HH4-PH

Hand Held

Digital pH/mV/Temperature Meter

Operation and Instruction Manual

AMALGAMATED INSTRUMENT CO PTY LTD *ACN: 001 589 439*

Unit 5, 28 Leighton Place Hornsby
NSW 2077 AUSTRALIA

Telephone: +61 2 9476 2244
Facsimile: +61 2 9476 2902

e-mail: sales@aicpl.com.au
Internet: www.aicpl.com.au

Table of Contents

1 Introduction

This manual contains information on the operation of the AIC HH4-PH Intelligent Digital pH meter. The HH4 is a general purpose portable pH meter which may be cycled between pH, millivolts (for Redox/ORP sensor inputs) and temperature by pressing the front panel keypad. When the HH4-PH is turned on, the display will indicate various power up messages and then settle into the measurement mode. The position of the decimal point allows the user to determine which range is currently selected. The pH range has a resolution of 0.01pH (XX.XX) i.e. 2 decimal point places, the millivolt range has a resolution of 1mV (XXXX) i.e. no decimal point places and the temperature range to 0.1°(XXX.X) i.e. one decimal point place.

Unless otherwise specified at the time of order, your HH4 has been factory set to a standard configuration (see next chapter “Read this first”). Like all other HH4 series instruments the configuration and calibration is easily changed by the user.

An automatic turn off function powers the instrument down after a preset time period - this feature is ideal for saving power.

By pressing the “Cal/Hold” button the display may be held on the current reading.

The HH4 series of Hand Held Digital Instruments are designed for high reliability in industrial or laboratory applications. The high contrast LCD provides good visibility and are ideal for battery powered applications.

2 Operation

The HH4-PH digital pH meter is operated by pressing the on/off button. The following display sequence is executed during startup:

8.8.8.8	Display check
HI C	Company name
PHX.X	Software version number

This sequence will take around eight seconds then the display will indicate the current pH value. If a millivolt or temperature reading is required, press the “pH/mV/Temp” keypad to obtain the required reading. The display may be cycled through “mV”, “temp” and “pH” by successively pressing the keypad. The current display may be held (frozen) at any time simply by pressing the “Cal/Hold” keypad.

Note: When the “Cal/Hold” keypad is pressed the display will indicate “Hold” and then hold the current reading, if the “Cal/Hold” keypad is pressed again the display will indicate LIVE and the display will be released from hold.

The instrument features an automatic turn off function and will automatically power down after a predetermined number of minutes (note: see chapter on setting up the instrument). This feature is ideal for saving power, when the instrument is accidentally left turned on. The automatic turn off function, may be disabled by selecting “0" minutes when setting up the instrument.

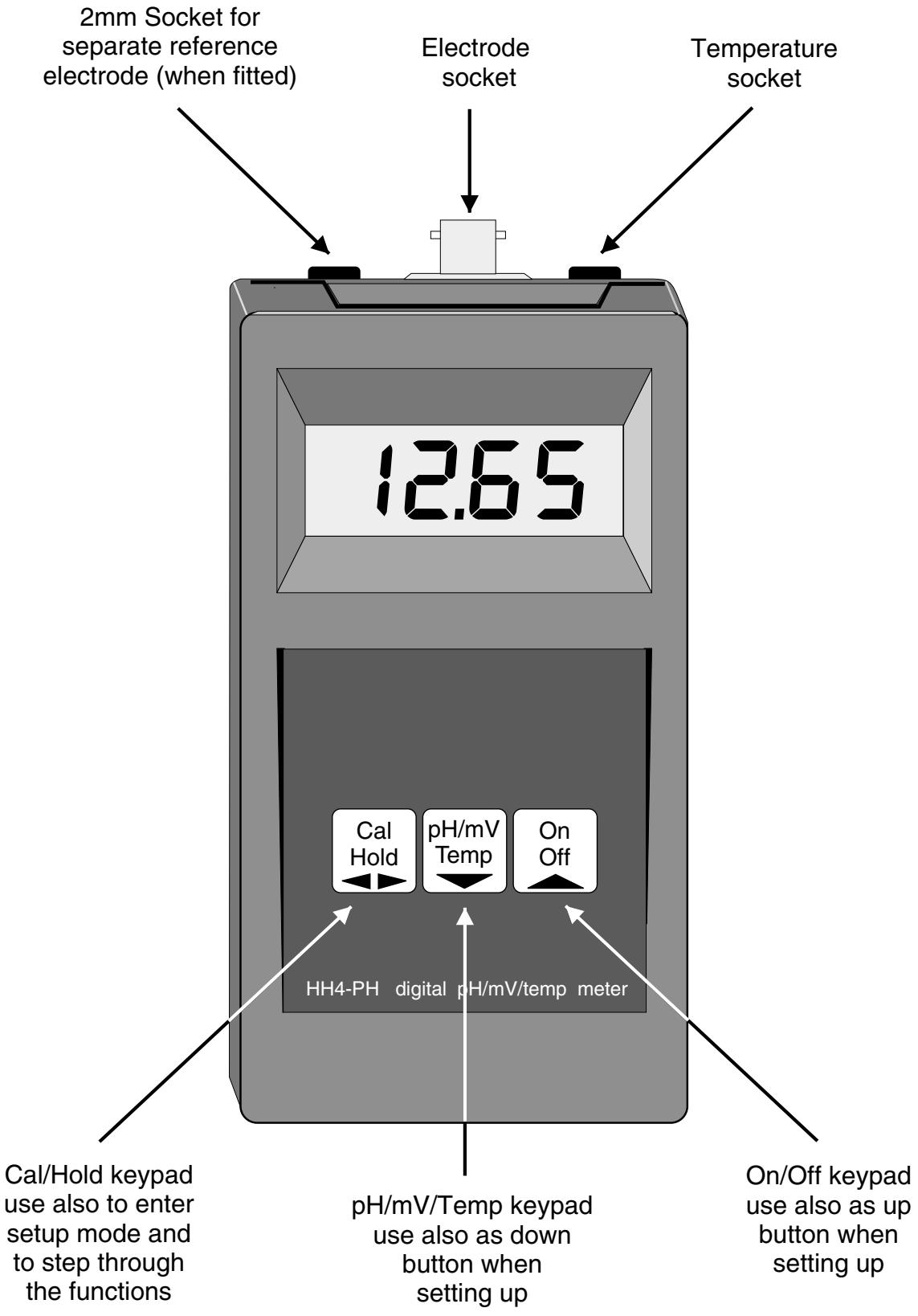
2 .1 Read this first

Your new HH4-PH has been supplied factory configured (unless otherwise specified), as follows:

Manual Temperature:	Set to 25°C
Temperature units:	Set to °C
Auto turn off:	Set to 10 minutes
Digital filter:	Set to 3 (range 0 to 8, 8=max)

3 Push Button Location & Function

The location and function of the pushbuttons is indicated below use details in conjunction with chapters “setting up the instrument” and “calibration”.



4 Setting up and programming functions

Setting up and calibrating the HH4-PH is extremely easy, since the functions are changed or viewed by pressing the pushbuttons. Several functions are available to allow the operator to set the operating modes, as follows:

4 .1 Step 1, Entering the setup mode

To enter the setup mode, a simple pushbutton sequence is necessary. First press the "Cal/Hold" button, release the button and then (within 2 seconds) press both the ▲ "On/OFF" button and the ▼ "pH/mV/Temp" buttons simultaneously. The display will now read FUNC thereby indicating that you have entered the Setup Function Mode.

Note: the "On/Off" button is used as an up button ▲

The "pH/mV/Temp" button is used as a down button ▼

4 .2 Step 2, Stepping through the settings

The display of FUNC is followed by the first setup message, OFSt. As with all other messages the first display lets you know which parameter will be affected when changes are made. Each time the "Cal/Hold" button is pressed another setup parameter is displayed until you reach the last function when FUNC End is displayed and the instrument returns to the normal pH display.

4 .3 Step 3, Making changes to the settings

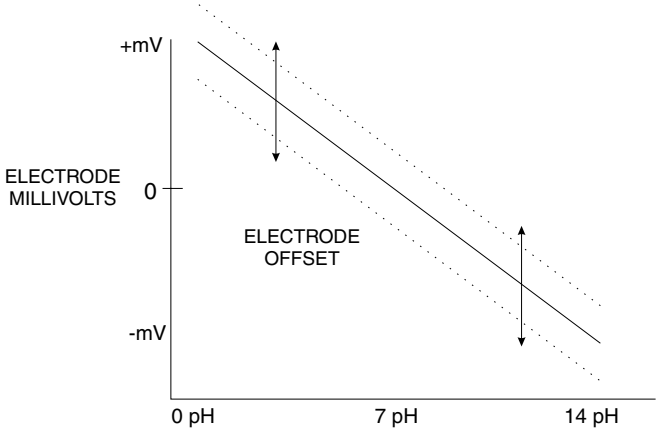
Whilst still in the Function Setup Mode, press the "Cal/Hold" button until you reach the parameter you wish to change. Initially the display will indicate the particular function (e.g. FLtr), this will be followed by a display showing the current status of that setting (e.g. 3) - press the ▲ "On/OFF" button or the ▼ "pH/mV/Temp" pushbutton until the desired value is displayed. You may then proceed through the functions (by pressing the "Cal/Hold" button) until you reach the next function that you wish to change or until you exit the function mode.

4 .4 Programming Functions:

The functions are described as follows:

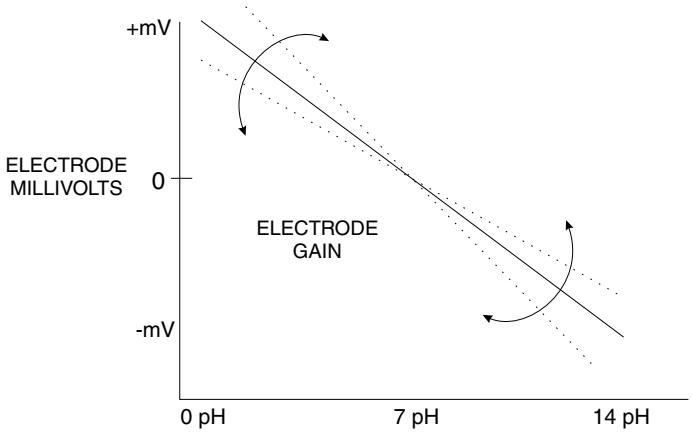
OFSt (pH offset calibration)

Used for fast single point calibration (usually around pH 7.00) to compensate for changes to the electrode, when exhibited as an offset error (see "Calibration" chapter).



GAIn (pH gain calibration)

Used for fast single point calibration to compensate for changes to the electrode, when exhibited as a gain error (see "Calibration" chapter).



SLPE (pH electrode slope)

This function displays the existing calibrated slope of the pH electrode in relation to the ideal slope of a pH electrode. The slope is expressed as a percentage and provides an indication of the electrode condition. When the electrode slope reduces to 80% the electrode should be discarded

Auto - **on**/**OFF** (set auto or manual temperature compensation)

Press the ▲ "On/OFF" button or the ▼ "pH/mV/Temp" button to change from automatic temperature compensation **on** or manual temperature compensation. When set to **on** the pH reading will automatically be compensated for temperature changes measured by the temperature probe. When set to **OFF** the pH reading will be compensated by the manual set value.

Note:

When the HH4-PH is set to manual, the manually set temperature will be displayed when the display is cycled to read temperature - if the temperature probe is not connected.

When the HH4-PH is set to automatic, the manually set temperature will not be displayed. However, if the temperature input is out of range (e.g. not connected) or is below 20°C then the instrument will default to the manual set temperature (**PrSt**) value. Use the ▲/ ▼ buttons to select the manual compensation temperature required. This value will also be used if **Auto** is selected to **on** and the temperature input is out of range.

PrSt (preset temperature value).

This function allows the user to set a temperature value to be used as the default value for temperature compensation when no temperature sensor is used. When no temperature This value should be set to the temperature of the solution being measured.

FLtr (digital filter)

Press the ▲ "On/Off" button or the ▼ "pH/mV/Temp" button to select the digital filtering value. Digital filtering is used for reducing susceptibility to short term interference. The digital filter range is selectable from 0 to 8, where **0** = none and **8** = most filtering. A typical value for the digital filter would be **3**.

APdt (set Auto Power Down Time)

Press the ▲ "On/Off" button or the ▼ "pH/mV/Temp" button to select the Automatic Power Down Time (auto turn off time). The time is programmable over the range of 0 to 250 minutes. Note: if continuous operation is required, select 0 to disable the auto turn off function.

Calibration functions (see also chapter titled "Calibration").

To enter this mode a special "power up procedure must be followed" this procedure prevents accidental alteration of calibration and provides a degree of calibration security.

Press the "On/Off" to turn the instrument on.

Press and hold the "Cal/Hold" button whilst the instrument displays 8.8.8.8 during the wake up cycle. The instrument will momentarily show CAL in the wake up message to let you know that the calibration level of the function mode is now accessible.
To enter into the calibration mode, you must now enter the function set up mode as described earlier in this chapter "entering the set up mode" and step through the functions until the display indicates CAL.

CAL 1 & CAL2 (pH calibration using 2 buffer solutions)

Displays and sets the two independent pH calibration points. See "Calibration" chapter for full details.

UCAL (pH uncalibration).

Used to set the instrument back to the factory calibration values. This function should only be used when calibration problems exist, and it is necessary to clear the calibration memory. See "Calibration" chapter for full details.

CAL.E (millivolt calibration).

The millivolt calibration is a single point calibration.
See "Calibration" chapter for full details.

UC.E (millivolt uncalibration).

Used to set the instrument back to the factory calibration values. This function should only be used when calibration problems exist. See "Calibration" chapter for full details., and it is necessary to clear the calibration memory.

CAL.t (temperature calibration).

This function is only available if Auto is set to on. The temperature calibration is a single point calibration. The temperature probe is placed in an accurately known environment and the correct value is entered into the instrument memory.

UC.t (temperature uncalibration).

This function is only available if Auto is set to on. Used to set the instrument temperature calibration back to the factory calibration value. This function should only be used when calibration problems exist, and it is necessary to clear the calibration memory.

Returning to the normal measure Mode

Important; When the calibration is complete, it is advisable to return the instrument to the normal mode (where calibration functions cannot be tampered with). To return to the normal mode - turn off the instrument power - wait a few seconds and then restore power.

5 Function Table

Initial display	Meaning of display	Next display	Record Your Settings
OFSt	pH calibration offset	Value stored in memory	
GAIn	pH calibration gain	Value stored in memory	
SLPE	pH electrode slope	Value from last calibration	
Auto	Auto or manual compensation	on or OFF	
Pr.St	Manually set temperature value	Manual temperature value	
FLtr	Digital filter range 0 to 8	0 to 8 (8= most filtering)	
APdt	eSt auto turn off time	0 to 250 minutes	
Functions below are accessible via the calibration (CAL) mode only			
CAL 1	Calibration point 1	Value stored in memory	
CAL2	Calibration point 2	Value stored in memory	
UCAL	pH uncalibration	See "Calibration" chapter	
CAL.E	mV calibration	See "Calibration" chapter	
UC.E	mV uncalibration	See "Calibration" chapter	
CAL.t	Temperature calibration	See "Calibration" chapter	
UC.t	Temperature uncalibration	See "Calibration" chapter	

6 Calibration

pH Calibration - 2 methods

The HH4-PH has provision for two methods of pH calibration, a single points may be used for routine calibration, whilst a two point method should be used for initial calibration, critical applications, when the electrode is replaced or for periodical maintenance etc.

The condition of the pH electrode may be evaluated by the electrode slope. As the electrode ages the sensitivity of the probe is reduced. When a slope value reduces to 80% the electrode should be discarded. The electrode slope may displayed by selecting **SLPE** in the function/setup mode.

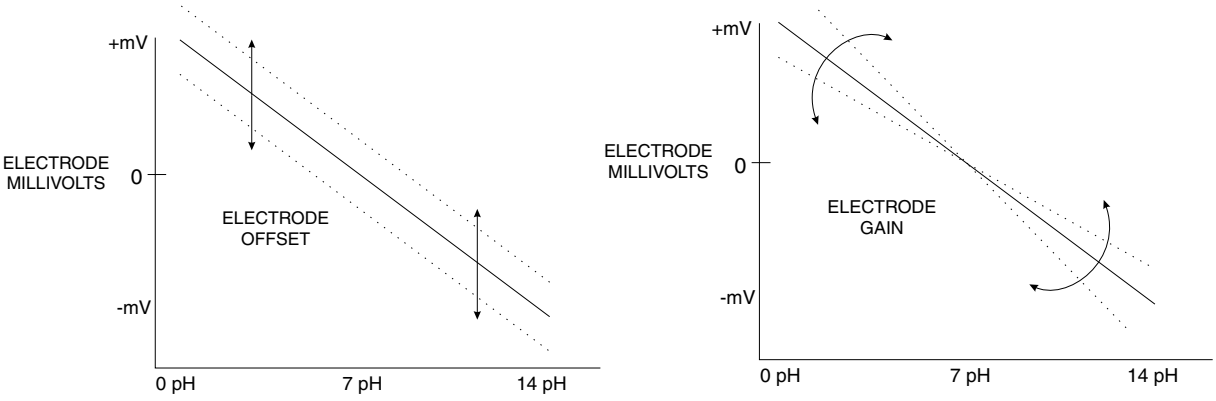
Routine pH calibration - single point adjustment

The two single point calibration functions are accessible by entering and stepping through the function mode (see chapter - "Setting up the Instrument"). These functions are used to compensate for changes to the offset and gain (slope) of the electrode due to normal ageing and electrode wear. Normally only one of the two points is used to carry out single point calibration - the choice is determined by evaluating the cause of the calibration shift. Ideally the difference between two pH values should be known.

If the pH reading has the same error at two points, then the offset calibration **OFSt** should be used.

If the pH reading is correct around 7pH (for electrodes with Eo=7pH) and increases progressively above or below 7pH, then the gain calibration (**GAIn**) should be used.

As a general rule, use the offset calibration, when the type of calibration shift is unknown.



Using the offset (**OFSt**) function

Enter the Setup Mode in the usual way by pressing the "Cal/Hold" button then pressing both the ▲ ("On/Off" button) and the ▼ ("pH/mV/Temp" button) simultaneously (within 2 seconds) the display will indicate **OFSt** (Calibration offset).

To enter the offset function press the ▲ and ▼ pushbuttons simultaneously - the display will indicate the current pH value at the probe. Place the probe in a known value pH buffer solution. When the display has stabilised, press the "Cal/Hold" button - the display will now read **PH** followed by the pH value, the value may now be changed using the ▲ or ▼ pushbuttons to read the pH value of the buffer solution. To store the new value press the "Cal/Hold" button. The display will show **OFSt End** followed by **FUNC End** and the system offset will be adjusted so that the display will show the corrected value.

Using the gain (GAIn) function

Enter the Setup Mode in the usual way by pressing the “Cal/Hold” button then pressing both the ▲ (“On/Off” button) and the ▼ (“pH/mV/Temp” button) simultaneously (within 2 seconds) the display will indicate OFSt. Press the "Cal/Hold" button again, the display will indicate GAIn (Calibration gain).

To enter the GAIn function press the ▲ and ▼ pushbuttons simultaneously - the display will indicate the current pH value at the probe. Either take a sample of the probe test solution (if its pH value is known) or place the probe in a known buffer solution. When the display has stabilised, press the “Cal/Hold” button - the display will now read PH followed by the pH value, the pH may now be changed using the ▲ or ▼ pushbuttons to read the correct pH value of the probe test solution or buffer. To enter the correct value press the “Cal/Hold” button. The display will show GAIn nEnd followed by FUNC End and the system gain will be adjusted so that the display will match the corrected value.

Two point calibration - see alsp HH4-PH two point calibration procedure example which follows.

To enter the calibration mode and gain access to the two point calibration functions a special “power up procedure” must be followed. This procedure prevents accidental alteration of calibration and provides a degree of calibration security.

Preparing to initialise

Turn instrument off by pressing the “On/Off” button.

Initialising the calibration mode

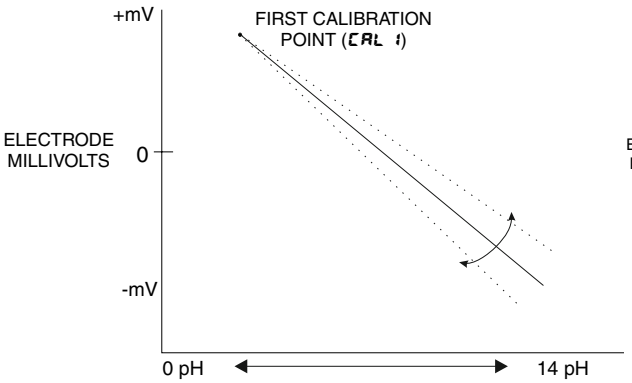
Press and hold the “Cal/Hold” button whilst applying power to the instrument (by pressing the “On/Off” button). The instrument will momentarily show CAL (during the wake up messages) to let you know that the calibration level of the function mode is now accessible.

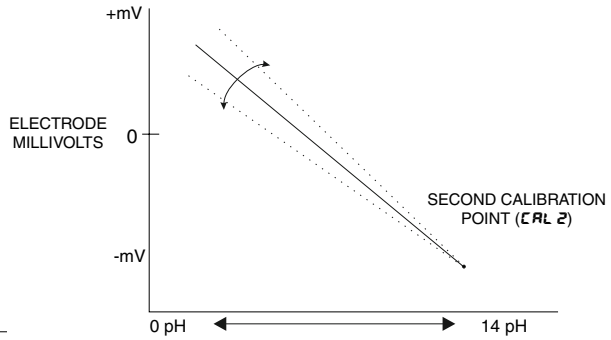
pH calibration (2 points)

Enter the Setup Mode in the usual way by pressing then releasing the “Cal/Hold” button then pressing both the “On/OFF (▲)” button and the “pH/mV/Temp (▼)” button simultaneously (within 2 seconds) and then step through the functions until the display indicates CAL 1 (first calibration point).

To enter the first pH calibration point press the ▲ and ▼ buttons simultaneously. The display will now indicate a pH value and CAL 1 will flash every 8 seconds. Immerse the electrode in a pH buffer solution e.g a 7 pH buffer. When the reading has stabilised press the “Cal/Hold” button. The display will now indicate PH 1 (scale 1) followed by the scale value in memory. Now press the ▲ or ▼ buttons to obtain the required scale (calibration) value i.e. enter the value of the first pH buffer. Press the “Cal/Hold” button to accept the new value. If the value has been accepted the message StNd will be seen.

The display will now indicate CAL2 (second calibration point). To enter the second calibration function press ▲ and ▼ simultaneously. The display will now indicate a pH value and CAL2 will flash every 8 seconds. Wash the electrode in distilled or pure water and immerse the electrode in a second buffer solution (this value is not critical, for best accuracy should not be too close to the previous value e.g. 4 pH). When the reading has stabilised, press the “Cal/Hold” button, the display will now read PH2 (scale 2) followed by the second scale value in memory. Press the ▲ or ▼ button to obtain the required scale value i.e. enter the value of the second pH buffer. Press “Cal/Hold” button the display will now read Stnd followed by FUNC End indicating that the calibration is complete. The display will return to the measure mode. Note: the buffer values used will remain in the instrument memory, thereby making future calibration easier, if the same value buffers are used.

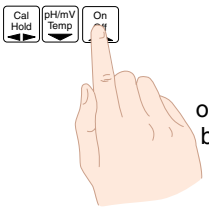




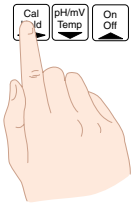
HH4-PH two point calibration procedure example

1. Enter CAL mode as shown below.
2. Step through the functions by pressing and releasing the F button until the CAL 1 function is reached.
3. Follow the procedure in the 2 Point calibration example shown below. Note the pH/mV Temp button is used as the DOWN button & the On Off button is used as the UP button when making adjustments to function settings.

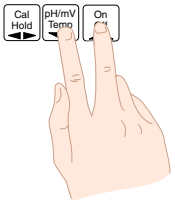
Entering CAL Mode



1. Remove power from the instrument using the On Off button. Hold in the Cal Hold button and switch on again by pressing the On Off button. The display will indicate CAL as part of the "wake up messages" when the CAL message is seen you can release the buttons.



2. When the "wake up" messages have finished and the display has settled down to its normal reading press, then release the Cal Hold button.



3. Within 2 seconds of releasing the Cal Hold button press, then release the On Off and pH/mV Temp buttons together. The display will now indicate FUNC followed by the first function.

Buffer solution 1

2 Point calibration example

First point

1. Wash and dab dry the probe then place probe in buffer 1 e.g. 7.00 pH. At the CAL 1 function press the UP and DOWN pushbuttons simultaneously. A live reading will be seen.
2. Allow the reading to stabilise then press the Cal Hold pushbutton. The display will show PH 1 followed by a value.
3. Use the UP or DOWN pushbutton to make this value equal the first buffer value e.g. 7.00 for a 7.00 pH buffer.
4. Press Cal Hold to accept this new scaling value. The message Stnd will be seen if the input has been accepted.

Second point

1. Wash and dab dry the probe then place probe in buffer 2 e.g. 4.00 pH. At the CAL 2 function press the UP and DOWN pushbuttons simultaneously. A live reading will be seen.
2. Allow the reading to stabilise then press the Cal Hold pushbutton. The display will show PH2 followed by a value.
3. Use the UP or Down pushbutton to make this value equal the first buffer value e.g. 4.00 for a 4.00 pH buffer.
4. Press Cal Hold to accept this new scaling value. The message Stnd will be seen if the input has been accepted followed by the message FUNC End. The instrument will then return to normal measurement.

Buffer solution 2.

pH uncalibration

This function sets the instrument calibration back to the factory calibrated value and closely matches that of an ideal electrode. Uncalibrate is useful as a temporary measure when the pH electrode is replaced and on the spot recalibration is difficult or when a calibrating error exists due to incorrect calibration. To enter the uncalibrate mode follow the procedure described above and step through the functions by pressing the “Cal/Hold” button until the display shows UC.PH. Press the ▲ and ▼ pushbuttons simultaneously the display will show CAL CLr followed by FUNC End indicating that the calibration is cleared. The display will return to the measure mode.

mV calibration (single point)

Step through the calibrate functions until the display indicates CAL.E (calibrate voltage). To enter the mV calibration mode press the ▲ and ▼ buttons simultaneously. The display will now show the “live” mV reading. Immerse the electrode in a buffer solution (this value is not critical and may be anywhere within the measuring range of the instrument). When the reading has stabilised press the “Cal/Hold” button. The display will now indicate SCLE followed by the scale value in memory.

Now press the ▲ or ▼ button to obtain the required scale (calibration) value. Press the “Cal/Hold” button the display will now indicate Stnd followed by FUNC End indicating that calibration is complete.

Note: the buffer values used will remain in the instrument memory, thereby making future calibration easier, if the same value buffers are used.

Redox uncalibration

This function sets the instrument calibration back to the factory calibrated value and closely matches that of an ideal electrode. This is useful as a temporary measure when the Redox electrode is replaced and on the spot recalibration is difficult or when a calibrating error exists due to incorrect calibration. To enter the uncalibrate mode follow the procedure described above and step through the functions by pressing the “Cal/Hold” button until the display shows UC.E. Press the ▲ and ▼ pushbuttons simultaneously the display will show CAL.E CLr followed by FUNC End indicating that the calibration is cleared. The display will return to the measure mode.

Temperature calibration

Step through the calibrate functions until the display indicates CAL.t (temperature calibration). Press the ▲ and ▼ buttons simultaneously to enter the temperature calibration mode. The display will now indicate CAL 1 (calibration point) followed by the “live” reading. Place the temperature probe into an accurately known temperature environment (this value is not critical and should ideally be close to the normal measuring temperature of the instrument). When the reading has stabilised press the “Cal/Hold” button. The display will indicate °C followed by the scale value in memory. Now press the ▲ or ▼ button to obtain the required scale (calibration) value i.e the known temperature. Press the ”Cal/Hold" button the display will now read CAL.t End followed by FUNC End indicating that the calibration is complete. The display will return to the measure mode.

Temperature uncalibration

This function returns the calibration to that of an ideal temperature probe and is useful when a temperature calibration error has occurred due to miscalibration and the conditions do not allow on the spot recalibration. To enter the uncalibrate mode follow the procedure described above and step through the functions by pressing the “Cal/Hold” button until the display shows UC.t. Press the ▲ and ▼ pushbuttons simultaneously the display will show CAL.t CLr followed by FUNC End indicating that the calibration is cleared. The display will return to the measure mode.

Returning to the normal measure mode

When the calibration procedure has been completed, it is advisable to return the instrument to the normal mode (where calibration functions cannot be tampered with). To return to the normal mode turn the instrument off by pressing the On/Off button (to exit the calibration mode), wait a few seconds and then turn on again.

7 Errors and Status Messages

The status message which represent conditions and errors, are as follows:

bAtt (low battery voltage)

Indicates that the battery voltage has reached approximately 6.4V. The unit will continue to operate - a new battery should be fitted as soon as possible.

CAL Err (calibration error)

If the display is in overrange during calibration and an attempt is made to calibrate, then this message will be displayed. The calibration will remain unchanged.

-or- (display overrange)

The value attempting to be displayed is above 9999 or below -1999. This indicates that calibration is in error. Uncalibrate the appropriate input and try recalibrating again.

---- (ADC overrange)

This indicates an ADC overrange. The input to the unit is out of the reading range of the ADC. Check the input level from the sensor and compare with the instrument input specifications.

8 Specifications

Technical Specifications

pH Input :	Any pH electrode where Eo=7 (-2V tp 2V nom):
mV Input:	-2000mV to 2000mV
Temperature Input:	LM335 temperature sensor
Temperature Range:	-50 to 150°C
Input Resistance:	Greater than 10^{10} Ohms (pH & mV)
ADC Resolution:	1 in 20,000
Accuracy pH & mV:	Better than 0.2% of full scale
Accuracy Temperature:	Better than 0.5% of full scale
Conversion Method:	Dual Slope ADC, 4 samples per second
Microprocessor:	MC1468HC05C85 CMOS
Ambient Temperature:	0 to 50°C
Humidity:	5 to 95% non condensing
Display:	LCD 4 digit 12.7mm
Power Supply:	9V 216 style battery, (Alkaline recommended)
Quiescent current:	10uA Maximum
Operating current:	10mA Maximum

Physical Characteristics

Case Size:	80mm (W) x 145mm (L) x 32 to 39mm (D)
Connections:	BNC connector for pH or Redox (mV) probe Mini Jack socket for temperature probe Banana socked for reference electrode (if fitted)
Weight:	250 gms including battery

9 Guarantee and Service

The product supplied with this manual is guaranteed against faulty workmanship for a period of 2 years from the date of dispatch.

Our obligation assumed under this guarantee is limited to the replacement of parts which, by our examination, are proved to be defective and have not been misused, carelessly handled, defaced or damaged due to incorrect installation. This guarantee is VOID where the unit has been opened, tampered with or if repairs have been made or attempted by anyone except an authorised representative of the manufacturing company.

Products for attention under guarantee (unless otherwise agreed) **must be returned to the manufacturer freight paid** and, if accepted for free repair, will be returned to the customers address in Australia free of charge.

When returning the product for service or repair a full description of the fault and the mode of operation used when the product failed must be given.

In any event the manufacturer has no other obligation or liability beyond replacement or repair of this product.

Modifications may be made to any existing or future models of the unit as it may deem necessary without incurring any obligation to incorporate such modifications in units previously sold or to which this guarantee may relate.

This product is designed and manufactured in Australia.