Congratulations !

You have purchased the latest in Handheld Dissolved Oxygen-Temperature instrumentation. We trust that your new **WP-82** will give you many years of reliable service.

The **WP-82** 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-82**. It also contains a full listing of all of the items that you should have received with your **WP-82**. 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-82**, 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.

TPS Pty Ltd
4 Jamberoo Street
Springwood, Brisbane,
Australia, 4127

Phone : (07) 32 900 400
International : 61 7 32 900 400

Fax : (07) 3808 4871
International : 61 7 3808 4871

E-mail : tps@tps.com.au
Web : www.tps.com.au

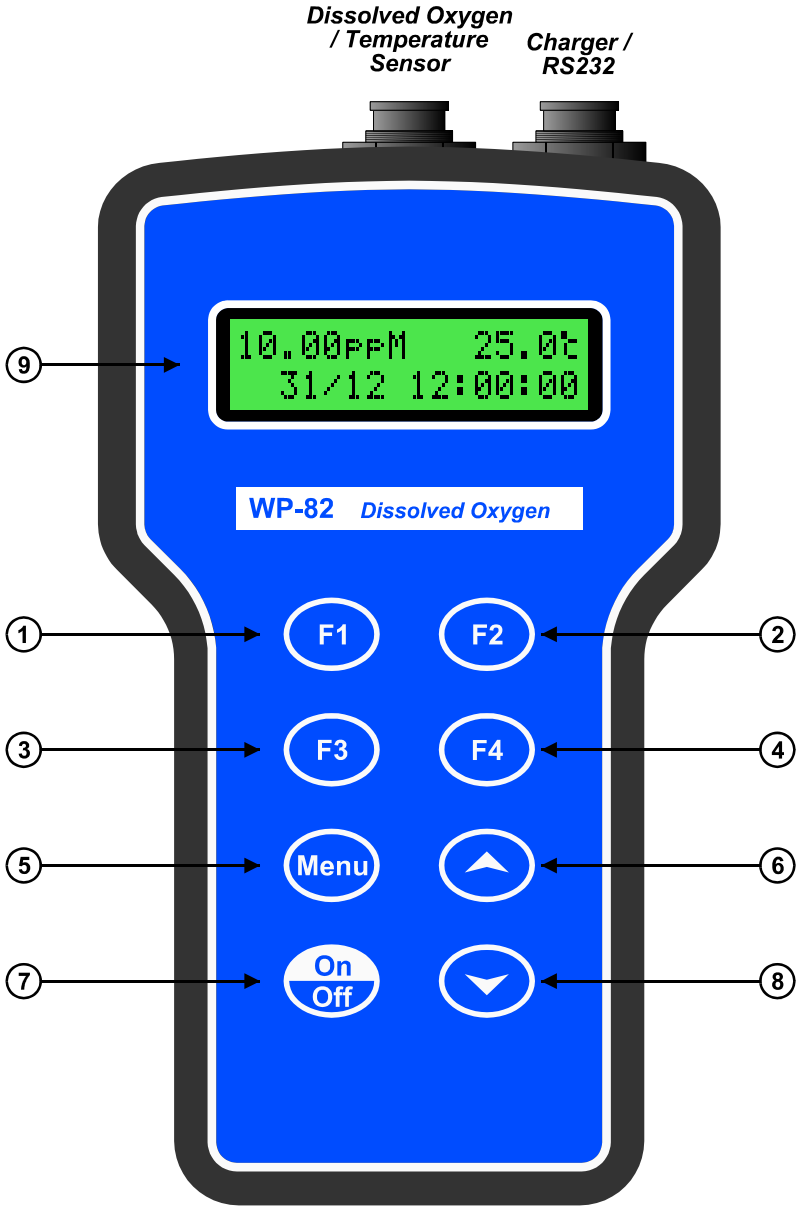
WP-82 & WP-82Y
Dissolved Oxygen - Temp Meter

Version : 1.4
Date : 05-Dec-2005
Author : AB

Contents

1. Introduction

1.1 WP-82 Display and Controls



① F1

Press to record readings into memory. See section 9.1.

Also used to switch the Altitude or Atmospheric Pressure Correction system on or off. See section 7.1.

② F2

Press to show or hide the date, time and Altitude or Pressure. See section 14.2.

③ F3

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.

④ F4

Only used within the menu system on the **WP-82**.

⑤ Menu

Press to access the user-friendly menu system which makes the **WP-82** easy to operate.

⑥ and ⑧

The ⑥ and ⑧ keys are used for calibrating temperature readout (section 5.1), setting the clock (section 14.1), setting the automatic logging period (section 10), and displaying GLP information (section 8.1).

The ⑥ key is also used to initialise the **WP-82** at turn-on. See section 15.

⑦ On Off

Switches the **WP-82** on and off.

⑨ **Display**

32 character alpha-numeric display with user-friendly menu and prompting system. Shows Dissolved Oxygen, Temperature simultaneously. Date, time, manual salinity value, altitude or pressure can also be displayed.

1.2 Unpacking Information

Before using your new **WP-82**, please check that the following accessories have been included:

1.2.1 WP-82

		Part No
1.	**WP-82** Dissolved Oxygen-Temperature Instrument	123147
2.	Battery charger	130037
3.	**WP-82 / WP-82Y** Handbook	130050

*Options that may have been ordered with your **WP-82**:*

1.	ED1 Dissolved Oxygen-Temperature Sensor (no cable)	123400
2.	1m Detachable cable for ED1	123228
3.	3m Detachable cable for ED1	123230
4.	5m Detachable cable for ED1	123232
5.	RS232 Serial Interface Cable	130041
6.	WinTPS Communication Software for Windows 95 & Later	130086
7.	USB to Serial Adaptor (requires 130041 also)	130087
8.	Hard Carry Case	130059
9.	Battery charger lead for 12V cigarette lighter socket	130046
10.	Solar Panel	130012
11.	Charger cable with clips for external 12V battery	130052

Other spares:

1.	6V NiMH Rechargeable Battery	130038

1.2.2 WP-82Y

		Part No
1.	**WP-82Y** Dissolved Oxygen-Temperature Instrument	123148
2.	Battery charger	130037
3.	**WP-82 / WP-82Y** Handbook	130050

*Options that may have been ordered with your **WP-82Y**:*

1.	YSI Dissolved Oxygen-Temperature Sensor	123204
2.	1m Cable for YSI DO_2 Sensor	123212
3.	3m Cable for YSI DO_2 Sensor	123221
4.	5m Cable for YSI DO_2 Sensor	123222
5.	RS232 Serial Interface Option (includes cable)	130039
6.	WinTPS Communication Software for Windows 95 & Later	130086
7.	USB to Serial Adaptor (required 130039 also)	130087
8.	Hard Carry Case	130059
9.	Battery charger lead for 12V cigarette lighter socket	130046
10.	Solar Panel	130012
11.	Charger cable with clips for external 12V battery	130052

Other spares:

1.	6V NiMH Rechargeable Battery	130038
2.	RS232 Interface Cable	130041

1.3 Specifications

ppM (mg/L)

Ranges * ..... 0 to 20.00 ppM (ED1 and YSI sensors)
20.0 to 40.0 ppM (YSI sensor only)
Resolution ..... 0.01 & 0.1 ppM
Accuracy ..... ±0.2% of full scale of selected range

% Saturation

Ranges * ..... 0 to 240.0 % Saturation (ED1 and YSI sensors)
240 to 450 % Saturation (YSI sensor only)
Resolution ..... 0.1 & 1 % Saturation
Accuracy ..... ±0.3 % Saturation

% Gaseous

Ranges * ..... 0 to 45.0 % Gaseous (ED1 and YSI sensors)
45 to 100 % Gaseous (YSI sensor only)
Resolution ..... 0.1 & 1 % Gaseous
Accuracy ..... ±0.1 % Gaseous

* Ranges subject to sensor performance. Automatic range selection for YSI sensor.

Temperature

Range ..... -10.0 to 120.0 ^{o}C (Sensor limit 50 ^{o}C)
Resolution ..... 0.1 ^{o}C
Accuracy ..... ±0.2 ^{o}C

Salinity Correction ..... User-set, from 0 to 50.0 ppK NaCl

Barometric Pressure Correction ..... User-set, from 800 to 1100 HPa

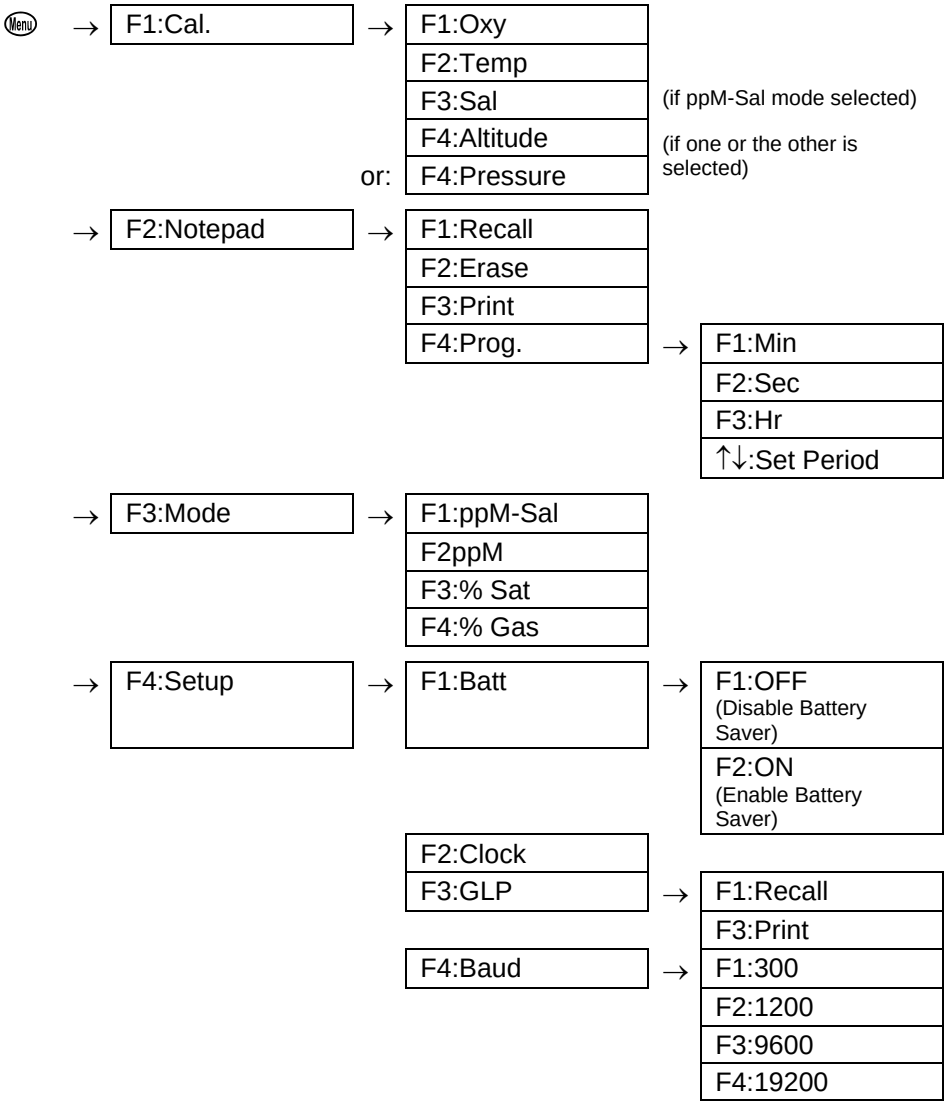
Altitude Correction ..... User-set, from 0 to 5000m

General Specifications

Temperature Compensation	Dual automatic temperature compensation system.
DO_2 Sensor Span Range	WP82 : 70 to 160% WP82-Y : 65 to 200%
DO_2 Sensor Zero Range	0 to 7.5%
Temp. Sensor Offset Range	-10.0°C to +10.0°C
Automatic Calibration	Zero in Sodium Sulphite (Na_2SO_3) Solution Span in Air.
Memory	2400 readings including date and time
Automatic Logging	User-set for one reading every 1 to 90 seconds, Minutes or 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. Readout of battery voltage available for troubleshooting.
Good Laboratory Practices	Date, Time and Value of last Dissolved Oxygen and Temperature calibration are stored, along with Altitude or Pressure setting at time of calibration. This information can be recalled or sent to the RS232 port at any time.
Power	6V NiMH Rechargeable Battery for approx 75 hours operation.
Dimensions	187 x 110 x 51 mm
Mass	Instrument only : Approx 440g Full Kit : Approx 1.5kg
Environment	Temperature : 0 to 45 °C Humidity : 0 to 90 % R.H.

2. WP-82 Menu Structure

A detailed breakdown of the menu system of the **WP-82** is shown below. This diagram provides a quick reference for the menu functions available for the **WP-82**.

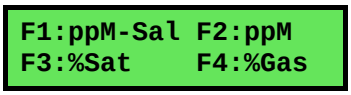


3. Operating Modes

The **WP-82** has four operating modes : Salinity-corrected ppM, uncorrected ppM, % Saturation, and % Gaseous.

To select a mode…

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



2. Press F1 to select Salinity-corrected ppM mode.

   Press F2 to select ppM mode with no salinity correction.

   Press F3 to select % Saturation mode.

   Press F4 to select % Gaseous mode.

4. Dissolved Oxygen Calibration

4.1 Calibration Procedure

1. Plug the Dissolved Oxygen sensor into the **Sensor** socket.
2. Switch the meter on.
3. Select the mode of your choice, as per section 3.
4. Ensure that temperature has already been calibrated (see section 5.1).

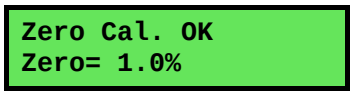
   NOTE: A " ∗ " in place of the decimal point in the temperature readout indicates that temperature is not calibrated.
5. Rinse the Dissolved Oxygen sensor in distilled water and blot dry.
6. **Zero Calibration**
   (a) Place the sensor into an oxygen-free solution. This solution may be prepared by dissolving 2g of Sodium Sulphite in 100mL of distilled water. A 50g bottle of Sodium Sulphite powder is supplied with a new ED1 sensor for this purpose (part number 123302).
   (b) Allow the reading to stabilise at or near zero. This may take 2-3 minutes.
   (c) Select Oxygen Calibration. (Menu → **F1:Cal.** → **F1:Oxy**)
   (d) Press the F1 key to calibrate.
   (e) A " ∗ " will not be removed from the display after a Zero Calibration.
7. Rinse the Dissolved Oxygen sensor in distilled water and blot dry.
8. **Air Calibration**
   (a) Hang the Dissolved Oxygen sensor in air. The tip of the sensor should be pointing downwards.
   (b) Allow the reading to stabilise. After a zero calibration, this may take up to 5 minutes.
   (c) Select Oxygen Calibration. (Menu → **F1:Cal.** → **F1:Oxy**)
   (d) Press the F1 key to calibrate.
   (e) A " ∗ " in the display will be replaced by a decimal point after a successful air calibration.
9. The **WP-82** is now calibrated and is ready for use.

4.2 Calibration & Measurement Notes

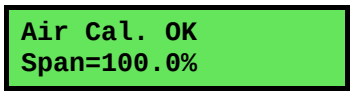
1. When taking sample measurements, always ensure that there is adequate flow of solution past the membrane for accurate, stable readings. See section 18.5.
2. If salinity-corrected ppM Dissolved Oxygen readings are required, set the salinity correction value before taking sample measurements. See section 6.
3. If Altitude or Atmospheric Pressure Correction is selected, set the correction value before calibrating and taking measurements. See section 7.
4. A zero calibration should be performed at least monthly. In applications where there is a low level of dissolved oxygen, a zero calibration may have to be done weekly.
5. An air calibration should be performed at least weekly. Of course, more frequent calibration will result in greater confidence in results.
6. The salinity correction value is ignored during zero and air calibration. There is therefore no need to re-set the salinity correction value when calibrating Dissolved Oxygen.
7. For optimum accuracy, set the altitude of atmospheric pressure before calibration.
8. All calibration information is retained in memory when the **WP-82** is switched off, even when the battery is removed. This information can be recalled or printed later using the GLP function (see section 8).

4.3 Calibration Messages

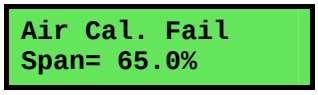
1. If a Zero calibration has been successfully performed, the **WP-82** will display the following message, and the zero value of the sensor. For example…



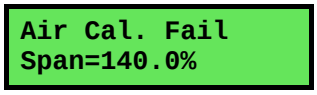
2. If an Air calibration has been successfully performed, the **WP-82** will display the following message, and the span value of the sensor. For example…



3. If an Air calibration has failed, the **WP-82** will display the following message, and the failed span value of the sensor. For example…



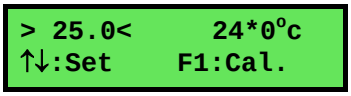
or:



5. Temperature Calibration

5.1 Calibration Procedure

1. Plug the Dissolved Oxygen/Temperature sensor into the **Sensor** socket.
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.** → **F2:Temp**).
5. The reading from the probe is now displayed on the right of the display, and the value you are going to set is shown on the left.



6. When the reading on the right has stabilised, press the ⌃ or ⌄ keys until the reading on the left shows the same temperature as the mercury thermometer.
7. Press the F1 key to calibrate the temperature readout.

   The * will now be replaced by a decimal point, if calibration was successful.

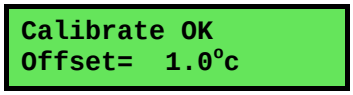
   Alternatively, press the Menu key to abort temperature calibration.

5.2 Calibration Notes

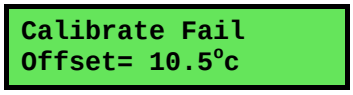
1. Temperature calibration information is retained in memory when the **WP-82** is switched off, even when the battery is removed. This information can be recalled or printed later using the GLP function (see section 8).
2. Temperature does not need to be recalibrated unless the sensor is replaced or the meter is initialised.

5.3 Calibration Messages

1. If a temperature calibration has been successfully performed, the **WP-82** will display the following message and the offset value of the probe. For example…



2. If a temperature calibration has failed, the **WP-82** will display the following message, and the failed offset value of the probe. For example…



6. Salinity Correction

Manual salinity correction for ppM Dissolved Oxygen readings is available on the **WP-82**.

1. Select Salinity-corrected ppM mode (section 3).
2. Select the Salinity correction calibration (Menu → **F1:Cal.** → **F3:Sal**).
3. The current salinity correction value is now displayed. For example…

   ```
   > 36.0< ppK Sal.
   ↑↓:Set    F1:Save
   ```

   Press the ⌃ and ⌄ keys until the display shows the desired salinity correction value.
4. Press the F1 key to save the salinity correction value.

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

7. Altitude or Atmospheric Pressure Correction

Manual altitude or atmospheric pressure correction are available on the **WP-82**. Either one or the other may be selected at any one time or the system can be switched off.

7.1 Selecting Altitude or Pressure Correction

1. Switch the **WP-82** off.
2. Press and hold the F1 key while switching the **WP-82** back on.
3. The Altitude or Pressure mode menu is now displayed…

   ```
   F1:Altitude
   F3:Pressure >F4:OFF
   ```

   The arrow indicates the current selection.
4. Press F1 to select Altitude correction.

   Press F3 to select Atmospheric Pressure correction.

   Press F4 to switch the Altitude or Pressure correction system OFF.
5. If F1 or F3 was selected, then the **WP-82** now asks for the altitude or pressure.

   ```
   >   0< m Alt
   ↑↓:Set    F1:Save
   ```

   or:

   ```
   >1013< HPa
   ↑↓:Set    F1: Save
   ```

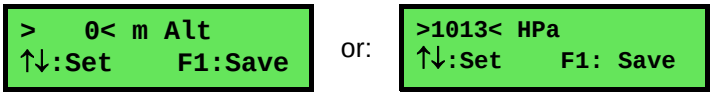
   Press the ▲ and ▼ keys to set the desired Altitude or Pressure.
6. Press the F1 key to save the Altitude or Pressure value.

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

7.2 Changing the Altitude or Pressure Correction value

To change the altitude or atmospheric pressure correction value when one or the other is switched on…

1. Switch the **WP-82** on.
2. Select Altitude or Pressure calibration, depending upon which is switched on..
   i.e. : Menu → **F1:Cal.** → **F4:Altitude**
   or : Menu → **F1:Cal.** → **F4:Pressure**
3. The **WP-82** now asks for the altitude or pressure.



   Press the ▲ and ▼ keys to set the desired Altitude or Pressure.
4. Press the F1 key to save the Altitude or Pressure value.
   Alternatively, press the Menu key to quit and retain the current setting.

7.3 Notes

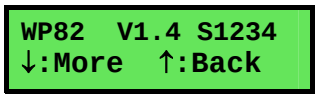
1. For optimum accuracy, the altitude or pressure should be set before calibrating or taking measurements.
2. When the altitude or atmospheric pressure correction system is switched off, the **WP-82** assumes sea level (0m) and 1013 HPa conditions. These values are satisfactory for the precision required for most Dissolved Oxygen measurements.
3. If Altitude correction is switched on, an "**A**" is added to the **WP-82** display in normal measurement mode.
4. If Atmospheric Pressure correction is switched on, a "**P**" is added to the **WP-82** display in normal measurement mode.
5. % Saturation and % Gaseous readings are normalised to sea level (0m) and 1013HPa, when altitude or atmospheric pressure compensation is in use.
6. ppM and salinity-corrected ppM modes show the actual oxygen present at the user-set altitude or atmospheric pressure.

8. Good Laboratory Practices (GLP)

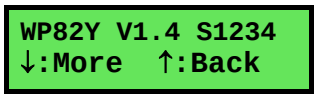
The **WP-82** keeps a record of the date and time of the last Dissolved Oxygen and Temperature calibrations as part of GLP guidelines.

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. For example…



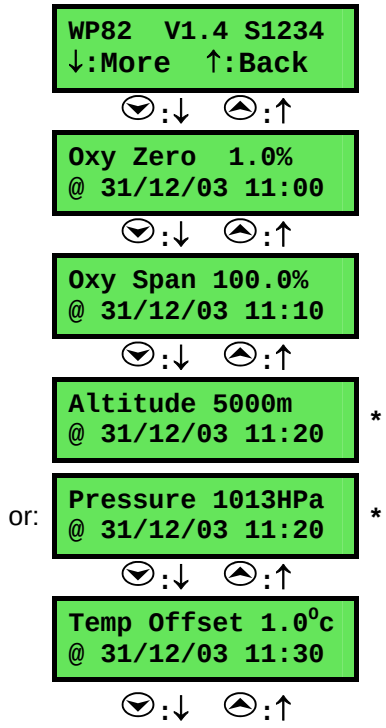
or:



Continued over the page…

GLP Recall, continued…

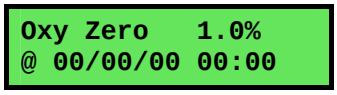
5. Press the ⌄ key to sequentially scroll through the GLP information for all parameters. Press the ⌃ key to scroll back to previous data. The sequence of information displayed is shown below. Press Menu to abort at any time.

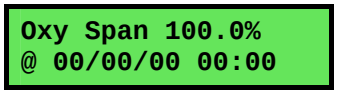


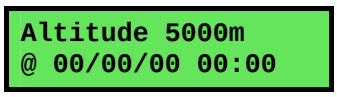
***** Altitude **OR** Pressure are displayed if either one was switched on at the time of the last calibration. If the Altitude or Pressure Correction system was switched off at the time of the last calibration, then the GLP moves directly from Oxygen Span to Temperature Offset.

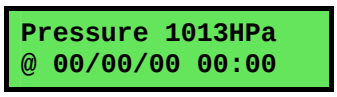
8.2 Failed Calibration

If calibration has failed, the GLP function will reset the date and time to zero. The **WP-82** still shows the results of the last successful calibration. For example…









Note that these calibration values are still used if further measurements are taken without recalibrating.

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.

1. Switch the meter on.
2. Ensure that the **WP-82** RS232 cable is connected to the instrument and to the printer or PC.
3. Send the GLP information to the RS232 port.
   (Menu → **F4:Setup** → **F3:GLP** → **F3:Print**)
4. The GLP information is sent to the RS232 port in formatted ASCII text. For example…

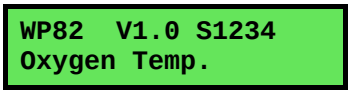
```
WP82    V1.4 S1234 @ 31/12/03 12:00
Oxygen       Zero=       0.0%     @ 31/12/03 11:00
Oxygen       Span=     100.0%     @ 31/12/03 11:10
Oxygen       Altitude=  5000m     @ 31/12/03 11:20
Oxygen       Pressure=  1013HPa   @ 31/12/03 11:20
Temperature Offset=     1.0oC    @ 31/12/03 11:30
ENDS
```

NOTE: Either Altitude **OR** Pressure is sent, depending upon which was selected the last time the instrument was calibrated. If the Altitude or Pressure Correction was switched off at the time of the last calibration, then neither is displayed.

8.4 Instrument Serial Number

In case the serial number that is fitted to the rear of the **WP-82** is removed or becomes illegible, it is also available on the **WP-82** display.

- The serial number is displayed at turn-on. For example…



  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 printout of GLP information (section 8.3).

8.5 Additional GLP Features

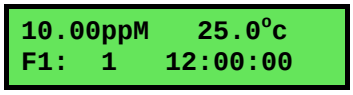
Another GLP requirement is to record the date and time of every reading. The **WP-82** does this for you when readings are recorded either with the Notepad function (section 9) or the Automatic Logging function (section 10).

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. Press (F1) to record the Dissolved Oxygen, Temperature, Date and Time into the notepad. This is labelled as reading number 1.

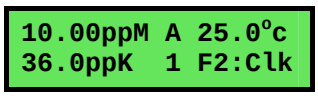
   If manual salinity, altitude or pressure correction are in use, they are also recorded with the reading.

3. Repeat steps 1 & 2 as often as required. The maximum number of readings that can be stored in the Notepad is 2400.

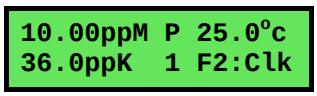
9.2 Recalling Records from the Notepad

To recall records from the Notepad onto the **WP-82** display:

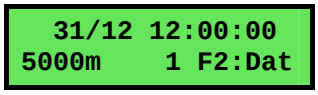
1. Select the Notepad menu ((Menu) → **F2:Notepad**).
2. Select F1: Recall from the menu.
3. Record number 1 is now displayed. Salinity is displayed for readings recorded in salinity-corrected ppM mode. An "**A**" is displayed if Altitude correction was switched on or a "**P**" is displayed if Pressure correction was switched on when the reading was recorded. For example…



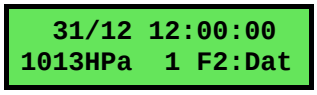
or:



4. Press (F2) to alternatively display the date and time or the data for this record. The Altitude or Pressure correction value is displayed with the date and time if either was switched on when the reading was recorded. For example…



or:



5. Press (▲) to move forward through the records.

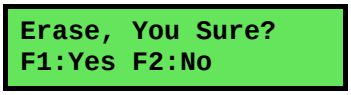
   Press (▼) to move backward through the records.

   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-82** now asks if you are sure that you wish to erase all records…

   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

1. Connect one end of the RS232 cable to the **Charger/RS232** socket of the **WP-82**. The charger, optional solar panel, or optional car battery lead can be connected into the spare socket on the cable for long term use, if required.
2. Connect the other end of the RS232 cable to an RS232 Printer, or to COM1 or COM2 of a PC.
3. Ensure that the baud rate for the printer or PC and the **WP-82** are the same.

   If necessary, alter the baud rate of the **WP-82** (see section 11.1).

   The **WP-82** uses XON/XOFF protocol. Ensure that the printer is set accordingly.
4. Select the Notepad menu (Menu → **F2:Notepad**).
5. 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 Datalogging

The **WP-82** 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 Datalogging.

1. Select the Program menu (Menu → **F2:Notepad** → **F4:Prog.**).
2. The datalogging program menu is now displayed. For example…

   ```
   >00< F1:Min F2:Sec
   ↑↓:Period   F3:Hr
   ```

3. Use the ▲ and ▼ keys to set the period at which the **WP-82** will automatically log records.
4. Use the ▲ and ▼ keys to set the period at which the **WP-82** will automatically log records.
5. When the logging period has been correctly set, select whether this period is in minutes or seconds.

   Press F1 to save the period as minutes.

   Press F2 to save the period as seconds.

   Press F3 to save the period as hours.

   eg: If the period was set to **05**, followed by F2, then the **WP-82** will automatically log a record every 5 seconds.
6. The **WP-82** will ask if the records are to be logged into the Notepad, or sent directly to the RS232 port.

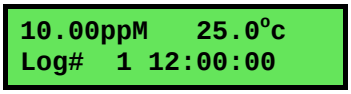
   Press F1 to log records into the Notepad (maximum of 2400 readings).

   Press F3 to send records directly to the RS232 port.
7. The automatic logging function is now programmed, and can be started and stopped as required.

Continued over the page…

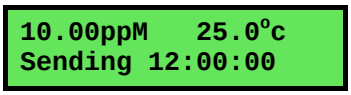
8. To start automatic logging, press F3 in normal display mode.

   If the **WP-82** is logging into the Notepad, the display will look like this:

   The log number will increment and the **WP-82** will beep each time a reading is recorded.

   If the **WP-82** is sending records directly to the RS232 port, the display will look like this:

9. Press F3 to stop automatic logging.

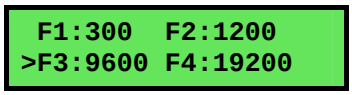
Notes:

1. The clock must be set before the **WP-82** 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 12) is disabled while the meter is in Automatic Datalogging 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…



   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-82** 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 datalogging. See section 10 for details.

11.3 RS232 Configuration

The **WP-82** RS232 configuration is 8 bits, No Parity, 1 Stop Bit, XON/XOFF Protocol.

11.4 Communication and Statistical Software

Communication between the **WP-82** and a PC can be handled with any RS232 communication software. **Win*TPS*** 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-82** 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 **Win*TPS*** CD-ROM.

11.5 Commands

The following commands can be sent from a PC to the **WP-82**. Note that <cr> denotes carriage return and <lf> denotes a line feed.

Action	Command	Notes
Request current data	?D<cr>	Returns the current Dissolved Oxygen, Temperature, date and time from the **WP-82**. Also returns salinity, altitude and pressure correction values if any of these are in use. The log number returned is set to Zero.
Request logged data	?R<cr>	Returns all logged records from the **WP-82** memory. The data ends with the message **ENDS**<cr>
Erase logged data	?E<cr>	Erases all logged records from the **WP-82** 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: **WP82♦♦V1.4♦S1234♦999**<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-82** in the following format. Please note that a " ♦ " shown anywhere in this section denotes one space.

LLLL♦DDDDDDddd♦SSSSSSppK♦TTTTTToC♦♦AAAAAAaaa♦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)
DDDDDD	is the Dissolved Oxygen Data. Maximum 6 characters, right justified.
ddd	is the unit description, either "**ppM**", "**%S♦**", or "**%G♦**"
SSSSSS	is the Salinity correction value. Maximum 6 characters, right justified.
ppK	is the salinity correction value unit description.
TTTTTT	is the Temperature Data. Maximum 6 characters, right justified.
oC♦	is the Temperature unit description
AAAAAA	is the Altitude **OR** Pressure correction value. Maximum 6 characters, right justified.
aaa	is the unit description, either "m♦♦" for Altitude or "HPa" or Atmospheric Pressure.
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-82** 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.

11.7 GLP Data Format

GLP information is returned as 5 or 6 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…

```
WP82    V1.4 S1234 @ 31/12/03 12:00
Oxygen      Zero=       0.0%     @ 31/12/03 11:00
Oxygen      Span=     100.0%     @ 31/12/03 11:10
Oxygen      Altitude=  5000m     @ 31/12/03 11:20
Oxygen      Pressure=  1013HPa   @ 31/12/03 11:20
Temperature Offset=     1.0oC    @ 31/12/03 11:30
ENDS
```

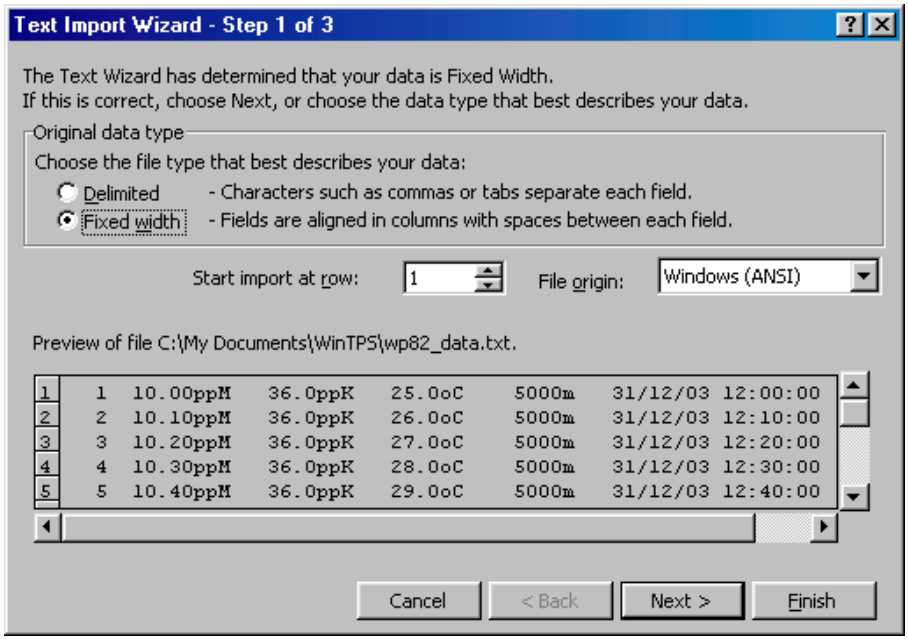
NOTE: Either Altitude **OR** Pressure is sent, depending upon which was selected the last time the instrument was calibrated. If the Altitude or Pressure Correction was switched off at the time of the last calibration, neither is displayed.

11.8 Importing Data into Microsoft Excel

The following procedure details the method for importing a **WP-82** 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.

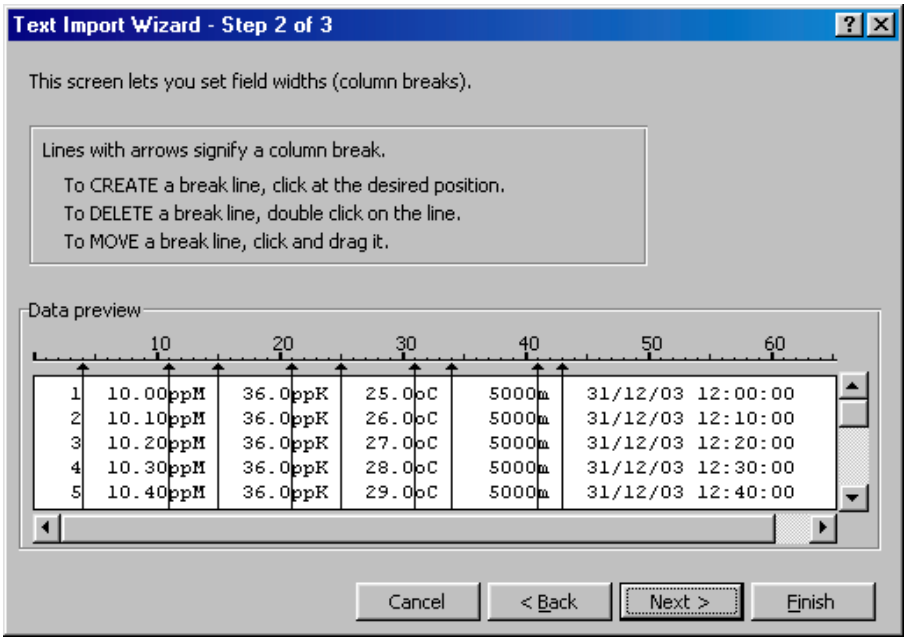
   Note: The default data folder for the WinTPS software is "C:\My Documents\WinTPS".
4. In step 1 of the Text Import Wizard select "Fixed width", as per the sample screen below, then press "Next >".



Continued over the page…

5. 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.



6. 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.

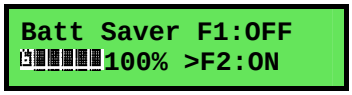
   For help on formatting the data columns, charting, graphing or other operations please consult the Microsoft® Excel® help file. Alternatively please contact TPS and we will try to provide further assistance.

12. Battery Saver Function

The **WP-82** 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 Datalogging 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.

13. 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-82** will switch itself off when the battery drops below 5.00 volts.

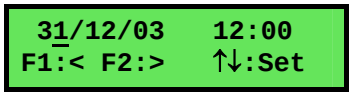
To recharge the battery…

1. Plug the battery charger, solar panel, or car cigarette lighter adaptor into the **Charger/RS232** socket. **DO NOT** plug into the **Sensor** socket, as this will damage the **WP-82**.
2. Charge for approximately 8 hours for full capacity. The **WP-82** has special circuitry to prevent overcharging, so the charger can be used continuously.
3. To ensure optimum battery life and capacity, the **WP-82** should only be charged once the 🔋 symbol starts to flash.

14. Clock Function

14.1 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.



3. Press the ▲ and ▼ keys until the day is correct.
4. Press F2 to move to the month. Press the ▲ and ▼ keys until the month is correct.
5. Press F2 to move to the year. Press the ▲ and ▼ keys until the year is correct.
6. Press F2 to move to the hour. Press the ▲ and ▼ keys until the hour is correct.
7. Press F2 to move the cursor to the minutes. Press the ▲ and ▼ 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-82** does not test for a valid day of the month when setting the clock (eg: attempting to enter 31/02/03 is not corrected).
2. The **WP-82** does test for leap years.

14.2 Displaying or Hiding the Clock

The date and time are normally displayed along with the Dissolved Oxygen and Temperature readings. In salinity-corrected ppM mode, the salinity correction factor is displayed instead of the date.

Press F2 in normal display mode to hide the date and time.

Press F2 again to display the time plus the date.

In salinity-corrected ppM mode, the salinity correction factor, replaces the date after 5 seconds.

15. Initialising the WP-82

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 electrode is replaced.

To initialise the **WP-82**…

1. Switch the **WP-82** OFF.
2. Press **and HOLD** the ⏠ key while switching the **WP-82** back on.
3. The following messages should be displayed…

Initialized MUST ReCalibrate	then :	WP82s V1.4 S1234 Oxygen Temp.

   (The “s” after **WP-82** is shown when the RS232 serial port option is fitted)
4. The meter then displays Dissolved Oxygen and Temperature. Note that the decimal points have been replaced with a “ ∗ “, to indicate that the unit requires re-calibration.
5. When the **WP-82** is initialised:
   (a) The manual salinity correction value is re-set 36.0ppK. See section 6 if you wish to change this value.
   (b) The Altitude or Pressure correction system is switched off, and the instrument assumes sea level (0m) and 1013HPa.

16. Instrument firmware version number.

If you need to phone or fax TPS for any further technical assistance, the version number of your **WP-82** firmware may of benefit to us. The version number is displayed by the **WP-82** at turn-on.

17. Troubleshooting

17.1 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. Both Zero and Air calibration will be required for Dissolved Oxygen (see section 4.1) and a 1 point calibration for temperature (see section 5.1).
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. 2. Faulty Instrument	Recharge the battery. If this fails, check the charger. If charger OK, replace the battery. Return to factory for repair.
Battery does not charge up when charger is connected.	1. Faulty battery charger or faulty battery. 2. Faulty instrument.	Connect the charger and switch the power on. Display the battery volts in the battery saver menu (section 12). 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. Return to factory for repair.

17.2 Dissolved Oxygen 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 15.
• Zero calibration fails (Zero is greater than 7.0%) • Air calibration fails (Span is less than 70% or greater than 135%). • Unstable or inaccurate readings.	1. Membrane is leaking or broken. 2. Gap between membrane and gold cathode is dry. 3. Incorrectly fitted membrane. 4. Electrode is empty. 5. Electrode is faulty.	Replace membrane and refill electrode. Undo the barrel 3 turns, then re-tighten to re-flush the filling solution. Membrane should be smooth and convex with no wrinkles. Re-fit membrane if necessary. Replace membrane and re-fill electrode. Return electrode to factory for repair or replacement
Blackened Silver anode wire	Electrode has been exposed to sulphides or other chemical poisoning.	Return to the TPS factory for cleaning and service.
Tarnished or scratched Gold cathode.	Electrode has been chemically poisoned or physically damaged.	Return to the TPS factory for cleaning and service.
Meter reads **OVR ppM** or **OVR%**.	1. Electrode has not yet polarised. 2. Electrode is faulty	Wait for 2-3 minutes for the electrode to polarise after the **WP-82** is switched on. Return electrode to factory for repair or replacement.

17.3 Temperature Troubleshooting

Symptom	Possible Causes	Remedy
Displays "**OVR°C**" when electrode is plugged in.	1. Faulty electrode. 2. Faulty instrument.	Return electrode to factory for repair or replacement. Return to factory for repair.
Temperature inaccurate and cannot be calibrated.	1. Faulty connector. 2. Faulty electrode. 3. Faulty instrument.	Check / replace connector. Return electrode to factory for repair or replacement. Return to factory for repair.

18. Dissolved Oxygen Sensor Fundamentals

The electrode used, is the amperometric type of Clark Electrode and is suitable for the measurement of oxygen pressures in the range 0 to 100 cm of mercury. While the probe actually reads partial pressure of oxygen, the circuit is calibrated to be read in percentage saturation or parts per million (Milligrams/litre). The operation of probes of the Clark type relies on the diffusion of oxygen through a suitable membrane into a constant environment of 0.1 molar potassium chloride. Measurements are best performed with a reasonable flow past the membrane. At sufficiently high flow rates, the oxygen current is totally independent of the flow (few cm / sec). The cell must not be shaken however or unstable readings will result from electrolyte surge bringing new oxygen from the reservoir to the working cathode surface.

18.1 Operating Principle

The Clark oxygen electrode consists of a gold cathode and a silver/silver chloride anode, placed in an electrolyte solution. This solution is contained behind a plastic membrane. In this case the plastic is 0.025mm intermediate density polyethylene sheet. PTFE (Teflon) can be supplied for special applications. It must be realised that using membranes of very different thicknesses will result in an error in the temperature compensation that is applied in the instrument for the membrane permeability. This coefficient (here +4.2%/^{o}C at 25^{o}C) is for this thickness polyethylene. A polarizing voltage of about 800 millivolts is applied between the two electrodes. The gold electrode is placed close to the membrane and because of the polarizing voltage, oxygen diffusing through the membrane will be reduced at the gold electrode.

Equation: $O_2 + 2H^+ + 2 \text{ electrons} \rightarrow H_2O_2$

This reduction process will produce a current through the oxygen electrode. A load resistor (actually a thermistor in this case) situated in the electrode itself, converts this current into a voltage proportional to the oxygen partial pressure. The thermistor provided within the body of the electrode can have a temperature coefficient of -4.2%/^{o}C. This gives an accurate temperature compensation for the temperature/permeability effect of the membrane to oxygen, over a range of $\pm$ 20^{o}C about a centre value of 25^{o}C. Note this compensation is not for the solubility effects. A separate sensor also included achieves this.

18.2 Probe Storage

The Oxygen probe should be kept moist when not in use to prevent the thin film of electrolyte behind the membrane from drying out. To achieve this, the probe can be stored with the tip in water.

For long term storage of the ED1 for several weeks or more, remove and empty the barrel. Replace the barrel with the membrane intact. When the electrode is stored in this way, the membrane should be replaced and the electrode refilled before use.

18.3 Notes On Units Of Dissolved Oxygen

The terms "Oxygen Concentration" and "Oxygen Partial Pressure" frequently give rise to some confusion.

- Oxygen Concentration is the absolute quantity of oxygen present per unit mass of the liquid.
- Oxygen Partial Pressure is the oxygen fraction of the total pressure of all of the gases present.

For any one liquid system, Oxygen Concentration and Oxygen Partial Pressure are proportional. However, if the solubility of oxygen in the liquid should change owing to increased quantities of solutes, etc., then the ratio of the Concentration to the Partial Pressure must change. Thus, if one saturates distilled water and a 25% solution of Sodium Chloride with air at atmospheric pressure (25^{o}C) both solutions will have almost exactly the same Oxygen Partial Pressure, namely 15.5 cm of mercury. However, the dissolved Oxygen Concentration parts per million (milligrams per litre) will be 8.2 in the distilled water and 2.01 in the salt solution. This is a rather extreme example, as ocean water is only 3.6% saline. It does however stress the importance of correct interpretation of the salinity, etc.

The Clark Electrode measures the partial pressure of oxygen diffusing through a membrane. The current is a linear measure of this partial pressure, assuming liquid flow conditions are met.

With air, at sea level, the 20.9% oxygen exerts about 15.5 cm (mercury standard) pressure. Water in equilibrium with air and with no C.O.D. or B.O.D., etc., is saturated and has this dissolved oxygen partial pressure. If we define 100% Saturation in Partial Pressure terms, then 15.5 cm. Hg = 100% Saturation. This is a practical unit to use. The probe linear readout is then a linear function of % Saturation. Organic cell walls behave like the probe and pressure units are valuable.

% Saturation is the best unit for industrial control and not ppM, contrary to popular beliefs. The partial pressure (and consequently the pressure defined % Saturation) varies only slightly with temperature. (Recall at this stage that the permeability of the membrane has a temperature coefficient, but the electronics has scaled this out by the operation of the Automatic Membrane Temperature Compensator Thermistor incorporated in the D.O. probe).

If mass units are used for measurement of Dissolved Oxygen, the temperature problem of relating the linear partial pressure reading of the probe, to the mass (ppM or mg/L) at different temperatures becomes more involved. As well, there is the mass variation due to dissolved salts (salinity correction). Therefore, the fully corrected instrument would need 3 correction systems.

(a) Membrane correction for temperature permeability effects.
(b) Solubility correction of Dissolved Oxygen with temperature and
(c) Salinity correction of Dissolved Oxygen by weight (Salinity has no effect on pressure units readout).

In the **WP-82** instrument,

(a) is achieved AUTOMATICALLY.
(b) To provide the mass units (ppM) readout (so popular due to the Winkler process used in the past), the **WP-82** Meter has Solubility Correction via an additional temperature sensor in the electrode.
(c) Salinity correction is provided by manual entry of the salinity of the sample. This must first be measured with a good quality salinity meter, such as a TPS model Aqua-C or a WP-84.

18.4 Equilibrium Conditions

Whilst Saline Water has a lower ppM than does Fresh Water, it does not mean it necessarily has less oxygen, biologically available. Both have 100% Saturation (presuming no Chemical Oxygen Demand (C.O.D.), Biological Oxygen Demand (B.O.D.), etc.) because both are in partial pressure equilibrium with air. Any usage of oxygen is immediately supplied by the dissolving of more from air, to meet partial pressure equilibrium requirements. This is so for both saline and fresh water. The reporting of oxygen at a lower level (in ppM units) in the Salt Water is therefore QUITE MISLEADING!

In closed systems, such as tanks, pipes and deep waters, equilibrium is not so readily available and the Salinity Effect gains the importance in the reporting of Dissolved Oxygen. It is suggested, unless such closed (or deep, low diffusion) systems are encountered, that Oxygen should be reported in % Saturation or ppM of equivalent Fresh Water.

18.5 Velocity Past The Membrane

Workers have shown that the relationship between the diffusion current (oxygen current) and the external velocity of the liquid is expotential. Some workers using thicker membranes have shown even less dependence of the diffusion current on liquid velocity. Because of the expotential nature of the relationship, very considerable changes in velocity have to be made before noticing any change in the diffusing current once the flow is sufficiently high. Tests with this electrode have shown that flow rates above 0.2 litres/minute past the membrane give results indistinguishable from those with appreciably higher flow rates (5 litres/minute). Fluctuations in readings due to air bubbles passing through the membrane are, however, a different matter. With the type of electrode to be used with this instrument, very little changes in diffusion current are caused by altering the pH of the external environment. Pressure changes over a moderate range exerted on the membrane also cause no change. The probe is sealed by glands for total immersion up to 3 metres.

19. Warranty

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

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

Shipping damage is not covered by this warranty.

Please Note:

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

Procedure For Service

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

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

To obtain this service, please follow this procedure:

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

Please check that the following is enclosed with your equipment:

- **Your Name and daytime phone number.**
- **Your company name, ORDER number, and return street address.**
- **A description of the fault. (Please be SPECIFIC.)**
  (Note: "Please Repair" does NOT describe a fault.)
- **either $13.50 for return freight for units under warranty,**
  or $24 to cover inspection costs and return freight.
  (These amounts are not applicable to full-account customers.)

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

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

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