pH-CUBE

Model *pH Cube* pH-ORP-Temp. Meter

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TPS
PRECISION MEASUREMENT™

Congratulations !
You have purchased the latest in benchtop pH-ORP-Temperature instrumentation. We trust that your new ***pH Cube*** will give you many years of reliable service.

The ***pH Cube*** 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.

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

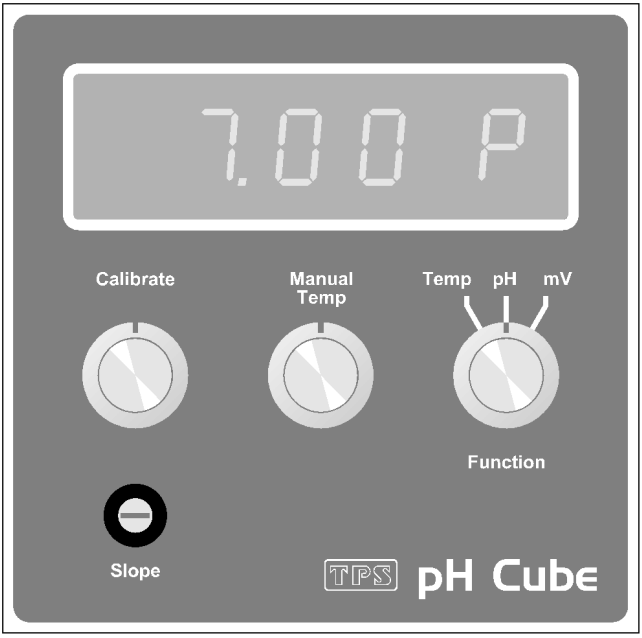
1. **Main Section**
   The main section of the handbook provides complete details of the ***pH Cube***, including operating modes, calibration, troubleshooting, specifications, and warranty terms.

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

Contents

1. Introduction

1.1 pH Cube Front Panel and Controls



Display

- 12.7mm LED display with mode enunciator.

Function Switch

- Switches between pH, ORP/mV and Temperature modes. See section 2.

Calibrate Control

- Used for pH asymmetry calibration in pH7.00 or pH6.86 buffer. See section 3.

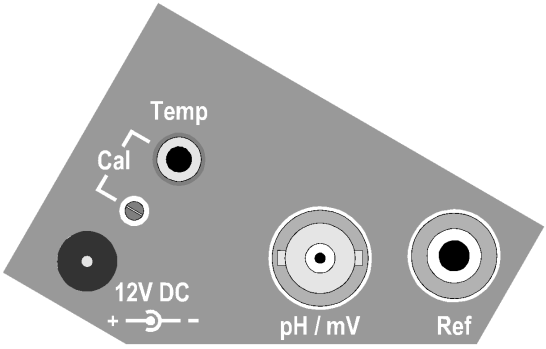
Slope Control

- Used for pH slope calibration in a buffer that is at least 2 to 3 pH away from pH7.00, eg. pH4.01, pH9.18 or pH10.01. See section 3.

Manual Temp Control

- Used to manually set the temperature of the solution for pH temperature compensation. Only active when temperature sensor is unplugged. See section 5.3.

1.2 pH Cube Side Panel and Connectors



pH / mV Connector

- Used to connect pH, ORP (Redox) and Specific Ion sensors.

Ref Connector

- Used to connect Reference sensor when a mono pH, ORP (Redox) or Specific Ion sensor is connected to the **pH / mV** Connector.

Temp Connector

- Used to connect Temperature sensor. This sensor provides temperature readout as well as Automatic Temperature Compensation for pH readings.

Temp Cal Control

- Used for temperature calibration. See section 5.

12V DC Power Connector

- Used to connect 12V AC/DC Adaptor. The ***pH Cube*** can run off any 12V DC source with at least 200mA output. The **12V DC** connector has a positive tip.

1.3 Unpacking Information

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

		Part No
1.	***pH Cube*** pH-ORP-Temperature Instrument	121122
2.	Combination pH Sensor	121207
3.	Temperature/ATC Sensor	121245
4.	pH7.00 Buffer, 200mL	121387
5.	pH4.01 Buffer, 200mL	121381
6.	Rod and Clamp for 2 x 12mm and 1 x 6mm diameter sensor.	121346
7.	AC/DC Power Adaptor	130044
8.	***pH Cube*** Handbook	130050

1.4 Specifications

	Ranges	Resolution	Accuracy
pH	0 to 14.00 pH	0.01 pH	±0.01 pH
ORP/mV	0 to ±1999 mV	1 mV	±1 mV
Temperature	-10.0 to 120.0 ^{O}C	0.1 ^{O}C	±0.2 ^{O}C

Input Impedance : >3 x 10^{12} Ω

Asymmetry Range : Approx -1.00 to 1.00 pH

Slope Range : Approx 85.0 to 105.0%

Temperature Compensation : Automatic : 0 to 100.0 ºC
Manual : 5 to 100 ºC

Power : 12V DC by AC/DC power adaptor.

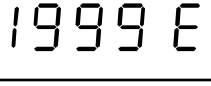
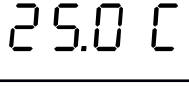
Dimensions : 120 x 120 x 120 mm

Mass : Instrument only : Approx 0.9 kg
Full Kit : Approx 2.1 kg

Environment Temperature : 0 to 45 ºC
Humidity : 0 to 90 % R.H.

2. Operating Modes

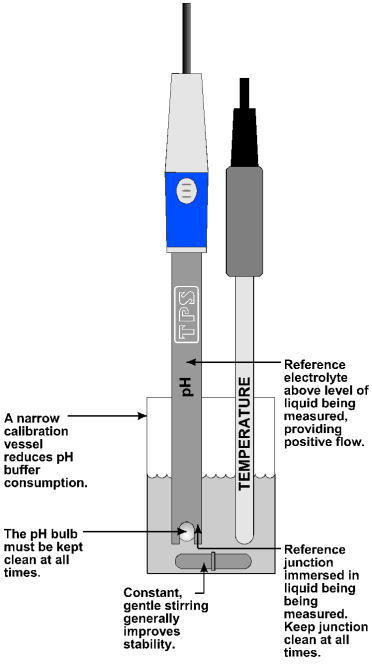
Switch the function switch to any one of the following three operating modes. Note the mode enunciator – **P** for pH, **E** for EMF (ORP/mV), and **C** for ^{O}C.

Function Switch Position	Display example
pH	
ORP/mV	
Temp	

3. pH Calibration

3.1 Calibration Procedure

1. Switch the ***pH Cube*** to pH mode (see section 2).
2. Plug the pH sensor into the **Sensor** socket and the temperature sensor into the **Temp** socket.
3. Ensure that temperature has already been calibrated or manually set (see sections 5.1 and 5.3).
4. Remove the wetting cap from the pH sensor.
5. Rinse the pH and Temperature sensors in distilled water and blot them dry.
6. Place both sensors into a small sample of primary buffer that is at or near pH7 (eg. pH7.00 or pH6.86). The bulb and reference junction should both be covered, as per the diagram below.



DO NOT place the sensors directly into the buffer bottle.

7. When the reading has stabilised, adjust the **Calibrate** control until the display shows the value of the buffer at the current temperature. For TPS buffers, this is shown on the bottle. Refer also to the table in section 7.1.

8. Rinse the pH and Temperature sensors in distilled water and blot them dry.

9. Place both sensors into a small sample of secondary buffer (eg. pH4.01, pH9.18 or pH10.01) so that the bulb and reference junction are both covered, as per the diagram in step 6 above.

   DO NOT place the sensor directly into the buffer bottle.

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

   When the reading has stabilised, adjust the **Slope** control until the display shows the value of the buffer at the current temperature. For TPS buffers, this is shown on the bottle. Refer also to the table in section 7.1.

10. The ***pH Cube*** is now calibrated and is ready for use.

    Discard the used samples of buffer.

3.2 Calibration Notes

1. A 1-point calibration using the **Calibrate** control in a pH7.00 or pH6.86 buffer should be performed at least weekly. In applications where the sensor junction can become blocked (eg. wines, dairy products, mining slurries etc) a 1-point calibration may have to be done daily.

1. A full 2-point calibration should be performed at least monthly. Of course, more frequent calibration will result in greater confidence in results.

4. ORP/mV Calibration

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

5. Temperature Calibration

The temperature readout must be calibrated or manually set before attempting pH calibration.

5.1 Calibration Procedure

1. Switch the ***pH Cube*** to Temperature mode (see section 2).
2. Plug the temperature sensor (Part No 121245) into the **Temp** socket.
3. Place the sensor alongside a good quality mercury thermometer into a beaker of room temperature water. Stir the sensor and the thermometer gently to ensure an even temperature throughout the beaker.
4. When the reading has stabilised, adjust the **Temp Cal.** control until the display shows the same temperature as the mercury thermometer.
5. The Temperature function of the ***pH Cube*** is now calibrated and is ready for use.

5.2 Calibration Notes

1. Temperature does not need to be recalibrated unless the Temperature sensor is replaced.

5.3 Manual Temperature Setting

Manual temperature setting is only available if the temperature sensor is not plugged in.

1. Switch the ***pH Cube*** on and select Temperature mode (see section 2).
2. Measure the temperature of the sample solution.
3. Adjust the **Manual Temp** control until the display shows the measured temperature of the sample solution.

6. Troubleshooting

6.1 pH and ORP/mV Troubleshooting

Symptom	Possible Causes	Remedy
Meter displays "**-1.** " as a reading.	pH reading is over-ranged.	pH sensor not connected or faulty. Replace sensor if necessary.
Asymmetry calibration with **Calibrate** control in pH7.00 or pH6.86 buffer fails. (Asymmetry is greater than +/-1.00 pH.)	1. Reference junction blocked. (See section 7.3) 1. Reference electrolyte contaminated.	Clean reference by immersing the probe in hot water (60°C) for a few minutes. Proteins can be cleaned off using a pepsin solution. Replace electrolyte if using a refillable sensor.
Slope calibration with **Slope** control in low or high buffer fails. (Slope is less than 85.0%.)	1. Glass bulb not clean. 1. Sensor is aged. 1. Connector is damp. 1. Buffers are inaccurate.	Clean glass bulb as per instructions supplied with the sensor. Attempt rejuvenation, as per instructions supplied with the sensor. If not successful, replace sensor. Dry in a warm place. Replace buffers.
Inaccurate readings, even when calibration is successful.	Reference junction blocked. (See section 7.3)	Clean reference junction by immersing the probe in hot water (60°C) for a few minutes.
Displays around pH7.00 for all solutions.	Electrical short in connector.	1. Check connector. Replace if necessary. 1. Replace sensor.
Displays 4-5 pH for all solutions.	Glass bulb or internal stem cracked.	Replace sensor.

pH and ORP/mV Troubleshooting, continued…

Unstable readings.	1. Reference junction blocked.	Clean reference junction as per instructions supplied with the sensor.
	1. Glass bulb not clean.	Clean glass bulb as per instructions supplied with the sensor.
	1. Bubble in glass bulb.	Flick the sensor to remove bubble.
	1. Faulty connection to meter.	Check connectors. Replace if necessary.
	1. Reference junction not immersed.	Ensure that the bulb AND the reference junction are fully immersed.
	1. KCl crystals around reference junction, inside the electrolyte chamber.	Rinse electrolyte chamber with warm distilled water until dissolved.

6.2 Temperature Troubleshooting

Symptom	Possible Causes	Remedy
Meter reads "**-1** " in Temperature mode.	Temperature sensor is connected, but is faulty.	Check the temperature sensor connector and replace if necessary. Replace temperature sensor (part no 121245) if problem persists.
Temperature readings do not vary and **Manual Temp** control is active when temperature sensor is plugged in.	1. Faulty connector. 1. Incorrect temperature sensor. 1. Faulty temperature sensor.	Check the connector and replace if necessary. Fit new temperature sensor, part number 121245. Fit new temperature sensor, part number 121245.
Temperature inaccurate and cannot be calibrated.	1. Faulty connector. 1. Faulty temperature sensor.	Check the connector and replace if necessary. Fit new temperature sensor, part number 121245.

7. Appendices

7.1 pH Buffer Values Vs Temperature

The following table lists the pH values of some popular buffers, with respect to Temperature. Any pH meter should always be calibrated to the correct value of the buffers at the current solution temperature.
Buffer temperature should not exceed 50oC during calibration.

Temp ^{O}C	pH4.01	pH6.86	pH7.00	pH9.18	pH10.01
0	4.00	6.98	7.13	9.46	10.32
5	4.00	6.95	7.09	9.40	10.25
10	4.00	6.92	7.06	9.33	10.18
15	4.00	6.90	7.04	9.28	10.12
20	4.00	6.88	7.02	9.23	10.06
25	4.01	6.86	7.00	9.18	10.01
30	4.01	6.85	6.99	9.14	9.97
35	4.02	6.84	6.98	9.10	9.93
40	4.03	6.84	6.97	9.07	9.89
45	4.04	6.83	6.97	9.04	9.86
50	4.05	6.83	6.97	9.01	9.83

7.2 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.

7.2.1 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 7 -1 illustrates how asymmetry is expressed.

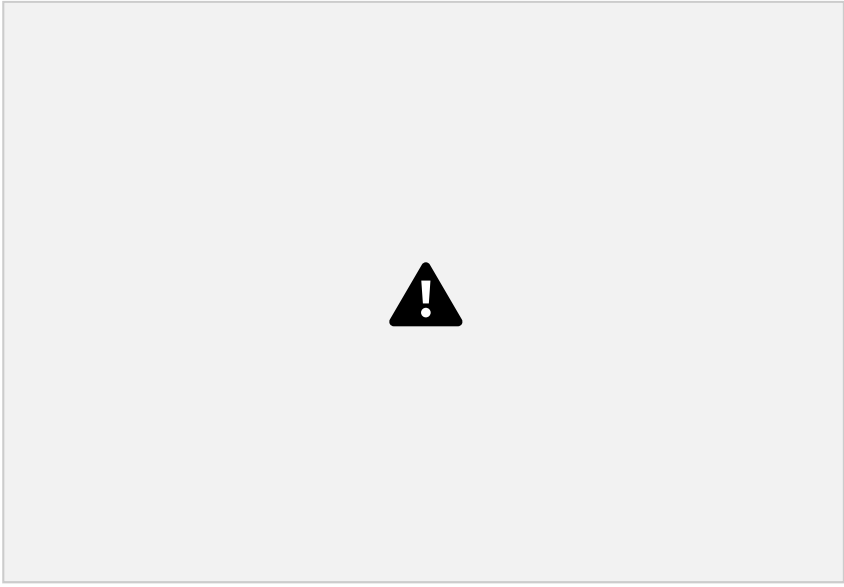


Figure 7-1

7.2.2 *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 ºC 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 7 -2).

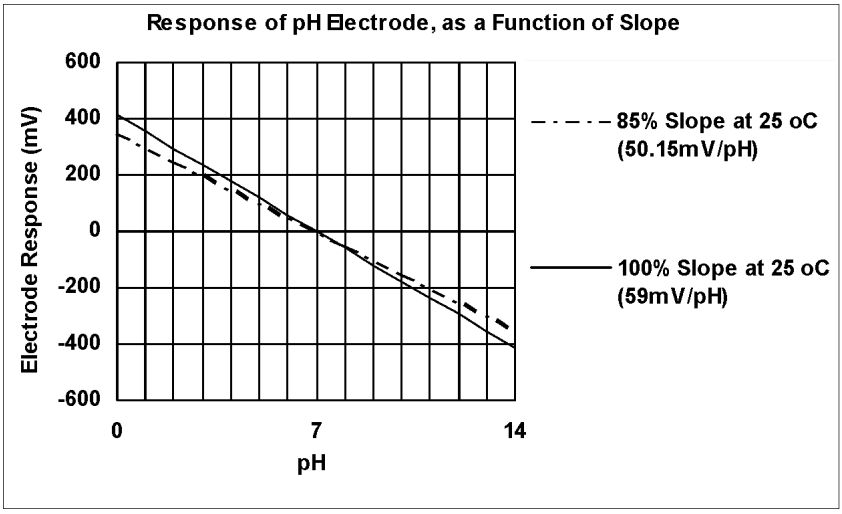


Figure 7-2

7.2.3 Temperature Compensation

The slope of a pH sensor (section 7.2.2) 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 7 -3 shows the slope of a pH sensor at various temperatures.

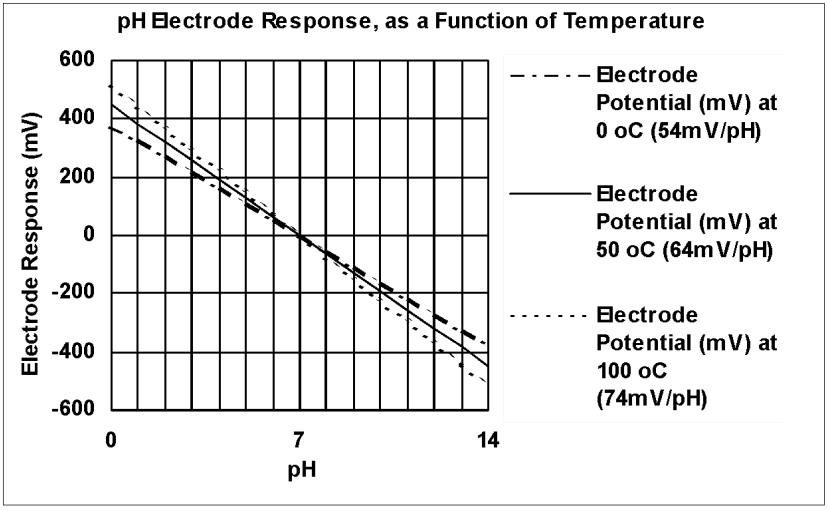


Figure 7-3

8. 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 TPS Pty Ltd Factory Service Centre, 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 six (6) months.

Freight costs to and from the factory are the responsibility of the purchaser. Shipping damage is not covered by this warranty.

TPS Pty Ltd accepts no liability for any incidental or consequential damages caused by or resulting from the use or misuse of this equipment either due to failure of the equipment, incorrect calibration, incorrect operation, or from interpretation of information derived from the equipment. Specifications are subject to change without notice. This warranty becomes invalid if modifications or repairs are carried out on this unit by unauthorised persons. There are no express or implied warranties which extend beyond the face hereof.

Procedure for Service

Please read service details on our **'Service and repair' web page.**

TPS Pty Ltd has a reputation for prompt and efficient 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.

Return the instrument AND ALL SENSORS to TPS Pty Ltd freight pre-paid. It is your responsibility as the sender to ensure that TPS Pty Ltd receives the unit, so consider using a traceable freight service.

Please check that the following is enclosed with your equipment:

- **A TPS '<u>Service / Return Goods Form</u>'**
- **Your full name**
- **Your company name**
- **Your email address or fax number**
- **Your return street address**
- **A description of the fault. (Please be specific - "Please Repair" does not describe a fault.)**

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

For instruments beyond warranty period, a repair cost will be calculated from parts and labour costs and emailed to you. If you decline to have the equipment repaired, the complete instrument will be returned to you freight paid, not serviced.