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WP Series Waterproof Portables

WP-81 User Manual



Waterproof



User Friendly



GLP Compliant



USB Download



Data logging



Multiple Power Options

Congratulations !

You have purchased the latest in Handheld Conductivity-TDS-Salinity-pH-ORP-Temperature instrumentation. We trust that your new **WP-81** will give you many years of reliable service.

The **WP-81** 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 **WP-81**. It also contains a full listing of all of the items that you should have received with your **WP-81**. 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 **WP-81**, 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.



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**Model WP-81 Cond,
TDS, Sal, pH, ORP,
Temp. Meter**

Version: 8.2

Date: 16/06/2021

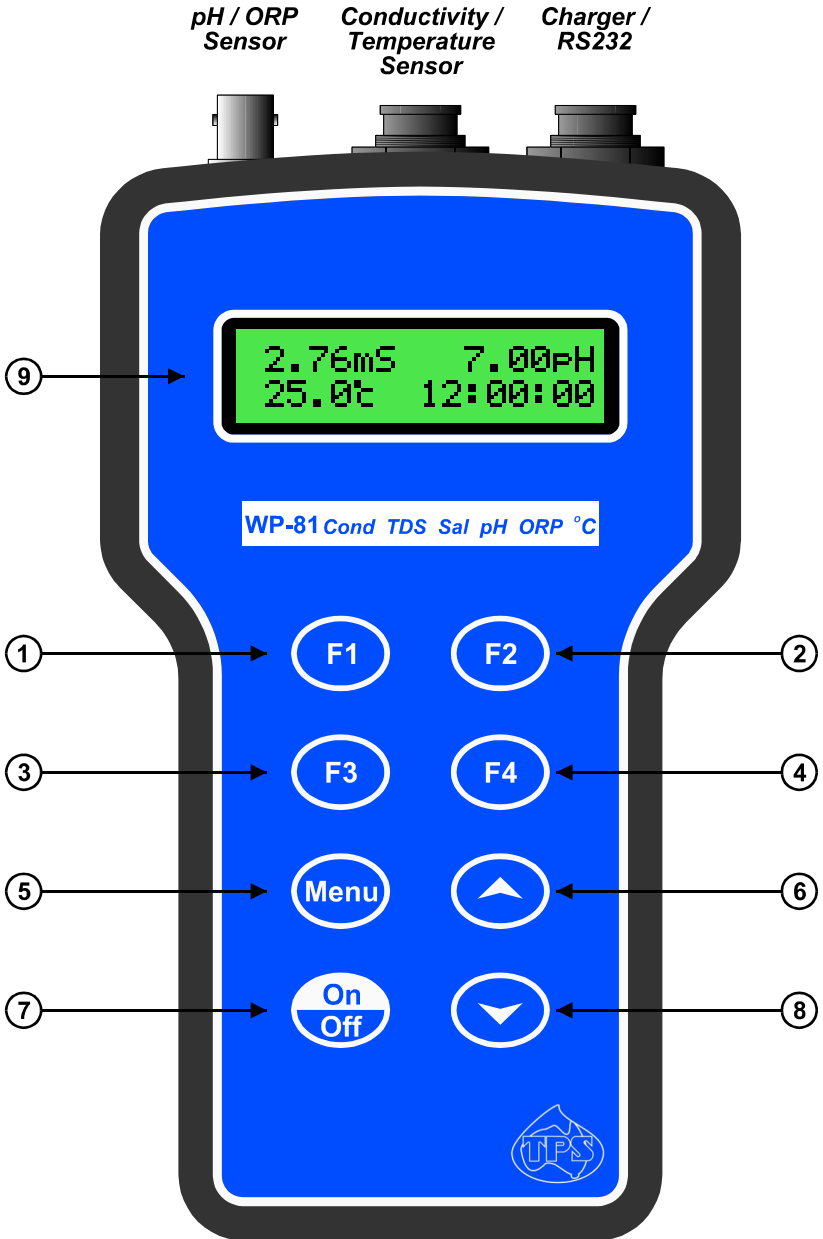
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1. Introduction

1.1 WP-81 Display and Controls





Press to record readings into memory. See section 9.1.

Also used to select pH buffers for automatic buffer recognition at pH calibration. See section 17.



Press to show or hide the date/time or temperature. See section 15.2.

Also used to select k=0.1 or k=10 sensor, when standard k=1 sensor is not being used.



Press to start or stop automatic logging. See section 10.

Alternatively, press to transmit current reading plus date and time to the RS232 port. See section 11.2.






Only used within the menu system on the **WP-81**.



Press to access the user-friendly menu system which makes the **WP-81** a breeze to operate.



The  and  keys are used for calibrating the temperature value (section 7.1), setting the manual temperature compensation (section 7.4), setting the clock (section 15.1), setting the automatic logging period (section 10), and displaying GLP information (section 8.1).

The  key is also used to initialise the **WP-81** at turn-on. See section 18.



Switches the **WP-81** on and off.

⑨ **Display**

32 character alpha-numeric display with user-friendly menu and prompting system. Shows Conductivity/TDS/Salinity, pH/ORP and Temperature simultaneously. Date and time can also be displayed.

1.2 Unpacking Information

Before using your new **WP-81**, please check that the following accessories have been included:

	Part No
1. WP-81 Conductivity-TDS-Sal-pH-ORP-Temp instrument	121132/1
	121132/3
	121132/5
2. Conductivity/ATC/Temperature Sensor:	k=1 1, 3 or 5m cable
(see cable label for part No)	k=10 1, 3 or 5m cable
	k=0.1 1, 3 or 5m cable
3. pH Sensor: (see cable label for part No)	1, 3 or 5m cable
4. Conductivity Standard, 200mL:	2.76 mS/cm 122306
	or 58.0 mS/cm 122315
	or 150.0 uS/cm 122320
5. pH7.00 Buffer, 200mL	121387
6. pH4.01 Buffer, 200mL	121381
7. Battery charger	130037
8. Manual	

*Options that may have been ordered with your **WP-81**:*

1. Extended cable 130040
2. RS232 Serial Interface Cable 130041
3. Communication software for Windows 95 and later 130086
4. USB to Serial Adaptor (requires 130041 also) 130087
5. Hard Carry Case 130059
6. Battery charger lead for 12V cigarette lighter socket 130046
7. Battery charger lead for 12V DC, with battery clips 130052
8. Solar Panel 130012

1.3 Specifications

Conductivity

Ranges 4 ranges, with automatic range selection.
k=0.1 Sensor...0 uS/cm to 2000 uS/cm
k=1.0 Sensor...0 uS/cm to 20.00 mS/cm
k=1.0 Sensor...*FOR WP-81 V7 and above:*
0 uS/cm to 200.00 mS/cm
k=10 Sensor...0 uS/cm to 200.0 mS/cm

Resolution 0.05% of selected range
Accuracy $\pm 0.5\%$ of full scale of selected range at 25 °C

TDS

Factor: 0.40 to 1.00 - user set (factory default 0.65)
Ranges: 4 ranges, with automatic range selection.
k=0.1 Sensor...0 ppM to 1000 ppM
k=1.0 Sensor...0 ppM to 10.00 ppK
k=10 Sensor...0 ppM to 100.0 ppK

Resolution 0.1% of selected range
Accuracy $\pm 0.5\%$ of full scale of selected range at 25 °C

Salinity.....k=0.1 Sensor 0 % to 0.10 %
0 PSU to 1.0 PSU
k=1.0 Sensor...0 % to 1.19 %
0 PSU to 11.9 PSU
k=10 Sensor...0 % to 8.00 %
0 PSU to 80.0 PSU

Resolution 0.01% / 0.1 PSU
Accuracy $\pm 0.5\%$ of full scale of selected range at 25 °C

pH

Range 0 to 14.00 pH
Resolution 0.01 pH
Accuracy ± 0.01 pH

mV/ORP

Range 0 to ± 500.0 and 0 to ± 1500 mV (auto-ranging)
Resolution 0.15 and 1 mV
Accuracy ± 0.3 and ± 1 mV

Temperature

Range -10.0 to 120.0 °C (Sensor limit 60 °C)
Resolution 0.1 °C
Accuracy ± 0.2 °C

General Specifications

Temperature Compensation:

Conductivity/TDS/Salinity	Automatic	-5 to 70 °C
pH (only – not for mV/ORP).....	Automatic	0 to 100 °C
	Manual	0 to 100 °C

Calibration:

pH Auto Standard Recognition in pH4.01,
pH6.86, pH7.00, pH9.18 or pH10.01

pH Sensor Asymmetry Range.-1.00 to +1.00 pH

pH Sensor Slope Range 85.0 to 105%

Input Impedance $>3 \times 10^{12} \Omega$

mV/ORP Sensor calibration not available.

Conductivity/TDS/Salinity	Auto Standard Recognition	150uS/cm, 1413uS/cm, 2.76mS/cm, 12.88mS/cm, 58.0mS/cm
---------------------------	---------------------------	---

Cond Sensor Span Range....k=0.1 Sensor: k=0.075 to k=0.133
k=1.0 Sensor: k=0.75 to k=1.33
k=10 Sensor: k=7.5 to k=13.3

Temperature Use a reference thermometer.

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

Memory 3600 readings including date and time.

Automatic Logging User-set for one reading every 1 to 90
seconds, 1 to 90 minutes, or 1 to 24 hours.

RS232 Output 300, 1200, 9600 & 19200 baud.
8 bits, no parity, 1 stop bit, XON/XOFF
Protocol.

Clock Calendar clock displays date, month,
hours, minutes & seconds.
Year is recorded in memory and
transmitted to the RS232 port, but is not
displayed.

Battery Saver.....On : Auto switch-off after 5 minutes
Off : Continuous use
Bar Graph display of battery charge level.
Value of battery voltage available for troubleshooting.

Good Laboratory Practices Date, Time and Value of last Conductivity, pH and Temperature calibration are stored, and can be recalled or sent to the RS232 port at any time.

Power 6V NiMH Rechargeable Battery for approx 40 hours operation.

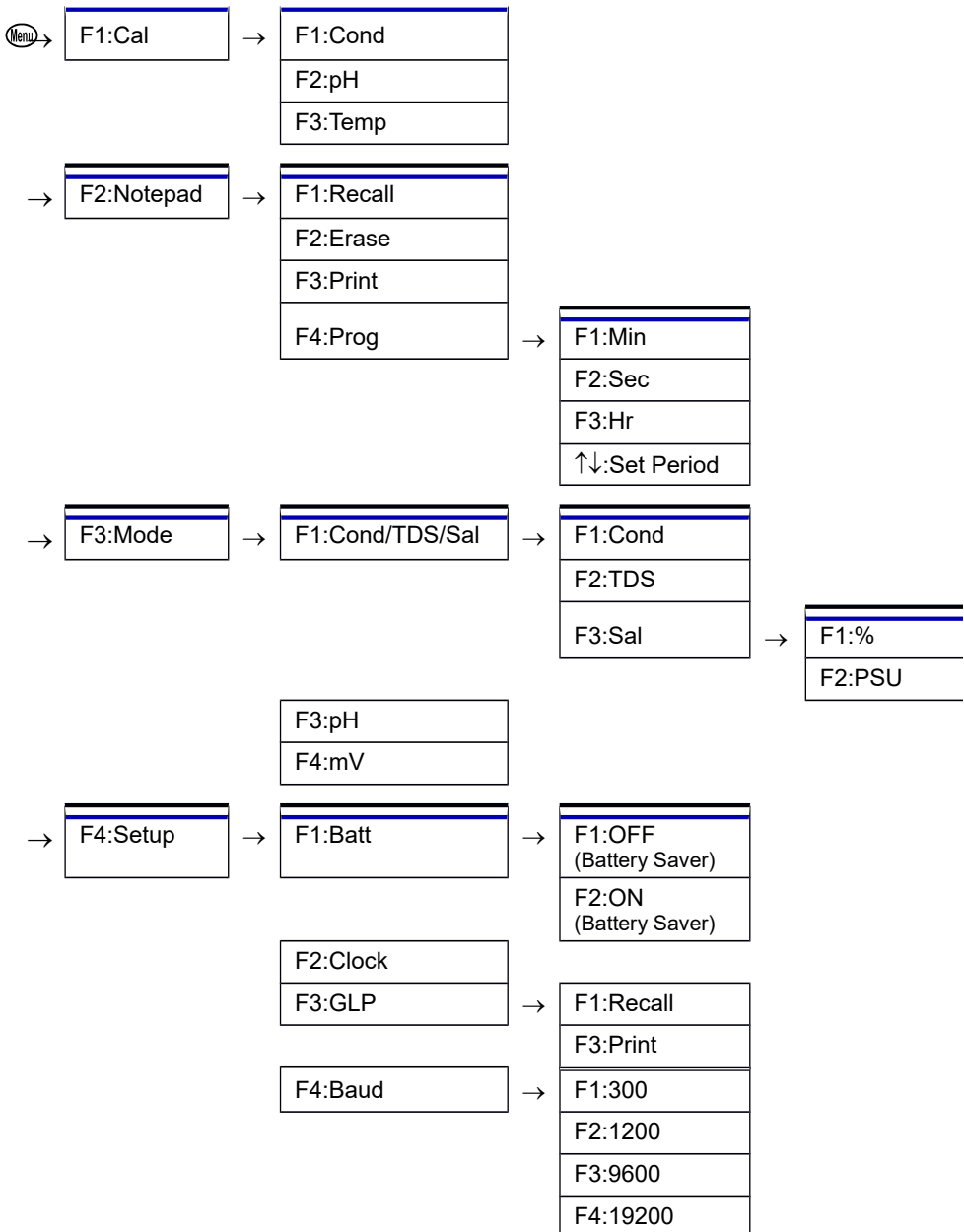
Dimensions 195 x 110 x 55 mm

Mass Instrument only : Approx 520g
Full Kit : Approx 2.5kg

Environment.....Temperature : 0 to 45 °C
Humidity : 0 to 95 % R.H.

2. WP-81 Menu Structure

A detailed breakdown of the menu system of the **WP-81** is shown below. This diagram provides a quick reference for the **WP-81** menu functions.



3. Operating Modes

3.1 Selecting Conductivity, TDS (setting factor) or Salinity Mode

To select Conductivity, TDS or Salinity mode...

1. Select the Mode menu (Menu) → **F3:Mode**)...

```
F1:Cond/TDS/Sal
F3:pH          F4:mV
```

2. Press (F1) to select Conductivity mode Menu.

```
F1:Cond.      F2:TDS
F3:Sal.
```

3. Press (F1) to select Conductivity mode.
Press (F2) to select TDS mode.
You will now be asked to enter the TDS Factor.

```
→0.65← TDS factor
↑↓:Set      F1:Save
```

Press (F3) to select Salinity mode menu.

```
Select units
F1:%          F2:PSU
```

Press (F1) to select % units.
Press (F2) to select PSU units.

Press (Menu) to quit and retain the current selection.

3.2 Selecting pH or ORP (mV) Mode

To select pH or ORP/mV mode...

1. Select the Mode menu (Menu) → **F3:Mode**)...

```
F1:Cond/TDS/Sal
F3:pH          F4:mV
```

2. Press (F3) to select pH mode.
Press (F4) to select ORP/mV mode.
Press (Menu) to quit and retain the current selection.

4. Conductivity (TDS/Salinity) Calibration

To achieve accurate Conductivity/TDS/Salinity results, the **WP-81** requires calibration to a known Conductivity standard. The TDS and Salinity values are derived from the Conductivity reading and do not require a separate calibration. The conductivity of a solution varies with temperature. The **WP-81** uses Automatic Temperature Compensation (ATC) referenced to the fixed temperature of 25°C.

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

4.1 Calibration Procedure

1. Plug the Conductivity sensor into the **Conductivity** socket.
If a k=0.1 or k=10 sensor is being used, ensure that the **WP-81** is set to the correct k factor before using the instrument (see section 16).
2. Switch the meter on.
3. Rinse the Conductivity sensor in distilled water. Shake off as much water as possible. Blot the outside of the sensor dry. **DO NOT BLOT THE SENSOR WIRES.**

4. **Zero Calibration**

Let the sensor dry in air.

Select Conductivity Calibration. (Menu) → **F1:Cal.** → **F1:Cond.**)

5. When the reading has stabilised at or near zero, press the (F1) key to calibrate.

A “*” will not be removed after a zero calibration.

6. **Standard Calibration**

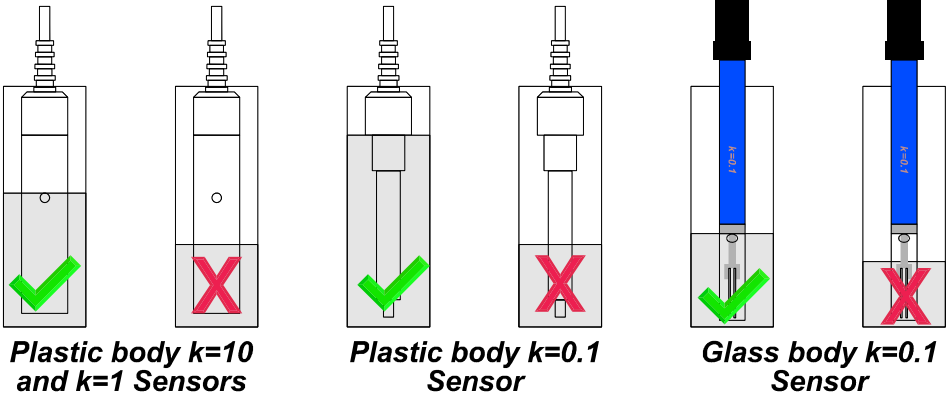
Allowable Conductivity standards are 150uS/cm, 1413uS/cm, 2.76mS/cm, 12.88mS/cm and 58.0mS/cm, and should be selected according to your range of interest.

If the **WP-81** does not recognise the standard, it will display the message, “**NOT STD**” during calibration. Calibration will fail if this message is displayed.

For plastic bodied $k=1$ and $k=10$ sensors, place the sensor into a sample of Conductivity standard, so that it is immersed at least to the vent hole in the white plastic cover. The white plastic cover **MUST** be in place for correct readings.

For plastic bodied $k=0.1$ sensors, the white plastic cover **MUST** be removed for correct readings.

For glass bodied sensors, immerse the sensor at least to the vent hole in the glass body.



DO NOT place the sensor directly into the bottle of standard. Discard the used sample of standard after use. It is advisable to use a narrow sample vessel to minimise the use of standard solution.

7. Select Conductivity Calibration. (Menu) → **F1:Cal.** → **F1:Cond.**)
8. When the reading has stabilised, press the (F1) key to calibrate.
The "*" will now be replaced by a decimal point, if calibration was successful.
9. The **WP-81** is now calibrated for Conductivity and is ready for use in this mode.

4.2 Calibration Notes

1. A Zero calibration should be performed at least monthly. In low conductivity applications (where a zero error is particularly significant) a zero calibration may have to be done weekly.
2. A Standard calibration should be performed at least weekly. Of course, more frequent calibration will result in greater confidence in results.
3. The **WP-81** does not require re-calibration when alternating between Conductivity, TDS and Salinity modes.
4. All calibration information is retained in memory when the **WP-81** is switched off, even when the battery is removed. This information can be recalled or printed later using the GLP function (see section 8).
5. The **WP-81** displays the value of the standard to which it will attempt to calibrate. Ensure that the standard value displayed corresponds to the standard that you are using.
6. If the **WP-81** does not recognise the standard, it will display the message, "**NOT STD**" during calibration. Calibration will fail if this message is displayed.

4.3 Calibration Messages

1. If a Zero calibration has been successfully performed, the **WP-81** will display the following message, and the zero value of the sensor. For example...

```
Calibrate OK  
Zero= 0.00 uS
```

2. If a Standard calibration has been successfully performed, the **WP-81** will display the following message, and the k factor of the sensor. For example...

```
Calibrate OK  
k= 1.00
```

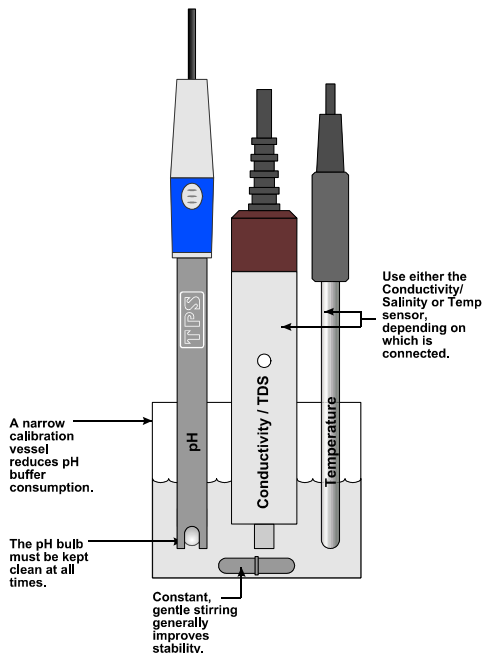
3. If a Standard calibration has failed, the **WP-81** will display the following message, and the failed k factor of the sensor. For example..

```
Calibrate Fail  
k= 1.50
```


5. pH Calibration

5.1 Calibration Procedure

1. Plug the pH sensor into the **pH** socket. Temperature measurements are made via the Conductivity sensor, so this needs to be connected for Automatic Temperature Compensation.
2. Switch the meter on.
3. Ensure that temperature has been calibrated or manually set (see sections 7.1 & 7.4). If the decimal point in the temperature reading is shown by a “*“, then the temperature value is not calibrated.
4. Remove the wetting cap from the pH sensor. Rinse the pH and Conductivity sensors in distilled water and blot them dry.
5. Ensure that you are using buffers which have been selected for automatic buffer recognition. See section 17 for a detailed explanation.
6. Place both sensors into a small sample of pH7.00 (or pH6.86) buffer, so that the bulb and reference junction are both covered, as per the diagram below. **DO NOT** place the sensors directly into the buffer bottle.



7. Select pH Calibration. (Menu → **F1:Cal.** → **F2:pH**)
8. When the reading has stabilised, press the (F1) key to calibrate. If a 1 point calibration has been performed, the “*” will not be removed until a full 2 point calibration has been performed.
9. Rinse the pH and Conductivity sensors in distilled water and blot them dry.
10. 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 6, above. **DO NOT** place the sensors directly into the buffer bottle.

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

11. Select pH Calibration. (Menu → **F1:Cal.** → **F2:pH**)
12. When the reading has stabilised, press the (F1) key to calibrate. The “*” will now be replaced by a decimal point, if calibration was successful.
13. The **WP-81** is calibrated for pH and is ready for taking pH measurements. Discard the used samples of buffer.

5.2 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 **WP-81** is switched off, even when the battery is removed. This information can be recalled or printed later using the GLP function (see section 8).
4. The **WP-81** displays the value of the pH buffer to which it will attempt to calibrate. Ensure that the buffer value displayed corresponds to the buffer that you are using.

5.3 Calibration Messages

1. If a 1-point calibration has been successfully performed, the **WP-81** will display the following message, and the asymmetry of the sensor. For example...

```
1 Point Cal. OK
Asy= 0.10pH
```

2. If a 1-point calibration has failed, the **WP-81** will display the following message, and the failed asymmetry value of the sensor. For example...

```
1 Point Cal. Fail
Asy= 1.50pH Hi
```

or :

```
1 Point Cal. Fail
Asy= -1.50pH Lo
```

3. If a 2-point calibration has been successfully performed, the **WP-81** will display the following message, and the asymmetry and slope of the sensor. For example...

```
2 Point Cal. OK
Asy= 0.10pH
```

then :

```
2 Point Cal. OK
Slope=100.0%
```

4. If a 2-point calibration has failed, the **WP-81** will display the following message, and the failed slope value of the sensor. For example...

```
2 Point Cal. Fail
Slope=130.0% Hi
```

or :

```
2 Point Cal. Fail
Slope= 70.0% Lo
```

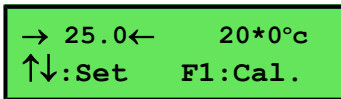
6. mV/ORP Calibration



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


7. Temperature Calibration

7.1 Calibration Procedure

1. Plug the Conductivity/Temperature sensor into the **Conductivity** socket. A separate temperature sensor can also be used in place of the Conductivity sensor for temperature value.
2. Switch the meter on.
3. 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.
4. Select Temperature Calibration. (Menu) → **F1:Cal.** → **F3:Temp**)
5. The reading from the sensor is now displayed on the right of the display, and the value you are going to set is shown on the left. For example...



6. When the reading on the right has stabilised, press the  and  keys until the reading on the left shows the same temperature as the mercury thermometer.
7. Press the **(F1)** key to calibrate the temperature value.
The “*” will now be replaced by a decimal point, if calibration was successful.

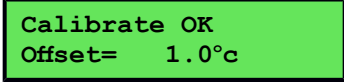
Alternatively, press the  key to abort temperature calibration.

7.2 Calibration Notes

1. Temperature calibration information is retained in memory when the **WP-81** is switched off, even when the battery is removed. This information can be recalled or printed later using the GLP function (see section 8).
2. Temperature does not need to be re-calibrated unless the sensor is replaced or the meter is initialised.

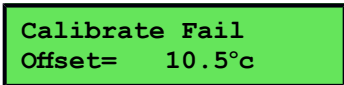
7.3 Calibration Messages

3. If a temperature calibration has been successfully performed, the **WP-81** will display the following message and the offset value of the sensor. For example...



Calibrate OK
Offset= 1.0°C

4. If a temperature calibration has failed, the **WP-81** will display the following message, and the failed offset value of the sensor.




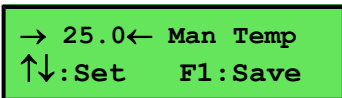
Calibrate Fail
Offset= 10.5°C

7.4 Manual Temperature Setting




If the Conductivity/Temperature sensor is not connected, and a temperature sensor is not used in its place, the temperature of the sample solution must be set manually for accurate pH measurements. A separate thermometer will be required for this.


NOTE: The Conductivity sensor has a separate sensor built in for automatic temperature compensation for Conductivity, TDS and Salinity.

1. Switch the meter on.
2. Measure the temperature of the sample.
3. Select Temperature Calibration. ( → **F1:Cal.** → **F3:Temp**)
4. The current temperature setting is now displayed.



→ 25.0← Man Temp
↑↓:Set F1:Save

5. Press the  and  keys until the display shows the temperature of the sample.
6. Press the  key to save the temperature value.

Alternatively, press the  key to quit and retain the current setting.

8. Good Laboratory Practices (GLP)

The **WP-81** keeps a record of the date and time of the last Conductivity, pH and Temperature calibrations as part of GLP guidelines.

8.1 To recall GLP information on the display

1. Switch the meter on.
2. Select the GLP menu. (Menu) → **F4:Setup** → **F3:GLP**)
3. Select **F1:Recall** from the menu.
4. The instrument model, firmware version number, and instrument serial number are displayed, along with a prompt describing how to scroll through the GLP information.
5. Press the (Down Arrow) key to sequentially scroll through the GLP information for all parameters. Press the (Up Arrow) key to scroll back to previous data. The sequence of information displayed is shown below. Press (Menu) to abort at any time.

```
WP81  V6.0  S1234
↓:More  ↑:Back
```

(Down Arrow):↓ (Up Arrow):↑

```
Cond Zero 0.00uS
@ 31/12/03 11:00
```

(Down Arrow):↓ (Up Arrow):↑

```
k=1.00 @ 2.76mS
@ 31/12/03 11:10
```

(Down Arrow):↓ (Up Arrow):↑

```
pH Asy 0.10pH
@ 31/12/03 11:40
```

(Down Arrow):↓ (Up Arrow):↑

```
pH Slope 100.0%
@ 31/12/03 11:50
```

(Down Arrow):↓ (Up Arrow):↑

```
Temp Offset 0.1°C
@ 31/12/03 12:00
```

(Down Arrow):↓

Exit

8.2 Failed Calibration

If calibration has failed, the GLP function will reset the date and time to zero. The **WP-81** still shows the results of the last successful calibration. For example...

Cond Zero 0.00uS
@ 00/00/00 00:00

k=1.00
@ 00/00/00 00:00

Asy 0.10pH
@ 00/00/00 00:00

Slope 100.0%
@ 00/00/00 00:00

Temp Offset 1.0°C
@ 00/00/00 00:00

Note that these calibration values are still used if further measurements are taken without re-calibrating.

8.3 Printing GLP Information to the RS232 Port

The GLP information stored in the instrument's memory can be sent to a printer or PC via the RS232 port. Switch the meter on.

1. Ensure that the **WP-81** RS232 cable is connected to the instrument and to the printer or PC.
2. Send the GLP information to the RS232 port.

(Menu) → **F4:Setup** → **F3:GLP** → **F3:Print**)

The GLP information is sent to the RS232 port in formatted ASCII text. For example...

8.4 Instrument Serial Number

In case the serial number that is fitted to the rear of the **WP-81** is removed or becomes illegible, it is also available on the **WP-81** display.

- The serial number is displayed at turn-on, for example...

```
WP81  v6.0  S1234  
Con  TDS  Sal  pH  °C
```

where **S1234** is the serial number.

- The serial number is display when recalling the GLP information (section 8.1).
- The serial number is included on the print-out of GLP information (section 8.3).

8.5 Additional GLP Features

Another GLP requirement is to record the date and time of every reading. The **WP-81** does this for you when readings are recorded either with the Notepad function (section 9) or the Automatic Logging function (section 10).

9. Notepad Function

9.1 Recording Readings into the Notepad

To record readings into the Notepad memory:

1. Press **F1** in normal display mode. The display should now look like this...

2.76mS	7.00pH
F1: 1	12:00:00

or :

2.00ppK	7.00pH
F1: 1	12:00:00

2. If you now press **F1**, the Conductivity/TDS/Salinity, pH, Temperature, Date and Time will be recorded into the notepad, and labelled as reading number 1.
3. Repeat steps 1 & 2 as often as required. The maximum number of readings that can be stored in the Notepad is 3600.

9.2 Recalling Records from the Notepad

To recall records from the Notepad onto the **WP-81** display:

1. Select the Notepad menu (**Menu** → **F2:Notepad**)
2. Select **F1:Recall** from the menu.
3. Record number 1 is now displayed, for example...

2.76mS	7.00pH
25.0°C	1 F2:Clk

4. Press **F2** to alternatively display the date and time or the data for this record.

Press **▲** to move forward through the records.

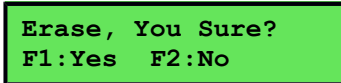
Press **▼** to move backward through the records.

Press and hold the **▲** or **▼** keys to roll rapidly through the readings.

9.3 Erasing Records from the Notepad

To erase all records from the Notepad:

1. Select the Notepad menu (Menu → **F2:Notepad**)
2. Select **F2:Erase** from the menu.
3. The **WP-81** now asks if you are sure that you wish to erase all records...



4. Press (F1) to erase all records from the Notepad
Press (F2) to quit without erasing the records from the Notepad.

9.4 Printing Records from the Notepad to the RS232 Port

5. Connect one end of the RS232 cable to the **Charger/RS232** socket of the **WP-81**. The charger, optional solar panel, or optional battery leads can be connected into the spare socket on the cable for long term use, if required.
6. Connect the other end of the RS232 cable to an RS232 Printer, or to COM1 or COM2 of a PC.
7. Ensure that the baud rate for the printer or PC and the **WP-81** are the same.

If necessary, alter the baud rate of the **WP-81** (see section 11.1).

The **WP-81** uses XON/XOFF protocol. Ensure that the printer or PC is set accordingly.

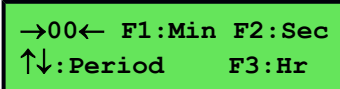
8. Select the Notepad menu. (Menu → **F2:Notepad**)
9. Select **F3:Print** from the menu.

Printing starts as soon as (F3) is pressed. The display shows the word “**Printing**” until printing is completed.



10. Automatic Data logging

The **WP-81** can automatically log records into the Notepad. First the logging period must be programmed, then automatic logging can be started and stopped as required. The clock must be set before attempting Automatic Data logging.

1. Select the Program menu. (Menu) → **F2:Notepad** → **F4:Prog.**)
2. The display should now look like this...



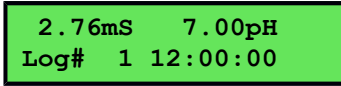
The screenshot shows a green rectangular display with black text. The text is arranged in two rows. The first row shows '→00← F1:Min F2:Sec'. The second row shows '↑↓:Period F3:Hr'. The '00' is centered between the left and right arrows.

3. Use the  and  keys to set the period at which the **WP-81** will automatically log records.
4. When the logging period has been correctly set, select whether this period is in minutes, seconds or hours.
Press **F1** to save the period as minutes.
Press **F2** to save the period as seconds.
Press **F3** to save the period as hours.
For example, if the period was set to **05**, followed by **F2**, then the **WP-81** will automatically log a record every 5 seconds.
5. The **WP-81** will ask if the records are to be logged into the Notepad, or sent directly to the RS232 port.
Press **F1** to log records into the Notepad (maximum of 3600 readings).
Press **F3** to send records directly to the RS232 port.
6. The automatic logging function is now programmed, and can be started and stopped as required.

Continued over the page...

7. To start automatic logging, press **F3** in normal display mode.

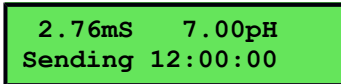
If the **WP-81** is logging into the Notepad, the display will look like this...



```
2.76mS    7.00pH
Log#  1 12:00:00
```

The log number will increment and the **WP-81** will beep each time a reading is recorded.

If the **WP-81** is sending records directly to the RS232 port, the display will look like this...



```
2.76mS    7.00pH
Sending 12:00:00
```

The **WP-81** will beep each time a record is sent to the RS232 port.

8. Press **F3** to stop automatic logging.

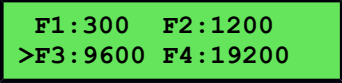
Notes:

1. The clock must be set before the **WP-81** will allow automatic logging to start. The message "**Clock Not Set**" is displayed if the clock is not set.
2. The Battery Saver function (section 13) is disabled while the meter is in Automatic Data logging mode, to stop the meter switching off while logging data. Even when the memory is full and the meter stops logging, the Battery Saver function is still disabled. This allows the data to be downloaded and the memory to be reset remotely.

11. RS232 Port

11.1 Setting the Baud Rate

1. Select the RS232 Set-up menu (Menu) → **F4:Setup** → **F4:Baud**)
2. The available baud rates are listed on the display...



```
F1:300  F2:1200
>F3:9600 F4:19200
```

The arrow shows the current selection.

3. Press (F1) to select 300 baud
Press (F2) to select 1200 baud
Press (F3) to select 9600 baud.
Press (F4) to select 19200 baud.
Press (Menu) to quit and retain the current setting.

11.2 Sending Readings to the RS232 Port

Press (F3) to instantly send readings to the RS232 port whenever the **WP-81** is in normal display mode. This function is disabled if the automatic logging period is set to greater than zero (see section 10).

Records can be sent directly to the RS232 port rather than stored in memory during automatic data logging. See section 10 for details.

11.3 RS232 Configuration

The **WP-81** RS232 configuration is 8 bits, No Parity, 1 Stop Bit, XON/XOFF Protocol.

11.4 Communication and Statistical Software

Communication between the **WP-81** and a PC can be handled with any RS232 communication software. **WinTPS** RS232 communication software for Windows® 95 and later is optionally available (part number 130086).

Once the data is saved to disk, the next problem is how to use it. The data sent by the **WP-81** is formatted in fixed-width columns that can be imported by programs such as Microsoft® Excel® and Lotus 123®.

Information on how to use the software and import data is provided in the manual provided with the **WinTPS** CD-ROM.

11.5 Commands

The following commands can be sent from a PC to the **WP-81**. Note that <cr> denotes carriage return and <lf> denotes a line feed.

Action	Command	Notes
Request current data	?D<cr>	Returns the current Conductivity/TDS/Salinity, pH, Temperature, date and time from the WP-81 . The log number returned is set to Zero.
Request logged data	?R<cr>	Returns all logged records from the WP-81 memory. The data ends with the message ENDS <cr>
Erase logged data	?E<cr>	Erases all logged records from the WP-81 memory. Returns the message ERASED <cr> to confirm that the records have been erased.
Request status information	?S<cr>	Returns the model name, firmware version number, instrument serial number and number of logged readings in memory, eg: WP81 ♦♦V1.0♦S1234♦9999 <cr>, where ♦ are spaces. Note that the number of logged readings is right-justified.
Request GLP information	?G<cr>	Returns all calibration GLP information, plus the instrument model and current date (see section 11.6 for data format and handshaking).

11.6 Data Format

Data is returned to the RS232 Port by the **WP-81** in the following format. Please note that a “ ♦ ” shown anywhere in this section denotes one space.

LLLL♦CCCCCccc♦PPPPPPppp♦TTTTTTttt♦dd/mm/yy♦hh:mm:ss

where...

- LLLL** is the Log Number. Maximum 4 characters, right justified.
The **WP-81** sends Zero for instant readings (section 11.2)
- CCCCC** is the Conductivity, TDS or Salinity Data. Maximum 6 characters, right justified.
- ccc** is the unit description, either “**uS♦**”, “**mS♦**”, “**ppM**”, “**ppK**”, “**%♦♦**” or “**psu**”.
- PPPPPP** is the pH or ORP/mV Data. Maximum 6 characters, right justified.
- ppp** is the unit description, sent as “**pH♦**” or “**mV♦**”
- TTTTTT** is the Temperature Data. Maximum 6 characters, right justified.
- ttt** is the Temperature unit description. The **WP-81** sends “**oC♦**” for real temperature data, or “**oCm**” when manual temperature compensation is being used.
- dd/mm/yy** is the date, month and year data.
- hh:mm:ss** is the hours, minutes and seconds data.

Notes

1. When requested by a PC with the ?D or ?R commands (section 11.5), the data is terminated with a carriage return.
2. When the data is sent by the **WP-81** using the Print function (section 9.4) or the Instant Send function (section 11.2), the data ends with a carriage return and a line feed.
3. When the Temperature is not within the ATC limits for Conductivity/TDS/Salinity or pH measurement “ATCLIM” will be sent instead of the Data.

11.7 GLP Data Format

GLP information is returned as 8 lines terminated by a carriage return. When using the “?G” command (section 11.5), the computer must respond with a character after receiving each line. For example...

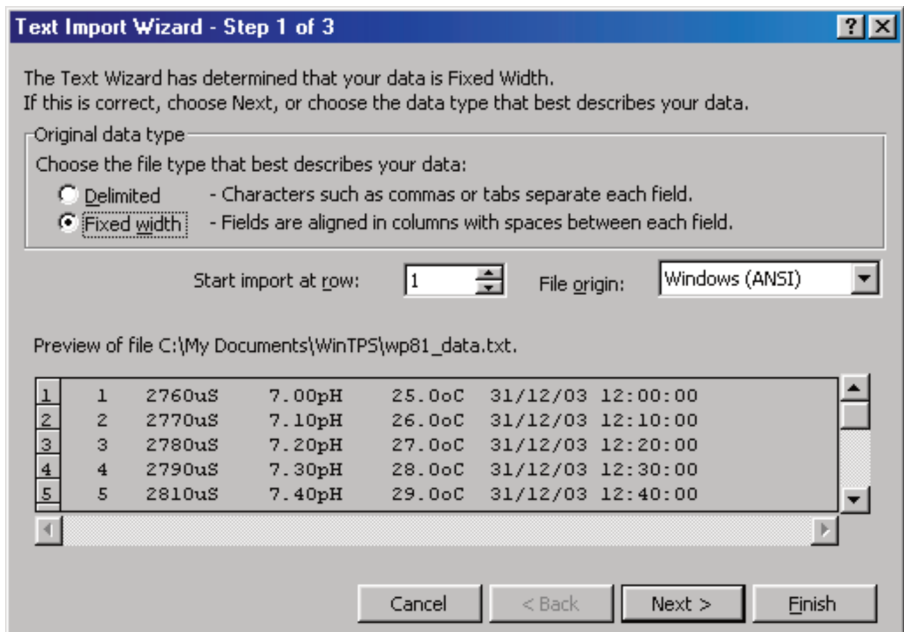
12. Importing Data into Microsoft Excel

The following procedure details the method for importing a **WP-81** text data file into Microsoft® Excel®.

1. Start Microsoft® Excel® and select File → Open
2. In the “Files of type:” pull-down box, choose “Text Files (*.prn; *.txt; *.csv)”.
3. Navigate to the folder where your data file is stored and double-click it to start the Text Import Wizard.

Note: The default data folder for the WinTPS software is “C:\My Documents\WinTPS”.

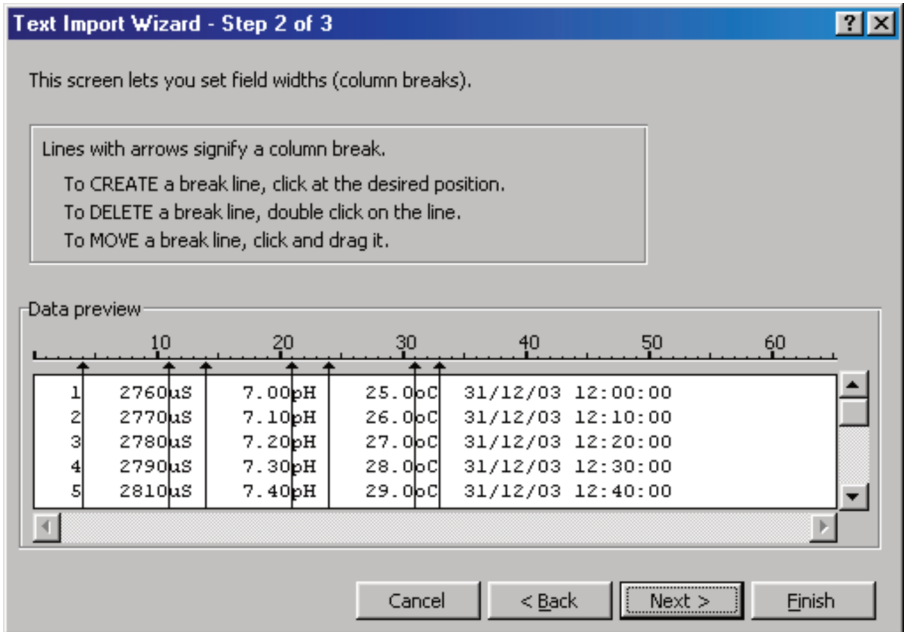
4. In step 1 of the Text Import Wizard select “Fixed width”, as per the sample screen below, then press “Next >”.



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- Step 2 of the Text Import Wizard allows you to select the points at which each data field will break into a new column. The sample screens below show where TPS recommends the breaks be inserted.

Press “Next >” after the column breaks have been inserted.



- Simply press “Finish” at step 3 of the Text Import Wizard. TPS recommends that the data format for each column be set once the data is in spreadsheet format.

For help on formatting the data columns, charting, graphing or other operations please consult the Microsoft® Excel® help file. Alternatively please contact TPS and we will try to provide further assistance.

13. Battery Saver Function

The **WP-81** 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 switched off for continuous use.

To enable or disable the battery saver function:

1. Switch the meter on.
2. Select Battery Saver Set-up (Menu) → **F4:Setup** → **F1:Batt**)
3. The battery saver menu is now displayed. For example...




The arrow indicates the current selection.


The bar graph and percentage indicate the approximate level of charge in the battery.

4. Press (F1) to disable the battery saver function for continuous use.
Press (F2) to enable the battery saver function. The meter will switch itself off if no key has been pressed for five minutes.
Press (Menu) to quit the battery saver menu and retain the current setting.

Notes:


1. For troubleshooting purposes, the battery volts can also be displayed in the battery saver menu. Press (F3) to display battery volts.
2. The  symbol flashes when the battery volts drops below 5.60 volts. At 5.00 volts the meter turns itself off.
3. The Battery Saver function is disabled while the meter is in Automatic Data logging mode (section 10), to stop the meter switching off while logging data. Even when the memory is full and the meter stops logging, the Battery Saver function is still disabled. This allows the data to be downloaded and the memory reset remotely.

14. Recharging the Battery

The  symbol flashes when the battery drops below 5.60 volts. The battery should be recharged at this point. If the battery is not recharged, the **WP-81** will switch itself off when the battery drops below 5.00 volts.

To recharge the battery...

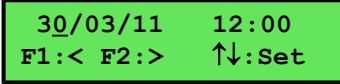
1. Plug the battery charger, solar panel, or car cigarette lighter adaptor into the **Charger/RS232** socket. **DO NOT** plug into the **Conductivity / TDS** socket, as this will damage the **WP-81**.
2. Charge for approximately 8 hours for full capacity. The **WP-81** has special circuitry to prevent overcharging, so the charger can be used continuously.

To ensure optimum battery life and capacity, the **WP-81** should only be charged once the  symbol starts to flash.

15. Clock Function

15.1 Setting the Clock

1. Select the Clock Set-up menu (Menu) → **F4:Setup** → **F2:Clock**)
2. The display now shows the current date and time. The cursor starts at the day.



30/03/11 12:00
F1:< F2:> ↑↓:Set

3. Press the (Up) and (Down) keys until the day is correct.
4. Press (F2) to move to the month. Press the (Up) and (Down) keys until the month is correct.
5. Press (F2) to move to the year. Press the (Up) and (Down) keys until the year is correct.
6. Press (F2) to move to the hour. Press the (Up) and (Down) keys until the hour is correct.
7. Press (F2) to move the cursor to the minutes. Press the (Up) and (Down) keys until the minutes are correct.
8. Check that the date and time are correct.

Press (F2) to save the settings.

If any changes are needed, press the (F1) key to move left to the desired position.

Press (Menu) to quit without resetting the clock.

Notes

1. The **WP-81** does not test for a valid day of the month when setting the clock (eg: attempting to enter 30/03/11 is not corrected).
2. The **WP-81** does test for leap years.

15.2 Displaying or Hiding the Clock

The time is normally displayed along with the Conductivity/TDS/Salinity, pH and Temperature readings.

Press (F2) in normal display mode to hide the time.

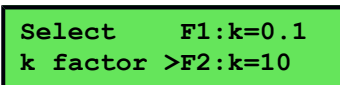
Press (F2) again to display the time plus the date.

The temperature reading replaces the date after 5 seconds.

16. Selecting k=0.1 or k=10 Conductivity Sensors

The **WP-81** automatically recognises a k=1.0 sensor. The **WP-81** **does not** automatically recognise k=0.1 or k=10 sensors. When a k=0.1 or k=10 sensor is used, the **WP-81** must be set to the correct k factor before use. The following procedure describes how to select a k=0.1 or k=10 sensor.

1. Switch the meter **OFF**.
2. Connect the k=0.1 or k=10 sensor.
3. Press **and HOLD** the **(F2)** key while switching the meter back on.
4. The k factor selection menu is now displayed (only if the k=0.1 or k=10 sensor is connected)...



```
Select      F1:k=0.1
k factor >F2:k=10
```

The arrow indicates the current selection.

5. Press **(F1)** to select a k=0.1 sensor.
Press **(F2)** to select a k=10 sensor.
Press **(Menu)** to quit buffer selection and retain the current setting.

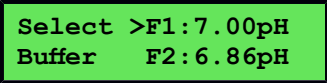
Notes

1. The manual k factor selection is kept in memory when the meter is switched off, even if the battery is removed.
2. The manual k factor selection is reset to k=10 during initialisation.
3. The **WP-81** will always automatically recognise a k=1.0 sensor, regardless of the manual k factor selection.
4. Calibration settings for k=0.1, k=1.0 and k=10 sensors are **NOT** stored separately. The **WP-81** requires re-calibration when a new k factor sensor is connected.

17. Selecting Buffers for Auto Buffer Recognition

The **WP-81** 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.

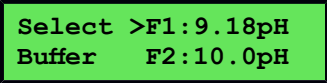
1. Switch the meter **OFF**.
2. Press **and HOLD** the **(F1)** key while switching the meter back on.
3. The buffer selection menu is now displayed.



```
Select >F1:7.00pH
Buffer   F2:6.86pH
```

The arrow indicates the current selection.

4. Press **(F1)** to select pH7.00 as the primary buffer.
Press **(F2)** to select pH6.86 as the primary buffer.
Press **(Menu)** to quit buffer selection and retain the current setting.
5. The display will now show the currently selected high pH buffer.



```
Select >F1:9.18pH
Buffer   F2:10.0pH
```


The arrow indicates the current selection.

6. Press **(F1)** to select pH9.18 as the high pH buffer.
Press **(F2)** to select pH10.01 as the high pH buffer (the display shows 10.0 for the latter, but this buffer is stored as pH10.01).
Press **(Menu)** to quit buffer selection and retain the current setting.
7. The setting is kept in memory when the meter is switched off, even if the battery is removed.

18. Initialising the WP-81

If the calibration settings of the **WP-81** exceed the allowable limits, the unit may need to be initialised to factory default values. This action may be required if the sensor is replaced.

To initialise the **WP-81**:

1. Switch the **WP-81** OFF.
2. Press **and HOLD** the  key while switching the **WP-81** back on.
3. The following messages should be displayed...

```
Initialized
MUST ReCalibrate
```

then :

```
WP81s V6.0 S1234
Con TDS Sal pH °C
```

(The “s” after **WP-81** is shown when the RS232 serial port option is fitted)

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

Notes:


1. The TDS Factor is reset to 0.65 when the meter has been initialized.
2. When the **WP-81** is initialised, the manual k factor selection is re-set to k=10. See section 16 if you wish to select a k=0.1 sensor.

19. Instrument firmware version number.

If you need to contact TPS for any further technical assistance, the version number of your **WP-81** firmware may of benefit to us. The version number is displayed by the **WP-81** at turn-on.

20. Troubleshooting

20.1 General Errors

Error Message	Possible Causes	Remedy
Factory Cal. Failed See Handbook	The EEPROM chip which contains the factory calibration information has failed.	The unit must be returned to TPS for service.
Memory Failed Calibration Lost Initialised MUST ReCalibrate	User calibration settings have been lost or corrupted.	Re-calibrate the instrument. A 2-point calibration will be required for Conductivity, & pH (sections 4.1 & 5.1) and a 1 point calibration for temperature (section 7.1).
Flashing  symbol.	Battery is below 5.60 volts.	Recharge the battery. Note that the unit will switch itself off when the battery falls below 5.00 volts.
Meter displays the word OFF , and switches off.	Battery is below 5.00 volts.	Recharge the battery. If this fails, check the charger. If charger OK, replace the battery.
Meter will not turn on.	1. Battery is exhausted.	Recharge the battery. If this fails, check the charger. If charger OK, replace the battery.
	1. Faulty Instrument	Return to factory for repair.
Battery does not charge up when charger is connected.	1. Faulty battery charger or faulty battery.	Connect the charger and switch the power on. Display the battery volts in the battery saver menu (section 13). If the battery volts are increasing then the charger is OK. If the battery volts do not increase, then the charger is faulty. Replace the charger or the battery, as required.
	1. Faulty instrument.	Return to factory for repair.

20.2 Conductivity 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 18.
Unit attempts Span calibration instead of Zero calibration.	Sensor has Zero error.	Thoroughly rinse sensor in distilled water and allow to completely dry in air before attempting zero calibration. If instrument does not calibrate at Zero with sensor disconnected, then the instrument is faulty.
Standard calibration fails, and k factor is greater than 0.133, 1.33 or 13.3, (depending on k factor of sensor).	<ol style="list-style-type: none"> Sensor is not immersed deeply enough. Sensor may have a build-up of dirt or oily material on sensor wires. Platinum-black coating has worn off. Standard solution is inaccurate. Sensor is faulty. Faulty instrument. k-factor incorrectly set if using $k=0.1$ or $k=10$ sensor. 	<p>Immerse sensor at least to the vent hole in the white plastic cover.</p> <p>Clean sensor, as per the instructions detailed in section 21.1.</p> <p>Sensor requires replatinisation. Return to the factory, or see details in section 21.2.</p> <p>Replace standard solution.</p> <p>Return sensor to factory for repair or replacement.</p> <p>Return to factory for repair.</p> <p>Set the correct k-factor, as per section 16.</p>

Continued next page...

Conductivity Troubleshooting, continued...

<p>Standard calibration fails, and k factor is less than 0.075, 0.75 or 7.5, (depending on k factor of sensor).</p>	<ol style="list-style-type: none"> 8. White protective cover is not fitted or upside down. 9. Standard solution is inaccurate. 10. Sensor may have a build-up of conductive material, such as salt. 11. Sensor is faulty. 12. Faulty instrument. 13. k-factor incorrectly set if using k=0.1 or k=10 sensor. 	<p>The white protective cover MUST be fitted for correct readings. The vent hole must be towards the cable end of the sensor.</p> <p>Replace standard solution.</p> <p>Clean sensor, as per the instructions detailed in section 21.1.</p> <p>Return sensor to factory for repair or replacement.</p> <p>Return to factory for repair.</p> <p>Set the correct k-factor, as per section 16.</p>
<p>Inaccurate readings, even when calibration is successful.</p>	<ol style="list-style-type: none"> 1. Sensor may have a build-up of dirt or oily material on sensor wires. 2. Platinum-black coating has worn off. 	<p>Clean sensor, as per the instructions detailed in section 21.1.</p> <p>Sensor requires replatinisation. Return to the factory, or see details in section 21.2.</p>
<p>Readings drift.</p>	<ol style="list-style-type: none"> 1. Sensor may have a build-up of dirt or oily material on sensor wires. 	<p>Clean sensor, as per the instructions detailed in section 21.1.</p>
<p>Readings are low or near zero.</p>	<ol style="list-style-type: none"> 1. Sensor may have a build-up of dirt or oily material on sensor wires. 2. Sensor is not immersed deeply enough. 3. Sensor is faulty. 4. Faulty instrument. 5. k-factor incorrectly set if using k=0.1 or k=10 sensor. 	<p>Clean sensor, as per the instructions detailed in section 21.1.</p> <p>Immerse sensor at least to the vent hole in the white plastic cover.</p> <p>Return sensor to factory for repair or replacement.</p> <p>Return to factory for repair.</p> <p>Set the correct k-factor, as per section 16.</p>
<p>Display flashes "ATC" and "LIMIT"</p>	<p>The Temperature is not within the ATC limits.</p>	<p>Cool/Heat solution before taking measurements.</p>

20.3 pH and mV/ORP 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 18.
1 Point calibration fails (Asymmetry is greater than +/- 1.00 pH).	<ol style="list-style-type: none"> Reference junction blocked. Reference sensor contaminated. 	<p>Clean reference junction, as per instructions supplied with the sensor.</p> <p>Flush with distilled water and replace sensor.</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 primary pH buffer for which the WP-81 has been set (see section 17).</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>
Unstable readings.	<ol style="list-style-type: none"> Sensor chamber needs to be refilled. Reference junction blocked. Glass bulb not clean. Bubble in glass bulb. Faulty connection to meter. Reference junction not immersed. KCl crystals around reference junction, inside the electrolyte chamber. 	<p>Refill with saturated KCl filling solution.</p> <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>

Continued next page...

pH and ORP/mV Troubleshooting, continued...

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.	1. Check connector. Replace if necessary. 1. Replace sensor.
Displays 4-5 pH for all solutions.	Glass bulb or internal stem cracked.	Replace sensor.
Display flashes "ATC" and "LIMIT"	The Temperature is not within the ATC limits.	Cool/Heat solution before taking measurements.

20.4 Temperature Troubleshooting

Symptom	Possible Causes	Remedy
Displays "OVR°C" when sensor is plugged in.	1. Faulty sensor. 2. Faulty instrument.	Fit new sensor, part number 122201. Return to factory for repair.
Temperature inaccurate and cannot be calibrated.	1. Faulty connector. 2. Faulty sensor. 3. Faulty instrument.	Check the connector and replace if necessary. Fit new sensor, part number 122201. Return to factory for repair.

21. Appendices: pH and Conductivity Sensor Theory

21.1 Care, Cleaning and Maintenance of Conductivity Sensors

21.1.1 Care of Conductivity sensors

The conductivity section of the sensor supplied with your **WP-81** consists of two platinum wires that are plated with a layer of “platinum-black”. This is quite a soft layer and is required for stable, accurate measurements. In time, the platinum-black layer may wear off in some applications, at which time the sensor will require replatinising (see section 21.2). You can help to maintain the platinum-black layer by following these simple rules:

1. **NEVER** touch or rub the sensor wires with your fingers, cloth etc.
2. Avoid using the sensor in solutions that contain a high concentration of suspended solids, such as sand or soil, which can abrade the sensor wires. Filter these types of solutions first, if possible.
3. Avoid concentrated acids. If you must measure acids, remove the sensor immediately after taking the measurement and rinse well with distilled water.

Conductivity sensors can be stored dry. Ensure that the sensor is stored in a covered container, to avoid dust and dirt build-up.

21.1.2 Cleaning of Conductivity of Sensors.

Platinised platinum Conductivity sensors can only be cleaned by rinsing in a suitable solvent. **DO NOT wipe the sensor wires**, as this will remove the platinum-black layer.

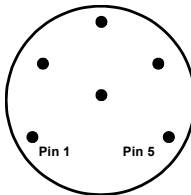
1. Rinsing in distilled water will remove most build-ups of material on the sensor wires.
2. Films of oils or fats on the sensor wires can usually be removed by rinsing the sensor in methylated spirits.
3. Stubborn contamination can be removed by soaking the sensor in a solution of 1 part Concentrated HCl and 10 parts distilled water. The sensor should not be soaked for more than approximately 5 minutes, otherwise the platinum-black layer may start to dissolve.
4. If all of these methods fail, then the last resort is to physically scrub the sensor wires, which will remove the contaminant and the layer of platinum-black. Use only a cloth or nylon scouring pad. **DO NOT USE STEEL WOOL**. The sensor will then need to be cleaned in HCl, as per step 3 and replatinised, as per section 21.2.

21.2 Replatinising Conductivity Sensors

There are several ways to replatinise Conductivity sensors.

1. The simplest way is to return the sensor to the TPS factory. We can fully clean the sensor, replatinise it and test all aspects of its performance.
2. An automatic replatiniser is available from TPS, along with replatinising solution. This will plate the sensors for the right amount of time at the correct current. Ordering details are as follows:

Automatic Conductivity Sensor Replatiniser	Part No 122160
20mL Platinising Solution (for approx 30 uses)	Part No 122300
3. Conductivity sensors can be manually replatinised, according to the following procedure:
 - a) Soak the sensor in a solution of 1 part Concentrated HCl and 10 parts distilled water for approximately 5 minutes.
 - b) Rinse the sensor well in distilled water.
 - c) Immerse the sensor in platinising solution at least to the vent hole in the white plastic cover. Platinising solution is available from TPS (part no 122300).
 - d) Alternatively, platinising solution can be prepared by dissolving 1g of Hydrogen Chloroplatinate (H_2PtCl_{16}) in 30mL of distilled water, and including about 0.01g of Lead Acetate ($(CH_3COO)_2Pb$) and a drop or two of concentrated HCl.
 - e) Apply a direct current of 10mA between pins 1 and 5 of the sensor plug, as per the diagram below. Reverse the polarity every 30 seconds. After approximately 8 minutes (4 minutes per sensor wire), they should have an even “soot” like appearance. Avoid excess current and this will cause incorrect platinising.
 - f) After platinising, rinse the sensor well in distilled water.
 - g) If you have any doubts about any of these steps, then you should consider returning the sensor to the factory. The cost of replatinising is quite low, and you will be guaranteed of the best possible result.



Sensor Connector

21.3 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.

21.3.1 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 21 -1 illustrates how asymmetry is expressed.

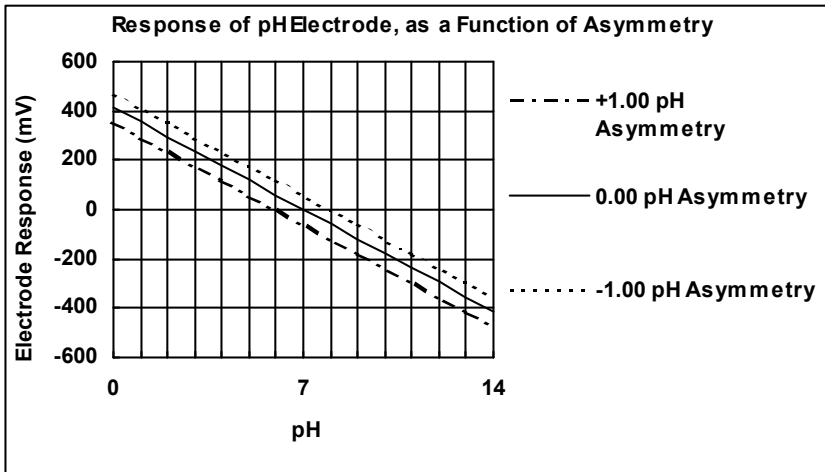


Figure 21-1

21.3.2 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 21 -2).

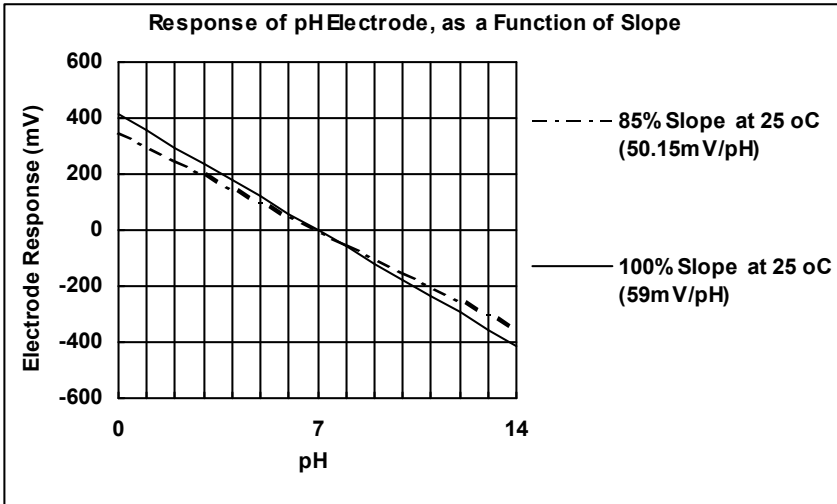


Figure 21-2

21.3.3 Temperature Compensation

The slope of a pH sensor (section 21.3.2) 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 21 -3 shows the slope of a pH sensor at various temperatures.

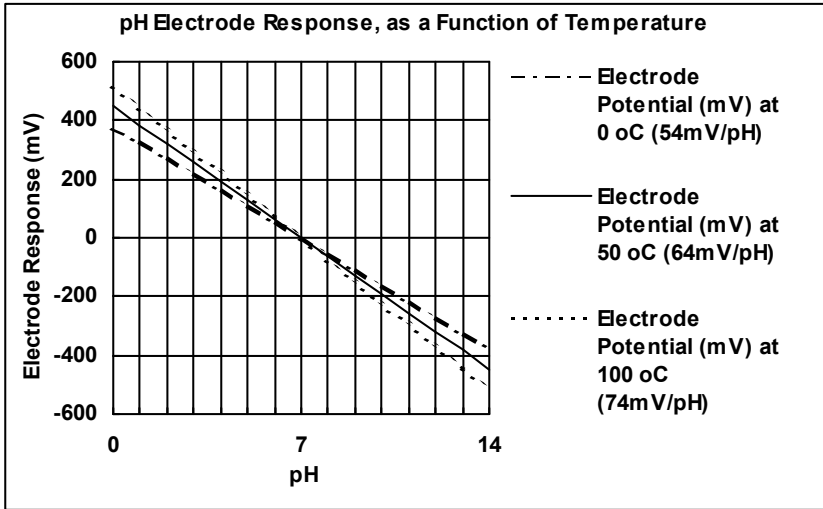


Figure 21-3