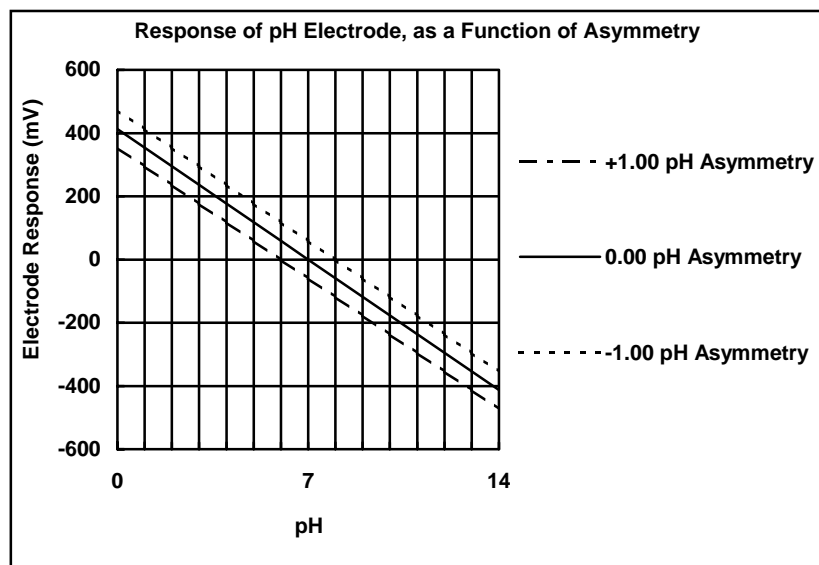


Figure 10-1

10.1.2 The Slope of a pH Sensor

As mentioned above, a pH sensor produces 0 mV output at around 7.00 pH. As the pH goes up, an “ideal” pH sensor produces -59mV/pH unit at 25 °C. As the pH goes down, an ideal pH sensor produces +59mV/pH unit. In practice, pH sensors usually produce slightly less than this. The output of a pH sensor is expressed as a percentage of an ideal sensor. For example, an ideal sensor that produces 59mV/pH unit has “100% Slope”. An sensor that produces 50.15mV/pH unit has “85% Slope” (see Figure 10-2).

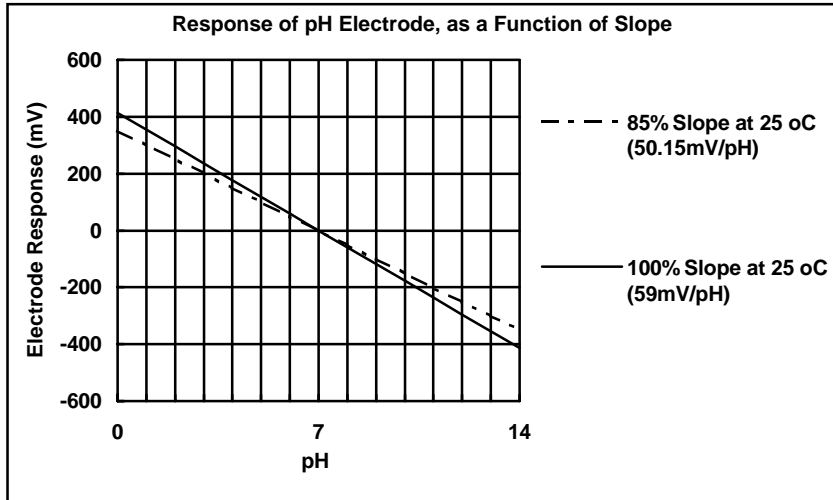
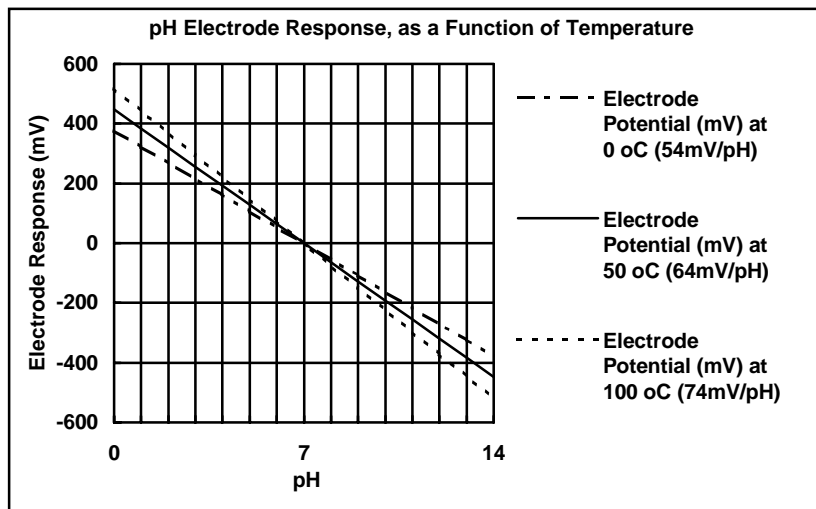


Figure 10-2

10.1.3 Temperature Compensation

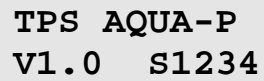
The slope of a pH sensor (section 10.1.2) is affected by temperature. This effect is compensated for either by using an Automatic Temperature Compensation (ATC) sensor or by entering the sample temperature manually. Figure 10-3 shows the slope of a pH sensor at various temperatures.



10.2 Instrument software version number.

If you need to phone or fax TPS for any further technical assistance, the version number of your **Aqua-pH** firmware may of benefit to us. Please obtain the version number before phoning or faxing.

The version number is displayed on the bottom left of the display when the **Aqua-pH** is switched on. For example...



TPS AQUA-P
V1.0 S1234

“v1.0” in this example is the firmware version number.

“s1234” in this example is the instrument’s serial number.

11. Warranty

TPS Pty. Ltd. guarantees all instruments and sensors to be free from defects in material and workmanship when subjected to normal use and service. This guarantee is expressly limited to the servicing and/or adjustment of an instrument returned to the Factory, or Authorised Service Station, freight prepaid, within twelve (12) months from the date of delivery, and to the repairing, replacing, or adjusting of parts which upon inspection are found to be defective. Warranty period on sensors is three (3) months.

There are no express or implied warranties which extend beyond the face hereof, and TPS Pty. Ltd. is not liable for any incidental or consequential damages arising from the use or misuse of this equipment, or from interpretation of information derived from the equipment.

Shipping damage is not covered by this warranty.

Please note

A guarantee card is packed with the instrument or sensor. This card must be completed at the time of purchase and the registration section returned to TPS Pty. Ltd. within 7 days. No claims will be recognised without the original guarantee card or other proof of purchase. This warranty becomes invalid if modifications or repairs are attempted by unauthorised persons, or the serial number is missing.

Procedure for service

If you feel that this equipment is in need of repair, please re-read the manual. Sometimes, instruments are received for "repair" in perfect working order. This can occur where batteries simply require replacement or re-charging, or where the sensor simply requires cleaning or replacement.

TPS Pty. Ltd. has a fine reputation for prompt and efficient service. In just a few days, our factory service engineers and technicians will examine and repair your equipment to your full satisfaction.

To obtain this service, please follow this procedure

Return the instrument AND ALL SENSORS to TPS freight pre-paid and insured in its original packing or suitable equivalent. INSIST on a proof of delivery receipt from the carrier for your protection in the case of shipping claims for transit loss or damage. It is your responsibility as the sender to ensure that TPS receives the unit.

Please check that the following is enclosed with your equipment:

- **Your Name and daytime phone number.**
- **Your company name, ORDER number, and return street address.**
- **A description of the fault. (Please be specific.)
(Note: "Please Repair" does NOT describe a fault.)**

Your equipment will be repaired and returned to you by air express where possible.

For out-of-warranty units, a repair cost will be calculated from parts and labour costs. If payment is not received for the additional charges within 30 days, or if you decline to have the equipment repaired, the complete unit will be returned to you freight paid, not repaired. For full-account customers, the repair charges will be debited to your account.

- **Always describe the fault in writing.**
- **Always return the sensors with the meter.**